4 Biological Environment

4.1 Benthic Ecology

4.1.1 Baseline Information

Introduction

4.1.1.1 This chapter provides baseline subtidal benthic ecological information within the area of the modified offshore transmission infrastructure (modified OfTI). This includes the types and distributions of the different seabed habitats and the communities of macrofauna and macroflora (i.e. animal and plant species which are generally 1 mm in size or larger) that are typically associated with each habitat type (collectively termed biotopes). The information presented here has been drawn from:

- desktop studies;
- a series of site specific benthic ecology field surveys;
- consideration of the relevant key legislative and planning information; and
- consultation with relevant statutory and non-statutory bodies.

4.1.1.2 Site specific information was collected using seabed video surveillance and grab sampling in agreement with Marine Scotland Science (MSS). Methods were comparable to those used during both the previous EIA investigations at both the three consented MORL wind farms (Telford, Stevenson and MacColl) and Beatrice Offshore Wind Limited's (BOWL) wind farms (MORL, 2012; BOWL, 2012; 2013) for which consents have already been granted. Methodologies, results and conclusions for the current site specific field surveys for the modified offshore export cable route corridor are detailed in:

- Technical Appendix 4.1 A - Subtidal Benthic Ecology Characterisation Report.

4.1.1.3 This baseline is used to inform the assessment of the likely significant effects of the installation, operation and decommissioning of the modified OfTI which is presented in:

- Section 4.1.2 – Benthic Ecology impact assessment; and
- Section 4.1.3 – Benthic Ecology – cumulative impact assessment.

4.1.1.4 The intertidal ecology at the modified export cable landfall site at Inverboyndie is described in Chapter 4.5.

4.1.1.5 Note that the benthic ecology of the outer Moray Firth and the potential impacts of the installation and operation of offshore wind farm transmission infrastructure (TI) on seabed habitats and species have already been studied and assessed as part of the previous MORL application and accompanying Environmental Statement (MORL, 2012). Experience gained from these previous studies, including survey methods, baseline descriptions and likely significant effects have been drawn upon to inform this Chapter.

Consultations

4.1.1.6 A full account of the consultation on the current modified TI proposals is presented in the Consultation Report accompanying this ES. Table 4.1-1 below summarises the consultations undertaken to inform the subtidal benthic ecology baseline data gathering and impact assessment.

Table 4.1-1 Summary of Consultations

Organisation	Consultation Response	MORL Approach
Marine Scotland Science (MSS)	Acceptance of survey specifications	The survey comprised collection of grab samples and seabed video and followed previous accepted methods (MORL, 2012, BOWL, 2012; 2013).
Joint Nature Conservation Committee (JNCC) and Scottish Natural Heritage (SNH) **(Scoping Response)**	Agreement with the scope of impacts to be considered. Agreement with initial survey plans. There is the potential for Annex I habitat rocky reef to occur within the cable search area as it approaches shore.	The survey comprised collection of grab samples and seabed video and followed previous accepted methods (MORL, 2012, BOWL, 2012; 2013).. Seabed video was collected to characterize rocky reef habitat and associated species. Acoustic data has been collected to indicate the extent of rocky habitat

Baseline Characteristics

4.1.1.7 This section sets the baseline subtidal benthic ecological conditions within the vicinity of the modified TI.

Desktop Studies

4.1.1.8 The MORL ES (Chapter 4.2: Benthic Ecology, MORL, 2012) described the Moray Firth as an "open system" being an integral part of the wider North Sea thus having common environmental factors. Dominant seabed sediments include moderately to well sorted, fine to medium grained sand and muddy sand, with some shell and are described as relatively homogeneous. Site specific survey found that the sediments of the Smith Bank comprised coarse and medium sands with quantities of fragmented shell and were characterised by typical assemblages of sediment burrowing polychaete worms, bivalve shells and small amphipod crustaceans. Sparse hydroids (sea firs) and bryozoans (sea mats), colonised the larger shell fragments and patches of gravel and cobbles. Corresponding biotopes classifications (Connor *et al.*, 2004) included SS.SSa.OSa.OfusAfil, SS.SSa.IMuSa.FfabMag and SS.SSa.CFiSa.EpusOborApri A range of larger, more mobile species were recorded from trawl sampling and seabed video including a range of flatfish, crabs and starfish species.

4.1.1.9 Previous video surveillance conducted between the BOWL and the proposed BOWL export cable landfall at Spey Bay identified four main seabed habitat types (BOWL, 2012). At the offshore end of the cable corridor on the Smith Bank, the seabed was dominated by coarse and medium sand sediments with varying quantities of shell. These sediments supported a typical suite of infaunal (burrowing) species such as the polychaete worms bivalve shells, sea urchins and small crustacean amphipods. Sponges, tube worms, sea firs and sea mats were found attached to stones, pebbles and larger fragments of shell.

4.1.1.10 Within the deeper waters below the southern flank of the Smith Bank, the seabed is dominated by homogenous muddy sand sediments characterised by seapens together with mounds and depressions created by the activities of sediment dwelling marine organisms, such as the Norway lobster (*Nephrops norvegicus*). This habitat type has been identified as representative of the "burrowed mud" Scottish Priority Marine Feature (PMF) and appears to be extensive throughout the southern half of the outer Moray Firth.

4.1.1.11 Approaching the landfall of the consented BOWL export cables, the seabed comprised fine and medium grade sands and gravel together with coarser, more mixed cobble, pebble and gravel substrates supporting a characteristic encrusting fauna such as tubeworms, barnacles, sea mats, algae and sea firs. Areas of dense cobbles resembled Annex I cobble reef. Outcropping bedrock with dense soft corals, kelps and red algae together with areas of encrusting *Sabellaria spinulosa* communities resembling Annex I *Sabellaria* reef habitat were recorded offshore of the original export cable landfall site at Fraserburgh (Chapter 4.2: Benthic Ecology MORL, 2012). No *Sabellaria* communities were recorded along the BOWL cable corridor (BOWL, 2012).

The Southern Trench

4.1.1.12 The Southern Trench is a distinct bathymetric low within the southern half of the outer Moray Firth. Benthic survey to the east of the trench (MORL, 2012) showed that the sea floor comprised gravelly shelly sand overlaid with a layer of fine silt. Conspicuous species included sea firs and sea mats, soft corals and hermit crabs together with various tube dwelling worms, crabs and starfish. Growths of the tube worm Salmacina or Filograna were identified at one location. No protected cold water corals (*Lophelia pertusa)* were recorded.

Site Specific Surveys

4.1.1.13 Site specific subtidal benthic ecological information was collected via seabed video surveillance and sediment grab sampling in agreement with MSS (see Technical Appendix 4.1 A: Subtidal Ecology Characterisation). Figure 4.1-1 shows the track of the seabed video and grab sampling locations within the modified export cable route corridor. A zig-zag survey pattern and cross lines were adopted in some places along the modified export cable route corridor to increase lateral coverage.

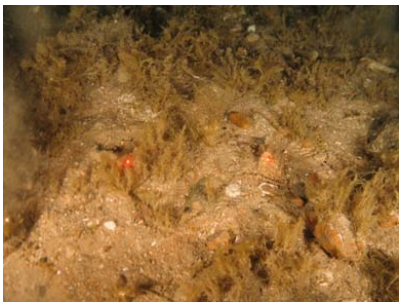
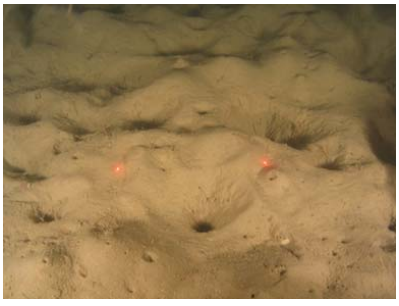
4.1.1.14 Seabed type and associated epifauna and epiflora (surface dwelling) species were used to classify biotopes following the UK Marine Habitat Classification Scheme (Connor *et al.*, 2004) with subsequent interpolation and GIS mapping based on geophysical (side scan sonar and bathymetry) data. Figure 4.1-2 shows the distribution and extents of the subtidal biotopes present along the proposed export cable corridor.

4.1.1.15 Seabed sediment samples were analysed within UKAS accredited laboratories for particle size distribution and sediment chemistry. Three samples within inshore areas of the modified export cable route corridor were not collected due to the coarse and hard nature of the ground present.

Results

4.1.1.16 Matching of survey data with the Marine Habitat Classification system identified a total of five biotopes as summarised in Table 4.1-2 below. Given the local complexity of the seabed habitats in some places it is likely that additional finer scale biotope classifications exist within the broader habitat descriptions. Previous grab sampling on the Smith Bank, for instance (MORL, 2012), identified the biotopes SS.SSa.OSa.OfusAfil, SS.SSa.IMuSa.FfabMag and SS.SSa.CFiSa.EpusOborApri which fall under the broader SS.SSa habitat.

Table 4.1-2 Summary of Biotopes Identified Along the Offshore Export Cable Route

Habitat / Biotope Classification	Typical Species	Representative Seabed Image
SS.SSa Sublitoral sand and muddy sediments	*Puguridae* (hermit crabs) *Triglidae* (gurnards) *Pleuronectes platessa* (Plaice) *Pecten maximus* (King scallop) Hydroid/bryozoan turfs *Asterias rubens* (common starfish) *Callionymidae* (Dragonet)	
SS.SSa **SS.SMx.CMx** **SS.SMx.CMx.FluHyd** Sublittoral sand and muddy sands with patches of circalittoral coarse sediments with the hydroids *Flusta foliacea* and *Hydrallmania falcate*.	*Liocarcinus* sp. (harbour crab) *Ammodytidae* (sand eels) *Pecten maximus* (King scallop) *Flustra* and *Hydrallmania* (bryozoans)	
SS.SMu.CFiMu.SpnMeg (coarser variant) Seapens and megafauna in circalittoral fine mud	*Virgularia mirabilis* (seapen) Pleuronectiformes (flatfish) *Asterias rubens* (common starfish) *Chaetopterus* spp. (tubes) (parchment worm) Mounds and burrows	
SS.SSa with **SS.SMx.CMx** Sublittoral sand and muddy sands with circalittoral coarse sediments as waves	Turf forming hydroids and bryozoans *Flustra foliacea*, *Sertularia, Abietinaria* and ?*Thuiaria thuja* Pleuronectiformes (flatfish) *Atelecyclus rotundatus* (round crab) *Munida rugosa* (rugose squat lobster) *Pecten maximus* (King scallop)	
SS.SMu.CFiMu.SpnMeg (fine sediment variant) Seapens and burrowing megafauna in circalittoral fine mud	*Pennatula phosphorea* (phosphorescent seapen) *Virgularia mirabilis* (slender seapen) *Nephrops norvegicus* (Norway lobster) *Anseropoda placenta* (goose foot starfish) *Oweniidae* (tubes) (polychaete worm)	

Habitat / Biotope Classification	Typical Species	Representative Seabed Image
CR.MCR.EcCr.FaAlCr.Pom Cobbles boulders and bedrock reef with encrusting and foliose red algae and *Pomatoceros* (now named *Spirobranchus*)	Hydroid/Bryozoan turfs *Alcyonium digitatum* (dead man's fingers) *Urticina* sp. (dahlia anemone) *Metridium senile* (plumose anemone) *Spirobranchus* (keel worm) *Munida rugosa* (rugose squat lobster) *Cancer pagurus* (brown crab) *Echinus esculentus* (edible sea urchin)	

Acoustic Data and Production of the Biotope Map for the Modified OfTI

4.1.1.17 Side scan sonar (acoustic) data were provided after completion of the benthic video survey. These data showed a series of distinct boundaries between different sediment acoustic regions such as changes in reflexivity indicating the different harder and softer seabed types as well as changes between areas of apparent complexity (i.e. boulders and rock outcrop areas) and comparatively more featureless, homogeneous seabed areas. Overlay of these sediment acoustic regions with the biotope classifications and subsequent interpolation was then undertaken to indicate the distribution and extents of the biotopes present throughout the modified offshore export cable route corridor. The resultant biotope map is provided in Figure 4.1-2.

Distribution of the Biotopes within the Modified OfTI Corridor

4.1.1.18 The biotopes found during the current site specific study were comparable with those recorded previously (MORL, 2012; BOWL, 2012). The study area was dominated by largely homogenous sedimentary seabed habitats including muddy sands, fine sandy mud and mixed sandy gravels. These areas are indicated in Figure 4.1-2 by the SS.SSa, SS.SMu.CFiMu.SpnMeg and SS.SMx.CMx classifications respectively. These types of habitats supported little or no conspicuous sessile epifauna with the exception of sparse growths of erect bryozoans and hydroids attached to patches of coarser material, including broken shell. Mobile epifauna, on the other hand, were relatively well represented and included starfish *Asterias rubens, Astropecten irregularis* and *Luidia sarsi*, small spider crabs *Inachinae*, hermit crabs *Paguridae*, whelks *Buccinum undatum*, urchin *Echinus esculentus*, brittlestars *Ophiura ophiura*, squat lobster (*Munida rugosa*) and benthic fish and shellfish such as gurnard Triglidae, sand eels, Ammodytidae, plaice (*Pleuronectes platessa*), brown crab (*Cancer pagurus*). Seapens, *Pennatula phosphorea* and *Virgularia mirabilis*, together with mounds and burrows of larger burrowing fauna, i.e. Norway lobster (*Nephrops norvegicus*), characterised large areas of fine sandy mud. Filamentous growths, thought to be diatomaceous floc (settled plankton), was frequently observed on the seafloor across the sediment areas.

4.1.1.19 Patches of more mixed coarse sand, gravel and shell material occurred occasionally throughout the video study area and were associated with a higher abundance and diversity of sessile bryozoan and hydroid species.

4.1.1.20 Further inshore, the seabed was dominated by comparatively coarser and more mixed sediment types, including areas of cobbles, boulders and exposed bedrock forming stony reefs (SS.SCS.CCS, CR.MCR and IR.MIR). Patches of clean, mobile fine

sand of varying thicknesses overlaid these coarser and rockier seabed habitat types creating a complex mosaic of biotopes in places. Sediment tolerant epifaunal communities (SS.SMx.CMx.FluHyd) dominated mixed sediment substrates whilst areas of more stable boulders and bedrock outcrops supported comparatively rich and diverse bryozoan and hydroid assemblages together with the soft coral *Alcyonium digitatum*, the calcareous tube dwelling worm *Spirobranchus* sp. and *anemones Metridium senile* and *Urticina felina* (CR.MCR.EcCr.FaAlCr.Pom and CR.MCR.EcCrFaAlCr.Adig). Conspicuous mobile fauna included urchins *Echinus esculentus*, the sunstar (*Crossaster papposus*), and spiny starfish (*Marthasteria glacialis*) together with brown crab and squat lobster. Encrusting and foliose red and brown algae species, such as *Delesseria sanguinea* and *Saccharina latissima* attached to cobbles.

Features of Nature Conservation Importance within the Modified OfTI Study Area.

4.1.1.21 Table 4.1-3 below presents benthic features of potential nature conservation importance identified within the study area from both the site specific survey and data review.

Table 4.1-3 Habitats and Species of Nature Conservation Importance within the Modified OfTI Study Area

Feature	Indicative Conservation Feature	Importance	Representative Photograph
Habitats			
Cobble and stony reefs.	Annex I Reef	International	
Muddy sand with seapens and burrowing fauna.	Priority Marine Feature (PMF) "burrowed mud"	National	
Species			
Arctica islandica (Ocean quahog)	OSPAR Priority Marine Feature (PMF)	International	

Palinurus elephas Spiny lobster	Priority Marine Feature (PMF)	National	
Arachnanthus sarsi (Mud burrowing anemone)	Priority Marine Feature (PMF)	National	
Maera loveni (mud burrowing shrimp)	Priority Marine Feature (PMF)	National	

Sediment chemistry

4.1.1.22 The sediment contaminants tested as part of the site specific survey were largely at concentrations that were below guideline levels and standards. Concentrations of arsenic and chromium, however, exceeded Cefas / Marine Scotland values for Action Level 1, relating to the disposal of dredged materials to sea, but fell within the more stringent Action Level 2 values. Typically, material containing contaminants at levels between Action Levels 1 and 2 require further testing and consideration prior to permitting their disposal to sea. In this instance, however, there will be no disposal of material to sea. Only temporary disturbance, and subsequent dispersion, of the natural sediments is predicted. No imported material will be added to the local benthic environment. The seabed video survey did not show any significant habitat and community difference or denuded areas associated with sediments with elevated chromium and arsenic levels suggesting no significant effects of current contaminant levels on benthic ecology. All contaminant levels were below OSPAR standards. Disturbance and suspension of sediments into the overlying water column as a result of the action of the cable burial tool would further dilute any associated contaminants within tidal dispersion pathways. Consequently, sediment contaminants have not been considered any further in this assessment.

Legislative and Planning Framework

4.1.1.23 The legislation and guidance which was taken into account in the benthic ecology assessment is summarised below:

- Council Directive 92/43/EEC on the Conservation of natural habitats and of fauna and flora (the 'Habitats Directive'). This was transposed into domestic legislation through the Conservation (Natural Habitats &c.) Regulations 1994, and the Conservation of Habitats and Species Regulations 2010). The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended) (the "Offshore Marine Regulations") extend the provisions of the Habitats Directive to offshore areas;

- Nature Conservation (Scotland) Act 2004 (provides for the conservation of biodiversity and for the conservation and enhancement of Scotland's natural features);
- Marine (Scotland) Act 2010 (provides for the publication of Priority Marine Features); and
- Wildlife and Countryside Act, 1981 (lists species of national nature conservation importance).

4.1.1.24 Specific guidance used in the preparation of both this chapter and its supporting field studies are provided below:

- DTLR (2002). Guidelines for the conduct of benthic studies at aggregate dredging site (now updated see Ware & Kenny, 2011);
- Cefas (2011). Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects;
- Johnston, C.M., Turnbull, C.G. and Tasker, M.L., 2002. Natura 2000 in UK Offshore Waters: Advice to support the implementation of the EC Habitats and Birds Directives in UK offshore waters [online]. JNCC Report No. 325, Joint Nature Conservation Committee, Peterborough;
- OSPAR (2008) Guidance on Environmental Considerations for Offshore Wind Farm Development. 2008-3;
- Wilhelmson *et al*. (2010). International Union for Conservation of Nature (IUCN). Greening Blue Energy: Identifying and managing the biodiversity risks and opportunities of offshore renewable energy;
- Scotland's National Marine Plan (2013) - Consultation Draft; and
- CIEEM 'Chartered Institute of Ecology and Environmental Management' (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland, Marine and Coastal.

4.1.2 Impact Assessment

Summary of Effects and Mitigation

4.1.2.1 This section provides an assessment of the likely significant effects of the installation, operation and decommissioning of the subtidal components of the modified OfTI on the subtidal benthic ecology. Effects on intertidal ecology at the proposed landfall site at Inverboyndie are addressed in Chapter 4.5 (Intertidal Ecology). Likely significant cumulative effects are addressed in section 4.1.3.

4.1.2.2 Information supporting this assessment has been collected from a site specific survey and data review as explained in Section 4.1.1 above.

4.1.2.3 In summary, the effects of the modified OfTI proposals on subtidal benthic ecology are predicted to be of minor significance and include:

- Loss of original habitat as a result of the placement of the two AC OSPs. Note that this effect will be less than that already assessed in the previous ES (MORL, 2012, Chapter 10: Benthic Ecology) because there will be fewer OSPs (two) and associated cable protection material compared to the previous Project Rochdale Envelope (eight). The use of suction bucket foundations in place of GBS foundations further reduces the effect footprint compared to the initial situation (MORL, 2012);
- Temporary seabed disturbances, smothering and suspended sediment effects on fauna and flora as a result of seabed preparatory works, cable laying activities and contact of legs and anchors of construction and

decommissioning vessels on the seabed. This effect will be greater than that previously assessed (MORL, 2012 Chapter 10 Benthic Ecology) as a greater number of trenches will be constructed compared with the previous Project Design (MORL, 2012). However, the modified OfTI does not coincide with potential Annex I (EC Habitats Directive) Sabellaria spinulosa reef, found previously and so no adverse disturbance effects on this international feature will occur as a result of the revised scheme;

- Habitat and associated community change as the result of the introduction of hard structures and subsequent colonisation by encrusting and attaching fauna and flora;
- Temporary fining of particulate habitats, smothering and scour effects on benthic species;
- Seabed contamination and increased bio-availability of pollutants to seabed faunal and floral populations as a result of seabed disturbances;
- Heat and electromagnetic field emissions and associated effects on benthic species.

4.1.2.4 Mitigation will include the application of best practice, including minimising the quantities of scour and cable protection material to reduce effects of loss of original habitat and habitat change, and adherence to the Environmental Management Plan to reduce any risk of accidental spillages of chemicals into the marine environment.

Summary of Effects

4.1.2.5 Overall, the effects of the installation, operation and decommissioning of the modified OfTI on subtidal benthic ecology are predicted to be of **minor** significance. This reflects the highly localised, short term, infrequent and reversible nature of the majority of the predicted effects (BERR, 2008) and the general tolerance and recoverability of the predominately sand and mixed sand and gravel habitats and species within the study area.

4.1.2.6 Muddy sand habitats indicative of the "burrowed mud" Scottish PMF together with cobble and rock habitats indicative of Annex I (EC Habitats Directive) stony reef habitat are widespread throughout the southern Moray Firth, having been recorded during previous EIA investigations (MORL, 2012 and BOWL, 2012). Given the small footprint of the cable burial operation, no significant adverse effects on the wider availability of these features are anticipated. Similarly, the important species for nature conservation are not predicted to be significantly affected by the modified OfTI as significant areas of their habitat will remain in adjacent areas following the installation and operation phases. Recovery of affected areas will occur from adult reproducing populations in adjacent non-affected areas. The spiny lobster PMF species is highly mobile and is likely to be capable of avoiding temporary, localised installation activities. The ocean quahog (PMR and OSPAR species) appears to be distributed on and around the Smith Bank and away from the boundaries of the modified OfTI, although this may, in part, be an artefact of historic sampling effort. Given its current apparent distribution, the population of ocean quahog in the outer Moray Firth is not likely to be significantly affected by the current proposals.

4.1.2.7 Effects of heat and electromagnetic field (EMFs) emissions during the operation of the cable are considered to be **not significant** to subtidal invertebrate benthic ecology. This is due to the shielding of emissions through cable burial, the distance separation provided by any cable protection material and the general insensitivity of benthic invertebrates based on current observations at other wind farm sites. Some mobile species, such as starfish, may be temporally attracted to and aggregate around heat sources although this is not predicted in light of proposed cable burial and placement of cable protection. Effects of EMF and heat emissions on fish and shellfish ecology are presented in Chapter 4.2 Fish and Shellfish Ecology.

4.1.2.8 The provision of hard structures such as foundations of OSPs and scour and cable protection material will provide suitable surfaces for attaching and encrusting indigenous and potential marine invasive non-native species (MINNS).

4.1.2.9 The Environmental Management Plan (EMP) (Technical Appendix 1.3 A within MORL ES, 2012) will control the use and storage of materials during the construction of the wind farms and will mitigate for accidental spillages or releases of chemicals, such as fuels, lubricants and grouting materials, into the marine environment and prevent harm to the benthic ecology. Accordingly, the residual effects from accidental seabed contamination are assessed as being of **minor** significance.

4.1.2.10 It is proposed that the export cables remain in situ during decommissioning. This will reduce the effects on subtidal benthic ecology compared to those that are predicted to occur during installation. Removal of OSP foundations during decommissioning will result in some localised sediment disturbances but these are usually regarded as being no more significant than those that will occur as a result of construction activities. Construction and decommissioning effects on benthic ecology are therefore considered jointly in this assessment.

Proposed Mitigation Measures and Residual Effects

4.1.2.11 Table 4.1-4 below summarises proposed measures to mitigate potential adverse effects on subtidal benthic ecology. This would include the use of best practice during construction such as minimising the quantities of scour and cable protection material to reduce loss of original seabed habitat and habitat change. In addition, a Construction Environmental Management Plan (CEMP) will be in place to control the use and storage of materials to mitigate for accidental spillages or releases of chemicals, such as fuels, lubricants and grouting materials, into the marine environment and prevent harm to the benthic ecology. Regular hull cleaning of construction vessels, maintenance of anti-fouling systems and ballast water management as part of vessel norma;l operating procedures will reduce the risk of introducing and spreading potential marine invasive non-native species.

Table 4.1-4 Impact Assessment Summary

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
Construction & Decommissioning				
Temporary Direct Seabed Disturbance	Sand and gravel sediment habitats and communities (biotopes)	Minor	n/a	minor
	Burrowed mud PMF habitat	minor	n/a	minor
Temporary increased suspended sediment concentration (SSCs) and sediment deposition	Sand and gravel sediment habitats and communities (biotopes)	minor	n/a	minor
	Burrowed mud PMF habitat	minor	n/a	minor
Seabed contamination as a result of accidental spillage of chemicals	Sand and gravel sediment habitats and communities (biotopes) and burrowed mud PMF habitat.	Up to major	Adherence to an EMP	Negligible

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
Operation				
Permanent net reduction of original habitat.	Sand and gravel sediment habitats and communities (biotopes).	minor	n/a	minor
	Burrowed mud PMF habitat	minor	n/a	minor
Habitat and associated community change (MINNS)	Indigenous species	Minor	Good practice (vessel maintenance)	minor
Effects on physical processes and related biological changes	Sand and gravel sediment habitats and communities (biotopes).	Not significant	n/a	Not significant
Effects of EMFs	Electro-magnetic sensitive and migratory invertebrate species	Not significant	n/a	Not significant
Effects of heat	Deep burrowing species such as Nephrops norvegicus	Not significant	n/a	Not significant

Introduction to Impact Assessment

4.1.2.12 This section identifies the potential effects of the installation, operation and decommissioning of the modified OfTI on subtidal benthic ecology in more detail and presents the methods used to evaluate their potential significance.

Details of Impact Assessment

4.1.2.13 A source – receptor – pathway approach was applied to identify the potential effects of the installation, operation and decommissioning of the modified OfTI and the subtidal benthic receptors likely to be affected. Table 4.1-5 shows the source-pathway-receptor model used to identify the pathways through which effects on potentially sensitive benthic ecological features/receptors may occur.

Table 4.1-5 Source-receptor-effect Pathways on Subtidal Benthic Ecology

Activity	Pathway	Receptor	Effect
Construction and Decommissioning			
Dredging, trenching & jetting, piling and cables removal	Seabed disturbances	Species, habitats	Displacement sediment instability, compaction and abrasion
Dredging, trenching & jetting, piling and cables removal	Raised sediment plumes	Species, habitats	Burial, smothering, habitat change (grain size)
Operation and Maintenance			
Foundations, scour and cable protection material	Presence on seabed	Habitats	Reduction in total area of original habitat for life of project and habitat change
	Colonisation	Species	Increase abundance and biomass of sessile fauna and flora
		Environmental quality	Increase risk of spread of marine invasive non-native species (MINNS)
Effects on physical processes and related biological changes	Erosion, scour and smothering	Habitats and species	Change of habitats and species
Cables	Electromagnetic field (EMF) and heat emissions	Species	Re-distribution of species

Rochdale Envelope Parameters Considered in the Assessment

4.1.2.14 The parameters within the Project Description (Chapter 2.2: Project Description) have been used to describe the realistic worst case scenario for each potential effect on benthic ecology (Table 4.1-6). The elements of the modified OfTI considered in this assessment include:

- 2 AC Offshore Substation Platforms (OSPs);
- Inter-platform cabling; and
- Offshore export cables.

Table 4.1-6 Rochdale Envelope Parameters relevant to the Benthic Ecology Impact Assessment

Potential Effect	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Temporary Direct Seabed Disturbance	**Maximum footprint = 1.76 km² based on:** • Length of cable corridor from boundary of three consented wind farm sites to landfall site = 52 km (not including micro-siting allowance); • No. of cable trenches = 4; • Width of trench affected area = 6 m; • Length of OfTI cable within three consented wind farms (including inter-platform cabling) = 70 km; • Area of seabed prepared for each OSP = 7,536 m²; • Maximum no. AC OSPs = 2 (installed at least one year apart); • Vessel anchors = 36,000 m²; and • Jack-up vessel footprint of 420 m² per installation. **Rationale** Suction buckets have the largest footprint of any foundation option within the current modified Rochdale Envelope and require the greatest extent of bed preparation prior to installation. Disturbed areas will be subsequently occupied by the turbine foundation and scour protection material. Jack-up barges using up to 6 legs and fixed to the seabed using spud cans with a total area of seabed disturbance for the vessel of 420 m². Maximum length of cabling required within the three consented wind farms area (including inter-platform cabling) is 70 km based upon maximum of two OSPs. Maximum length of export cable corridor from boundary of three consented wind farm sites is 52 x 4 (208 km of cabling not including micro-sitting allowance) under the 220 kV solutions. Area affected by anchors assumes 6 x 12 Te anchors each 4.5 m wide x 3.64 m long, penetrating to a depth of one metre deployed in a radial pattern around barge and re positioned every 200 m and each affecting a nominal area of seabed of 5 m². Upon decommissioning, the seabed will become re-exposed on removal of foundations, scour and cable protection material. Species attached to turbine foundations, scour material and cable protection material will be lost on removal of infrastructure. A full decommissioning plan will be agreed with the relevant government department at the point of decommissioning.
Temporary increases in SSCs and sediment deposition	Fine sediment arising from installation of four export cables from the boundary of the three consented wind farms to landfall (although these will be temporally separated)(total length 208 km), inter-platform cables and cabling up to the boundary of the three consented wind farms (total length 70 km) via jetting and seabed preparatory works for suction bucket foundations for the two OSPs transported and dispersed via tidal currents and wave events as described within Chapter 3.1 Hydrodynamics, Sedimentary and Coastal Proceses.
Seabed contamination as a result of accidental spillage of chemicals	The construction window is five years in which time there will be 72 vessel movements and 255 total vessel working days associated with the OSP, inter-platform and export cable installations (indicative vessel movements). Maximum increase in vessel activity over the maximum construction timeframe provides for highest potential for accidental spills.

Potential Effect	Rochdale Envelope Scenario Assessed
Operation	
Permanent net reduction of original habitat	• Total footprint = 0.1 km² based on: • Area per OSP foundation and scour material = 7,536 m²; • Cable protection (assuming protection is required to a distance of 100 m from each OSP foundation to a width of 10 m and up to 20 "J" tubes (or cable connections) per OSP = 20,000 m²; • No. AC OSPs = 2; • Nominal area of cable protection material required along each export cable = 11,000 m²; • No. of export cables = 4; and • Use of rock cutting equipment in water depths <10 m. **Rationale** Net loss of seabed habitat is assessed as the total area of seabed occupied by OSP foundations, scour material and cable protection material on completion of the construction phase. However, it is acknowledged that there will be an incremental loss of seabed habitat throughout the construction phase as the OSPs and associated cable protection will be installed at yearly intervals.
Habitat and associated community change	• No. AC OSPs = 2; • Cable protection (assuming protection is required to a distance of 100 m from the foundation to a width of 10 m and up to 20 "J" tubes (or cable connections) per OSP = 20,000 m²; • No. of export cables = 4; and • Nominal area of cable protection material required along each export cable = 4,000 m². **Rationale** The introduction of OSP foundations, scour and cable protection material will provide localised hard substrata for colonisation by encrusting and attaching species changing the predominately sedimentary communities to hard substrata communities within the footprint of the infrastructure.
Effects on physical processes and related biological changes	• Development of secondary scour • Change in tidal flow and sediment transport rates
Effects of heat and EMF emissions	• Export cables of 52 km each to be laid in 4 trenches (total 208 km); • Cabling within the three consented wind farms area (including inter-platform cabling) of 70 km length; and • Target burial depth is 1 m.

EIA Methodology

4.1.2.15 The impact assessment methodology follows that previously employed (MORL, 2012 Chapter 7.1: Benthic Ecology) and follows Institute of Ecological and Environmental Management (IEEM, 2010) guidelines to define effect **magnitude** and receptor **sensitivity**. The following explains how both effect magnitude and receptor sensitivity is determined and how these two assessment components combine to evaluate overall impact significance.

Magnitude of Effect

4.1.2.16 The magnitude of the effect on benthic ecology is defined in terms of the following criteria;

- Spatial extent - the geographical extent of an effect. Typically this includes consideration of effects at local (i.e. within the boundaries of a wind farm turbine array), regional, (i.e. a specific water body of comparable physical attributes), national and international scales and typically expressed as a percentage of the total area of the development and / or as a distance measure;

- Duration - the temporal aspect of the effect. Guidance offered by Wilhelmsson *et al.* (2010) suggests temporal scales based on the different phases of the actual development thus short term effects are those which occur within the construction phase, long term effects are those that occur through the operational phase whilst permanent effects are those that are still detectable after decommissioning;
- Frequency – the number of occurrences of an activity causing an effect per unit of time; and
- Reversibility (where appropriate) – whether the effect can be reversed i.e., conditions can be returned to that of the baseline prior to the effect occurring either through natural processes or intervention as mitigation.

4.1.2.17 The magnitude of effect is categorised as 'High', 'Medium', 'Low' or 'Very Low' based on the quantification of the above parameters. This process of quantification can necessitate a degree of subjectivity as decisions are based on professional judgement and experience (IEEM, 2010), although underpinned by a strong evidence-base and quantified data where possible. Table 4.1-7 presents the specific parameters used to facilitate the definition of effect magnitude.

Table 4.1-7 Assessment of Magnitude of Effect (Source: from Wilhelmsson *et al.*, 2010 modified)

Characteristic	Description	Categories of effect magnitude	
Spatial extent	The geographic area of influence where the effect is noticeable against background variability	Very Low	Within 10 m from source or < 0.1% of the development area.
		Low	10-100 m from source of <1% of the development area.
		Medium	100-1,000 m from source or <10% of the development area.
		High	>1,000 m from source or >10% of the development area.
Duration	The temporal extent the effect is noticeable against background variability	Very Low	Potential through construction/operation phase
		Low	Through construction phase
		Medium	Through operational phase
		High	Impact persist beyond the operational and decommissioning phases
Frequency	How often the effect occurs	Very Low	Occurs at 5 year intervals or greater.
		Low	Occurs at intervals of between 1 and five years.
		Medium	Occurs on a monthly basis.
		High	Occurs at least on a weekly basis.

Sensitivity of Receptor

4.1.2.18 When a receptor is judged to be exposed to an effect (see Table 4.1-8), its overall sensitivity to that effect is determined. As for magnitude, this process incorporates a degree of subjectivity and expert opinion (IEEM, 2010) to apportion 'High', 'Medium', 'Low' or 'Negligible' categories.

4.1.2.19 The sensitivity of a particular receptor incorporates a variety of criteria including its ability to adapt, its tolerance of the effect and its potential to recover following cessation of an effect. In this assessment, benthic ecological receptors have been classified into biotopes for which considerable quantities of sensitivity information exist via the Marine Life Information Network (MarLIN) website (www.marlin.aco.uk) (see Technical Appendix 4.1 A Subtidal Ecology Characterisation). MarLIN is a charitable organisation funded and supported by the UK statutory nature conservation authorities, DEFRA and associated executive agencies to provide sensitivity assessments for UK marine species and biotopes. The MarLIN sensitivity assessments therefore provide an accepted framework within which effects can be described based on tolerance and recovery criteria to various effects (factors). Evidence/confidence categories caveat the determination of sensitivity within the MarLIN framework although in this assessment a degree of expert judgement and reference to relevant industry experience in other sectors is also made to further refine the overall effect. Importantly, the biotope level allows a degree of flexibility in community structure which might fluctuate in response to natural or anthropogenic influences, i.e. seasonal variations and / or demersal fishing. Observations from other studies including licence monitoring of offshore wind farm and marine aggregates activities are also used here to support assessment of receptor sensitivity.

4.1.2.20 This assessment also considers the value of the receptor as an intrinsic component of its sensitivity, be it in terms of its nature conservation, rarity at a particular geographical scale or functional role within the wider ecosystem as described within Table 4.1-8. IEEM (2010) also attribute social/community and economic values. Valuable ecological assets are usually identified within national and international legislation and/or through local or national nature conservation plans, such as UK Biodiversity Action Plans (UK BAPs). Important species and habitats may be afforded protection through the designation of sites of nature conservation under national and/or international statutes. The presence of a legislative hierarchy relating to nature conservation provides a range of convenient standards on which to assist the evaluation of the sensitivity and associated impact significance of the receptor. Areas which are not currently designated but nevertheless fulfil criteria for designation are assessed and considered in the same way as designated features with respect to assignment of effect significance and mitigation (IEEM, 2010).

4.1.2.21 Many species and biotopes lie outside current policy and legislative frameworks but are considered of importance nonetheless as a result of their functional roles within the wider ecosystem. This is especially relevant where particular features fall under broader habitat classifications with high conservation value, i.e. a sand biotope which forms part of an Annex I sandbank habitat or which falls under the broader "subtidal sands and gravels" UK BAP habitat. Table 4.1-8 presents categories of receptor sensitivity used in this assessment.

Table 4.1-8 Assessment of Receptor Sensitivity (Source : MarLIN, modified)

Characteristic	Description	Sensitivity Categories	
Adaptability	How well a receptor can adapt to an effect	Very Low	The habitat or species can be destroyed or killed (low tolerance) or damaged (medium tolerance) and is expected to recover only partially over a very long period of time (>25 years) and may take >25 years or not at all (negligible recoverability)
		Low	The habitat or species can be destroyed or killed (low tolerance) or damaged (medium tolerance) and is expected to recover over a long period of time (between 10 and 25 years) (low recoverability)
		Medium	The habitat or species can be destroyed or killed (low tolerance) or damaged (medium tolerance) but is expected to recover within 10 years (medium recoverability)
		High	The habitat or species can be destroyed or killed (low tolerance) or damaged (medium tolerance) but is expected to recover within one to five years (high recoverability)
Tolerance	The ability of a receptor to be either affected or unaffected (temporarily and/or permanently) by an effect.	Very Low	Species important for the structure and/or function of the biotope or its identification are likely to be killed and/or the habitat is likely to be destroyed by the impact under consideration
		Low	The population of species important for the structure and/or the function of the biotope or its identification may be reduced or degraded by the impact under consideration, the habitat may be partially destroyed, or the viability of a species population, diversity and function of a community may be reduced.
		Medium	Species important for the structure and/or function of the biotope or its identification will not be killed or destroyed by the impact under consideration and the habitat is unlikely to be damaged. However the viability of a species population or the diversity/functionality in a community will be reduced.
		High	The impact does not have a detectable impact on the structure and/or function of a biotope or the survival or viability of species important for the structure and/or function of the biotope or its identification.

Characteristic	Description	Sensitivity Categories	
Recoverability	A temporal measure of how well a receptor recovers following exposure to an effect	Very Low	Partial recovery is only likely to occur after about 10 years and full recover may take over 25 years or never occur.
		Low	Only partial recovery is likely within 10 years and full recovery is likely to take up to 25 years.
		Medium	Only partial recovery is likely within five years and full recovery is likely to take up to 10 years.
		High	Full recovery will occur over many months or years but should be complete within about five years
Value	The scale of importance (conservation status/importance), rarity (geographical extent relative to the potential area impacted) and worth (socioeconomic, biodiversity)	Very Low	The habitat/species hold no conservation importance, are widespread and play key role in the ecosystem
		Low	The habitat/species hold regional conservation importance, are widespread and play a key role within the ecosystem
		Medium	The habitat/species hold national conservation value
		High	The habitat/species hold international conservation status

Evaluation of Significance of Effects

4.1.2.22 Having described the effect that the proposal has on the benthic ecological receptor, the EIA process requires a level of significance to be assigned to that effect. This is achieved through a synthesis of the magnitude and sensitivity components to determine the significance of effect. A statement of the significance of effect is used to summarise the evaluation process in terms of positive or negative effects and is defined using the following four categories:

- **Not significant:** an effect that is predicted to be indistinguishable from natural background variation using conventional monitoring techniques. The effect is not significant in the context of the nature conservation objectives or legislative requirements;
- **Minor significance**: the effect will be measurable in the short term and/or over local scales (with or without mitigation) using standard monitoring techniques. The effect does not affect nature conservation objectives and falls within legislative requirements. Effects are typically reversible;
- **Moderate significance:** the effect will be measureable in the long term and over a broad to very broad spatial scale and is likely to have a measurable effect on wider ecosystem functioning. It does not affect nature conservation objectives or legislative requirements. Effects may be reversible; and
- **Major significance:** a permanent effect which has a measurable effect on wider ecosystem functioning and nature conservation objectives and exceeds acceptable limits or standards.

4.1.2.23 A conceptual diagram of how effect significance is determined for this assessment is provided below in Table 4.1-9. With respect to this assessment, a significant effect will be any effect that is of moderate significance and above.

Table 4.1-9 Matrix for Determining Significance of Effect from Magnitude and Sensitivity on Benthic Receptors

Magnitude \ Sensitivity	Very Low	Low	Medium	High
Very Low	No Effect	Minor Significance	Minor Significance	Moderate Significance
Low	Minor Significance	Minor Significance	Moderate Significance	Moderate Significance
Medium	Minor Significance	Moderate Significance	Moderate Significance	Major Significance
High	Moderate Significance	Moderate Significance	Major Significance	Major Significance

Uncertainty

4.1.2.24 Uncertainties associated with each assessment are defined using the following criteria:

- **Low uncertainty:** Interactions are well understood and documented. Receptor sensitivity has been investigated in relation to the specific factor under assessment. Predictions relating to effect magnitude are modelled and/or quantified. Information/data have very comprehensive spatial coverage/resolution;
- **Medium uncertainty:** Interactions are understood with some documented evidence. Receptor sensitivity is derived from sources that consider the likely effects of a particular factor. Predictions are modelled but not validated and/or calibrated. Information/data have relatively moderate spatial coverage/resolution; and
- **High uncertainty:** Interactions are poorly understood and not documented. Predictions are not modelled and maps are based on expert interpretation using little or no quantitative data. Information/data have poor spatial coverage/resolution.

Impact Assessment

Construction

4.1.2.25 The following presents the assessments of the identified effects of the construction of the modified OfTI proposals on subtidal benthic ecology. A summary of the significance of the identified effects is presented in Table 4.1-4 above.

Temporary Direct Seabed Disturbances

4.1.2.26 Seabed habitats and their characterising species (collectively termed biotopes) will be directly disturbed as a result of the action of the offshore export cable burial tool during the installation of the export and inter platform cables as well as seabed preparation works associated with the placement of foundations for the AC OSPs. This effect is of interesting as it will increase sediment instability and displace and kill species through crushing, burial and abrasion resulting in the reduction of species

diversity, abundance and biomass within the footprint. In addition, the periodic deployment and lifting of anchors to facilitate positioning of the offshore export cable laying barge may dislodge, damage and kill fauna and flora. Mobile species such as crabs, shrimps and benthic fish, including the spiny lobster PMF species, may be able to avoid disturbances or re-position within the sediment profile if buried, but sedentary and sessile fauna and flora may be damaged or dislodged leading to mortality of these species including those of nature conservation importance such as *A. islandica*, *M. loveni*, and *Arachnanthus sarsi*.

4.1.2.27 Direct effects will be highly localised and limited to the footprint of the offshore export cable burial tool, anchors and the dredger draghead. Effects will also be of very short duration lasting as long as the passage of the burial tool, the seabed preparations and anchor deployments, after which habitat recovery and species re-colonisation will occur.

4.1.2.28 Recovery and re-colonisation rates typically depend upon a number of factors including the prevailing hydrodynamic and sediment transport regime, the severity of the original effect and the nature of the baseline community and local re-producing populations. Habitat restoration is facilitated through natural backfilling as part of the cable laying process (BERR, 2008) whilst longer term morphological recovery will take place under the natural wave and tidal driven sediment transport mechanisms. Species recolonisation may be quicker in spring and summer, relative to autumn and winter, due to the greater availability of eggs, spores and larvae from adjacent re-producing populations at these times of year.

4.1.2.29 Sensitivity assessment (Rayment, 2008; Tyler-Watts, 2008) shows that local sand and mixed sand and gravel biotopes are highly intolerant of disturbance but that recovery is high with full recovery expected within a few months to five years following cessation of the disturbance. This reflects the opportunistic traits of the key characterising species, such as high fecundity and rapid larval dispersal.

4.1.2.30 The SpenMeg biotope, which occupies much of the southern half of the outer Moray Firth, on the other hand, may take up to 10 years to recover (Hill, 2008). This is because of the relatively slow growing and long lived nature of the characterising fauna, such as seapens (Hughes, 1998) and Norway lobster, which can take up to five years or more to reach reproductive maturity. Also, this biotope occurs in deeper water where the natural sediment stirring and weathering by large wave / storm events might be comparatively limited so that morphological recovery through natural dynamic process may occur more slowly relative to the recovery of biotopes present on the Smith Bank or in shallower inshore waters.

4.1.2.31 Given its close association with the SpenMeg biotope, recolonisation of affected areas by the mud burrowing amphipod M. loveni may also take more than five years to occur.

4.1.2.32 The reproductive behaviour and longevity of the burrowing mud anemone PMF species, (*Arachnanthus sarsi*) is currently unclear (Wilding & Wilson, 2009) and SNH regard it as rare with low resilience to physical seabed disturbances (see http://www.snh.gov.uk/docs/B988482.pdf). As a precaution, it is considered that this species may take longer than five years to re-colonise affected areas.

4.1.2.33 Trenching and/or dragging of anchors through a stony reef is likely to result in a permanent linear scar as the overlying wave and tidal process will be insufficient to remobilise cobbles and boulders to complete any natural backfilling and habitat restoration. Trenches through these features may instead be in filled by fine transient sediments that are present within the ambient bedload transport resulting in a change in the nature of the seabed to a finer sediment habitat. However, the likelihood of this actually occurring is low. This is because stony and rocky reef areas will be unsuitable for trenching. Instead, installation will be more likely to be achieved using concrete mattressing or rock placement (see below for assessment of habitat and community change).

4.1.2.34 The ocean quahog (*A. islandica*) is very long lived (+100 years) and reaches reproductive maturity at between 5 and 11 years (Sabatini *et al*., 2008). Maximum growth is thought to occur between 3–7 years of age. Recolonisation of disturbed areas and restitution of biomass is thus expected to be partially complete within five years but may take up to 10 years to be restored to pre-construction conditions. However, given its apparent distribution away from the boundaries of the modified TI (see section 'baseline characteristics' above), then no significant adverse effect on the population is forecast.

4.1.2.35 Effects will be highly localised, of short duration and will occur only once. Habitats predicted to be affected occur widely throughout the southern Moray Firth and in this broader scale context, their structure and function is not expected to be affected. Accordingly, the magnitude of effect is predicted to be low. Recovery of habitats and species is generally expected to be complete within five years following cessation of the disturbance although a longer recovery period of up to 10 years for affected parts of the SpenMeg biotope is forecast. Receptor sensitivity is thus judged to be low. Despite their nature conservation importance, the sensitivities of the "burrowed mud" PMF and associated PMF species receptors are also considered to be low given the broad distribution of this habitat type and availability of reproducing populations in adjacent non affected areas. The overall impact is therefore considered to be of **minor** significance.

4.1.2.36 The footprint of the effect is quantified and receptor sensitivity has been assessed through site specific survey and peer reviewed data (MarLIN) and thus uncertainty associated with this assessment is low. Note that significant adverse direct effects have not been identified during licence monitoring of offshore wind farms (MMO, 2014).

Temporary Increases in Suspended Sediment Concentrations and Sediment Deposition

4.1.2.37 Installation of the cables and seabed preparatory work associated with the foundations of the AC OSPs will raise suspended sediment concentrations (SSCs) and increase sediment deposition over adjacent seabed areas. This effect is of potential interest as the re settlement of suspended sediments over surrounding seabed areas and the potential for associated smothering and scour effects on benthic fauna may cause a loss of species diversity, abundance and biomass where effects are significant. Sessile epifaunal species may be particularly affected by increases in SSCs as a result of potential clogging or abrasion of sensitive feeding and respiratory apparatus. Larger, more mobile animals, such as crabs, fish, shrimps and prawns are expected to be able to avoid any adverse SSCs and areas of deposition. Effects will be temporary and will cease on completion of the construction activity.

4.1.2.38 As explained in Chapter 3.1 (Hydrodynamics, Sedimentary and Coastal Processes), local benthic faunal communities may be expected to be naturally exposed to levels of SSCs measuring 100s to 1,000s mg/l during periods of extreme wave events. Numerical modelling of the effects of raising SSCs (Technical Appendix 3.1 A Hydrodynamics, Sedimentary and Coastal Processes) shows that installation activities will increase SSCs by one or two orders of magnitude above the range of that which occurs naturally but only over a very small distance from the point of disturbance (i.e. to 125 m) and for a very short duration (i.e. minutes). Fine sediments are more dispersive and are forecast to remain at levels above the natural variation for up to three hours and for a distance of 2.5 km from the point of disturbance. Sediment thickness of re settled material also exceeds the natural variation but again, this will only occur very close (within 10s of metres) to the disturbance with subsequent wave and tidal driven transport processes further dispersing this material over adjacent areas over time. Sand and gravel sediments will be deposited locally at the point of release and will, therefore, be of the same type as the ambient substrate.

4.1.2.39 The MarLIN benchmark for assessment of the sensitivity of biotopes to raised SSCs and smothering is 100 mg/l for one month and 5 cm depth of burial by sediment for up to one month, respectively. These benchmark criteria are not forecast to be exceeded during the modified offshore export cable installation and OSP seabed preparatory works and so significant effects on receiving biotopes are not, therefore, expected. Sediment biotopes, and associated sediment burrowing species, along the majority of the cable corridor are expected to be tolerant of temporary light sediment effects. Burrowing species will re locate within the sediment profile and re-establish burrow openings if buried. Seapen species are able to retract into the sediment and so may be able to avoid temporary adverse effects of sediment smothering and scour. Important species such as *A. islandica*, *P. elephas*, *A. sarsi* and *M. loveni* are sediment burrowers or mobile species and so are expected to be tolerant to predicted sediment influences or can avoid significant adverse areas.

4.1.2.40 Epifaunal communities, such as those characterising the SS.SMx.CMx.FluHyd biotope, are typical of turbid conditions and so are not expected to be significantly affected by indirect sediment effects unless within a few metres of the disturbance where predicted sediment thicknesses may temporarily bury these species. Soft coral *Alcyonium digitatum* populations, which characterise stony and bedrock reef areas, are similarly tolerant to increases in SSCs and are able to slough off excess fine sediment particles through increased mucus production. Burial up to 5 cm for a prolonged period of time, however, may kill soft coral but such levels are not forecast. Recovery of epifauna populations is, therefore, predicted to be quick (within a few months to five years). Epifauna attached to vertical or sloping rock will not be affected by smothering as fine sediments are unlikely to accumulate on such surfaces.

4.1.2.41 As noted during consultation with the Inshore Fisheries Group (MORL, 2012, Chapter 4.2: Benthic Ecology) bryozoan and hydroid communities are believed to be important for the settlement of the spat of the King scallop (*Pecten maximus*) and squid (*Loligo* spp.) eggs. The localised and temporary nature of the effect and the rapid recovery capability of local bryozoan and hydroid species following sediment disturbances suggest no long term significant effects to important scallop and squid benthic habitat. Furthermore, the SS.SCS.CCS biotope associated with hydroids and bryozoans comprise very coarse gravel and cobble material which is highly unlikely to be ejected into the water column and transported any great distance over surrounding seabed area as a result of the proposed construction activities. Consequently, effects on component sessile epifaunal communities will be highly localised to the point of initial disturbance and will be limited in duration to the period of the activity following which rapid recovery will occur.

4.1.2.42 The effect would be highly localised and of short duration. Effect magnitude is therefore considered to be low. Biotope and species receptors are expected to be tolerant to the predicted sediment effects and/or able to avoid significant adverse areas and recovery is forecast to occur within the short term (five years). Receptors are widely distributed and well represented throughout the region. Receptor sensitivity is therefore considered to be low. Impact significance is therefore predicted to be **minor**.

4.1.2.43 This assessment carries low uncertainty as the effects of raised SSCs have been modelled and the footprint of the effect quantified. Receptor sensitivity has been assessed through site specific survey and peer reviewed data (MarLIN). Note that significant adverse indirect (sediment) effects have not been identified during licence monitoring of offshore wind farms (MMO, 2014).

Operation

Permanent Net Reduction of Original Habitat

4.1.2.44 Permanent net reduction of original habitat will occur as a result of the placement of the foundations of the OSPs and associated scour and cable protection material on

the seabed. In addition, any cutting of rock within inshore areas as part of the cable lay operation will result in the loss of an area of this habitat type proportional to the size of the cut. This effect is of potential interest as this will constitute a reduction in the total area of benthic habitat relative to the baseline condition.

4.1.2.45 Based on the worst case design parameters summarised in Table 4.1-6 for the modified OfTI, a total of 0.1 km² of habitat will be lost, although in comparison with the previous Rochdale Envelope for the three consented wind farms and TI (MORL, 2012) the effect will be reduced as fewer OSPs will now be constructed.

4.1.2.46 Loss of original habitat will occur at the offshore end of the modified OfTI due to the placement of the foundations of the OSPs and associated cable protection material on the seafloor. Consequently, only those biotopes corresponding to the offshore mixed sand and gravel and fine sand habitats on Smith Bank will be reduced in extent (including the SS.SSa.OSa.OfusAfil, SS.SSa.IMuSa.FfabMag and SS.SSa.CFiSa.EpusOborApri biotopes).

4.1.2.47 Shallow water coarse cobbles and rock habitats closer inshore may be unsuitable for trenching methods and consequently may be subject to concrete mattressing / rock placement (or similar) to achieve successful cable installation resulting in a reduction in the total area of these habitat types. The mattressing / rock placement may replace potential Annex I stony reef but is highly likely to be colonised by fauna and flora that are representative of local populations within a year or two. However, given that it will be a different (artificial) material possibly with reduced complexity, relative to the ambient rocky habitat, the colonising community is expected to be a simpler and less diverse variant of the surrounding communities. This would constitute a negative effect, although its spatial extent would be localised around the area of the mattressing / rock placement.

4.1.2.48 Further rock habitat may be lost on a permanent basis following any cutting of rock as a part of the cable lay process. At this stage the quantity of rock cutting required (if any) is not known. The cutting of rock will remove habitat and the species attached to it. However, it will present new rocky surfaces for colonisation by local species from surrounding unaffected areas once the installation process is complete. Recovery is likely to be very rapid, subject to the presence of nearby reproductive colonies, with establishment and growth of locally occurring foliose red algae, ascidians, bryozoans and the soft coral A. digitatum occurring within one year (Budd, 2008).

4.1.2.49 The spatial extent of the effect will be very low to low as it will relate to the direct footprint of the OSP foundation, rock placement and rock cutting (if any) only. Duration will, however, be medium as the foundations for the OSPs and the scour and cable protection material will be in place throughout the operational phase of the scheme. Furthermore, any rock cutting will leave a permanent localised impact on the seabed but affected areas will be rapidly recolonised. Effect frequency will be very low as the effect will only occur once. Overall, effect magnitude is thus considered to be low. No biotopes or species populations will be lost due to the current proposals. Ecological diversity and functioning across the wider region is therefore not expected as all components of habitat and associated communities will remain post construction. Colonisation of cable protection material and exposed rock surfaces following rock cutting is expected to be rapid although diversity may be lower in comparison to adjacent communities inhabiting the natural rock. Receptor sensitivity is therefore judged to be low. Accordingly, the significance of the loss of original habitat is considered to be **minor**.

4.1.2.50 The footprint of potential habitat loss is quantifiable. MESH data exist to indicate wider context for this assessment. Consequently, uncertainty associated with this assessment is considered to be low.

Habitat and Associated Community Change

4.1.2.51 The foundations of the AC OSPs together with the associated scour and cable protection material will introduce new hard substrate for colonisation by attaching and encrusting species and will change the ambient sedimentary habitats to a more heterogeneous coarse, hard substrate habitat. This effect is of potential interest as it will change benthic ecological conditions relative to the baseline. The increase in the availability of hard substrata is of further potential interest as it increases the risk of enhancing the spread of marine invasive non-native species (MINSS), such as the Japanese ghost shrimp (*Caprella mutica*) and associated loss of indigenous species. Effects of (a) indigenous species and (b) MINNS are assessed separately below.

Indigenous species and habitats

4.1.2.52 Hard structures in predominantly sedimentary biotopes would increase habitat diversity and complexity and would promote local diversity abundance and biomass of epifaunal organisms by providing stable surfaces for attaching and encrusting species. Recent experiences at the Kentish Flats Offshore Wind Farm (EMU Ltd., 2008a), Barrow Offshore Wind Farm (RSK, 2006; EMU Ltd., 2008b), North Hoyle Offshore Wind Farm (Bunker, 2004), Egmond aan Zee Offshore Wind Farm in the Dutch North Sea (Bouma and Lengkeek, 2009) and the Horns Rev Offshore Wind Farm in the Danish North Sea (BioConsult, 2006) show a vertical zonation of epifaunal species colonising turbine columns including high densities of common mussels together with barnacles, common starfish, worms, crabs, bryozoans and hydroid at upper most depths, whilst tube dwelling amphipods, anemones and hydroids dominated surfaces below 10 m. Scour protection rocks supported crab, oyster and slipper limpets and appeared to provide refuge and food for fish such as cod and pouting (BioConsult, 2005; Lindeboom *et al*., 2011). The placement of scour material may provide refuge/micro-niches and increased feeding opportunities for a range of larger more mobile species creating a possible aggregation effect and attracting a variety of fish, molluscs and crustaceans such as wrasse, brown crab, pacific oyster and common mussels (Linley *et al*., 2007).

4.1.2.53 Picken (1986) offers valuable insight into the types of epifaunal organisms that might be expected to colonise the OSP structures as a result of historic studies on the fouling organisms of artificial structures in the Moray Firth, including those within the adjacent Beatrice Field. Structures were initially colonised by barnacles and tubeworms within the first year of placement. Over the following two to three years, these became overgrown with common mussels together with growths of seaweeds in the uppermost 5 m of water. These growths were succeeded after four years by hydroids which dominated surfaces below the seaweeds together with soft corals and the ascidians sea squirts.

4.1.2.54 Krone *et al*. (2013) predicts that introduced hard substrata associated with offshore wind farms will increase stocks of substrata-limited mobile demersal hard bottom species. Predation by these species is expected to be localised around the turbines themselves, where the greatest benefits and feeding opportunities exist, although Krone *et al*. (2013) did notice several hard substrata associated species, such as brown crab and velvet swimming crab venturing onto the surrounding soft bottom seafloor at a wind farm site in the North Sea. This suggests that predation pressure by these species may be increased within a halo beyond each turbine foundation and scour material, although the degree to which this will, if at all, and any associated effect is unclear due to the lack of specific studies.

4.1.2.55 Biogenic material (principally mussel shell) that has grown on and subsequently become detached and fallen from turbines and scour protection rocks (Bouma & Lengkeek, 2012) can accumulate on surrounding seabed areas and within scour pits. Significant accumulation may modify local habitats and associated communities as a result of changes in sediment grain size distribution, organic

enrichment and possible attraction and aggregation of scavenging or predatory species such as common starfish, whelks and fish (Love *et al*., 1999; Degreaer *et al*., 2012) although such effects have not been recorded during licence monitoring of offshore wind farms in the UK (MMO, 2014). Localised benthic change has, however, been recorded around the bases of Californian oil platforms (Wolfson *et al*., 1979; Love *et al*., 1999) including deposits of mussel shells, as well as other biological material, supporting very high densities of predatory and scavenging species, particularly starfish at distances of up to 50 m away. The same studies also noted high densities of tube dwelling polychaetes up to 100 m from platforms and attributed this to the availability of biogenic material falling from the platforms for the construction of tubes. In addition, soft sediment communities were found to be modified up to a distance of 50 m from gravity bases at a wind farm in Belgium as a result of changes in sediment grain size distribution and increased enrichment attributable to the presence of turbine structures (Degreaer *et al*., 2012).

Marine Invasive Non-Native Species (MINNS)

4.1.2.56 Offshore renewable developments have been shown to act as stepping stones for several species (Svane and Petersen, 2001, cited in Petersen and Malm, 2006); this has raised concerns about their effect as facilitators for MINNS.

4.1.2.57 Previous examples of offshore wind projects at which MINNS have been recorded include:

- Acorn barnacle (*Elminius modestus*) at Thornton Bank (Kerckhof *et al*., 2009, 2010) and Kentish Flats (EMU, 2008);
- Giant barnacle (*Megabalanus coccopoma*) at Thornton Bank (Kerckhof *et al*., 2009, 2010);
- Slipper-limpet (*Crepidula fornicata*) at Thornton Bank (Kerckhof *et al*., 2009, 2010) and Egmond aan Zee (Bouma and Lengkeek, 2009);
- Pacific Oyster (*Crassostrea gigas*) Egmond aan Zee (Bouma and Lengkeek, 2009);
- Asian sea squirt (*Styela clava*) at Kentish Flats (EMU, 2008);
- Giant midge (*Telmatogeton japonicas*) Thornton Bank (Kerckhof *et al*., 2009, 2010) (Non-marine species); and
- Japanese skeleton shrimp (*Caprella mutica*) at Horns Rev (BioConsult, 2006).

4.1.2.58 MINNS is a qualitative descriptor for determining good environmental status under the Marine Strategy Framework Directive (MSFD). However, their management is still evolving and remains at an early stage mainly due to limited knowledge of the ecology of the species involved.

4.1.2.59 Most of the MINNS have been identified in intertidal and coastal environments with offshore wind farms potentially acting as a corridor for MINNSNIS species to settle and establish (ICES, 2009; Olenin *et al*., 2010). This is because each turbine column creates an intertidal environment offshore and therefore offers favourable conditions. Some of the MINNS classified as problematic (OSPAR, 2010), or as having deteriorating effects (Defra, 2011) have in fact been found at offshore wind farm sites (e.g. *Crassostrea gigas* or *Styela clava*), although not as major components of the faunal community. However, the intertidal environment created by foundation structures including offshore renewables and oil and gas infrastructure, appear to be favourable for some MINNS.

4.1.2.60 The effect of colonisation by indigenous species and MINNS would be highly localised around each installed OSP structure although duration would be medium, lasting throughout the operational phase.

4.1.2.61 The likely significant effects of MINNS on legislative requirements such as MSFD are currently unknown and so the uncertainty associated with this particular assessment is high. Sensitivity is therefore assessed as medium and reflects a precautionary approach in light of apparent uncertainties and previous stakeholder consultation (MORL, 2012). Consequently the significance of the effects of MINNS is regarded as **minor adverse**. Normal vessel maintenance and operating procedures such as hull cleaning, control of ballast water and use of anti-fouling coatings, and as part of the project EMP would reduce the risk of introduction and spread of MINNS.

4.1.2.62 Uncertainty associated with this assessment is high as the effects of the localised increases in predation pressure and accumulation of biogenic material on the seafloor (if any) are unknown and relevant studies are lacking.

Effects on Physical Processes and Related Biological Changes.

4.1.2.63 The effects on physical processes and associated benthic ecological effects within the three consented wind farm sites have been assessed in the previous ES (MORL, 2012 Chapter 10.1:Benthic Ecology).1 in relation to the presence of 339 turbines (maximum number of turbines if the lowest rated turbines are installed). This showed that very small changes in physical process are forecast resulting in no effects on benthic ecology. The presence of only two foundations as part of the modified TI is highly unlikely to raise the significance of this effect or alter the conclusions already made. The cable along the majority of the length of the route will be buried to a target depth of 1 m and so is unlikely to contribute to changes in physical processes. Given the predominately sedimentary nature of the seabed, it is likely that successful cable burial will be achieved throughout the majority of the cable route. This means that the quantity of any new or replacement cable protection material during the operation of the scheme is likely to be very small. Consequently, effects of the modified OfTI on physical processes and associated impacts on benthic ecology are assessed to be of **no significance**.

Effects of EMFs

4.1.2.64 This section addresses potential effects of EMF on benthic invertebrates. Effects of EMFs on fish and shellfish are considered in Chapter 4.2 (Fish and Shellfish Ecology).

4.1.2.65 BERR (2008) explains that sensitivity in benthic organisms, where present, is thought to be related to orientation and direction finding. Therefore, effects of EMFs are of potential interest as these may cause changes in a range of behaviours from local foraging to migration of benthic species depending upon the scale and magnitude of the influence.

4.1.2.66 The survival and physiology of selected species of prawns, crabs, starfish, marine worms and blue mussels, have been studied in relation to EMF levels corresponding to the intensity on the surface of ordinary sub marine DC cables in the Baltic Sea. Results showed no significant effects for any of the species under consideration after three months of exposure (Bochert and Zettler, 2004). In addition, a visual survey of benthic communities on wind power cables and the peripheral areas, showed no differences in assemblage structure (Wilhelmsson *et al*., 2010). Additionally, the occurrence of apparently healthy and diverse communities on existing offshore wind farm structures provides evidence that EMFs are unlikely to pose a significant threat to the colonising communities (Linley *et al*., 2007). This suggests that receptor sensitivity is low or very low.

4.1.2.67 The offshore export cables will be buried to a target depth of 1 m (see Chapter 2.2, Project Description). This is likely to provide some mitigation for possible impacts associated with EMFs, as a result of the dampening effects of the substrate and the physical separation of the receptors from the EMF source but as pointed out by Gill *et al*. (2005) EMFs may still remain detectable to the most sensitive of species even if the cable was buried to several metres below the seabed. Some dampening of

EMFs may also be achieved through the placement of concrete mattresses or rock protection over the cable, although the effectiveness of this in comparison to burial in sediment is not known.

4.1.2.68 The effect is highly localised around the cable and will be of medium duration lasting throughout the operational phase of the development but will be reversible upon decommissioning. Effect magnitude is therefore considered to be low. These factors coupled with current field observations described above (i.e. very low receptor sensitivity) and the mitigation through burial suggests that EMF effects on subtidal benthic ecology will be **not significant**.

4.1.2.69 This assessment carries medium uncertainty as the number of experimental field studies addressing invertebrate tolerance/sensitivity to EMF is currently rather limited. However, the offshore export cable will be buried so that potential EMF effects will be reduced. Monitoring at other wind farm sites (MMO, 2014, Cefas, 2010; Wilhelmson *et al*.,, 2010) have not detected any significant adverse effects attributable to EMF emissions on benthic ecology.

Effects of Heat

4.1.2.70 The passage of electricity through a cable will generate heat, which will then be dissipated within the overlying water or surrounding sediment substrate. This effect is of interest as it may cause increases in seabed temperatures, which might cause changes in physicochemical conditions of sedimentary substrates. These, in turn, may affect the physiology, reproduction or even mortality of certain benthic species (OSPAR, 2009). Effects of heat from cables laid on the surface of the seabed are considered to be of less concern, as the heat will be rapidly dissipated within the overlying water column. Some mobile species may be temporarily attracted to heat sources resulting in some possible localised re-distribution although observations are lacking.

4.1.2.71 The target cable burial depth is beyond the normal burrowing capabilities of species characterising local biotopes including Nephrops norvegicus. These typically occupy the uppermost few tens of cms of seabed sediment only and are therefore not expected to come on to contact with buried operational cables. In any case, mobile burrowers would be expected to be able to avoid adverse areas.

4.1.2.72 Emissions of heat from cables will be long–term, lasting for the duration of the operation and maintenance phase of the modified OfTI. but reversible on decommissioning. The effect is likely to be highly localised around the cable. The magnitude of this effect is therefore assessed as being very low and the sensitivity of benthic fauna would be very low. Accordingly, the effects of heating from the offshore export cables is assessed to be **not significant**.

4.1.2.73 This assessment carries low uncertainty as the spatial extents of the effects are well understood and licence monitoring at offshore wind farms have not detected any significant adverse effects on benthos due to heat emissions (MMO, 2014).

Decommissioning

4.1.2.74 It is proposed that the export cable will be left in situ and so no effects on benthic ecology will occur during its decommissioning.

4.1.2.75 Removal of the AC OSP foundations will disturb seabed sediments for subsequent re distribution over adjacent areas resulting in potential smothering effects. The dominant sediment habitats and communities will be tolerant to these effects (as assessed above) and the significance of related effects is expected to remain minor.

4.1.2.76 Removal of the OSP foundations will result in the removal of the epifaunal communities attached to them. The protected cold water coral Lophelia pertusa is not expected to colonise OSP foundations during the operation of the wind farm, as the comparatively shallow water conditions locally are thought unsuitable. As such, adverse decommissioning effects on high value benthic ecological receptors are not forecast.

4.1.2.77 Removal of the foundations and scour material will expose the natural seabed previously lost under these structures. These areas are expected to be rapidly re colonised from surrounding reproducing populations with full restitution of the habitats and biotopes expected within five years, subject to the condition of the seabed substrate and stability compared to the baseline situation.

Accidental Spillages of Chemicals

4.1.2.78 Accidental spillages or release of chemicals such as grouting, fuel and oil during the construction, operation and maintenance and decommissioning phases of the wind farms may potentially impact upon the subtidal benthic ecology. The severity of this effect depends upon the quantities and nature of the spillage / release, the dilution and dispersal properties of the receiving waters and the bio-availability of the contaminant to species.

4.1.2.79 In the worst case scenario the magnitude of effect would be high. Depending upon the nature of the spill, sensitivity of receptors would also be high. Impact significance would therefore be major. However, the embedded mitigation measures, which include the development and implementation of construction and operation and maintenance environmental management plans, would reduce the likelihood of such an event occurring so that the magnitude of the effect would be very low and that the impact significance would be **not significant**.

Proposed Monitoring and Mitigation

Construction

4.1.2.80 Development of and adherence to an Environmental Management Plan (EMP) compliant with ISO14001 or BSA 555, will limit the risk of accidental spillages or releases occurring and to ensure that adequate contingency is in place (i.e. spill plan) to resolve any incidents quickly. Also, establishment of an EMP will identify appropriate measures to avoid or minimise adverse effects on marine life.

4.1.2.81 The development and adherence to a protocol to minimise risk of introducing MINNS via attachment to marine plant and/or specialised equipment is recommended by SEPA (MORL, 2012 Chapter 4.2 Benthic Ecology). This may include regular hull cleaning of construction vessels, maintenance of anti-fouling systems and ballast water management as part of vessel normal operating procedures.

4.1.2.82 The use of best practice to minimise the quantities of scour and cable protection material will reduce loss of original seabed habitat and habitat change.

Operation

4.1.2.83 Development of and adherence to an EMP will limit the risk of accidental spillages or releases occurring or ensure that adequate contingency is in place to resolve any incidents quickly.

Decommissioning

4.1.2.84 A decommissioning plan will be developed and agreed with the relevant authority on decommissioning. Development of and adherence to an EMP will limit the risk of accidental spillages or releases occurring or ensure that adequate contingency is in place to resolve any incidents quickly.

4.1.3 Cumulative Impact Assessment

Summary

4.1.3.1 This section presents the results of assessment of the potential cumulative effects upon subtidal benthic ecology arising from the modified OfTI in conjunction with other existing or reasonably foreseeable marine developments and activities. MORL's approach to the assessment of cumulative effects is described in Chapter 1.3: Environmental Impact Assessment.

4.1.3.2 A summary of the likely significant cumulative effects is provided in Table 4.1-10 below. Given the largely static or sedentary nature of benthic ecological receptors, other developments and activities considered here include those which are adjacent to the modified OfTI and which are forecast to give rise to similar effects on benthic ecology. Projects which are distant to the modified OfTI, such as the Hywind Demonstrator Project, are considered to be outside of the potential zone of influence of the modified OfTI with respect to effects on benthic ecology and are thus not considered in this cumulative assessment.

4.1.3.3 In conjunction with other developments and activities within the locale, the modified OfTI will only have minor cumulative effects on benthic habitat loss and introduction of new substrate as a result of the operation of the proposals. Cumulative effects of temporary seabed disturbances arising from the construction phase of the projects are considered to be not significant with regard to benthic ecology.

Table 4.1-10 Cumulative Impact Summary

Effect/Receptor	**Residual significance level for modified TI**	**Whole project assessment:** **Modified TI + Stevenson, Telford and MacColl**	**Mitigation Method**
Construction & Decommissioning			
Temporary increases in SSCs and sediment deposition	Not significant	Not significant	n/a
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.1.3.5)***	Effects arising from each scheme will be localised and short term. Sediment plumes will be dispersed along parallel tidal axes. The predominately sedimentary receptors are expected to be tolerant to predicted sediment effects. The cumulative effect is predicted to be not significant.		
Operation			
Habitat loss	Minor	Minor	n/a
Total Cumulative Impact Assessment **(Whole project plus those developments listed in Section 4.1.3.5)**	The footprint of temporary seabed disturbances will be small within the context of the availability of seabed habitat across the outer Moray Firth. No loss of biotope diversity or species populations is forecast. The cumulative effect is predicted to be minor.		
Habitat change	Minor	Minor	n/a
Total Cumulative Impact Assessment **(Whole project plus those developments listed in Section 4.1.3.5)**	The addition of 2 OSP foundations, scour material and cable protection material as part of the modified OfTI will represent a small amount of new habitat within the wider context of the wind farm and oil and gas infrastructure in the outer Moray Firth. The effect is judged to be minor.		

Assessment of Cumulative Effects

4.1.3.4 A whole project assessment has been done for the likely significant cumulative effects of the modified TI in conjunction with the three consented wind farms (Telford, Stevenson and MacColl).

4.1.3.5 The following developments were considered in detail for the total cumulative impact assessment for the whole Project:

- BOWL and transmission infrastructure as consented;
- MORL Western Development Area (WDA);
- Beatrice Demonstrator Turbines;
- SHE-T cable;
- SHEFA telecoms cable;
- Beatrice and Jacky platforms and associated infrastructure; and
- Licence Block 12/27 oil and gas exploration Suncor Energy UK Ltd (Suncor)

4.1.3.6 The spatial context within of this cumulative assessment is set by the expected range of the benthic ecology receptors (habitats and species). These are relatively immobile and will be generally constrained to the respective boundaries of the projects identified above. Some benthic fish and larger crustaceans obviously have the potential to range beyond project boundaries and are considered within Chapter 4.2 Fish and Shellfish Ecology, although the smaller species, which typically fall within the consideration of subtidal benthic ecology, will only range comparatively small distances. Consequently, any direct effects of far field projects and activities beyond the modified offshore export cable route corridor will not contribute to direct cumulative effects on benthic ecology and are thus excluded from this assessment. The exception to this is the perceived incremental loss of original seabed habitat and the introduction of new hard substrata across the wider region as a result of multiple offshore developments, for instance the modified OfTI, three consented wind farms in combination with the BOWL, the MORL Zone Western Development Area (WDA) and existing Beatrice and Jacky platforms. In this respect, the spatial context of the assessment is broadened to encompass other projects within the outer Moray Firth where comparable biotopes serving similar ecosystem functions occur.

4.1.3.7 Indirect effects associated with the movement of sediment plumes from other developments and activities may interact with those arising from the modified Project giving rise to indirect cumulative (sediment) effects. This section therefore considers other local projects and on-going activities within the Moray Firth, which may give rise to sediment plumes. Given that such sediment plume interaction will only occur within the extents of tidal excursions, any projects and activities outside of this tidal range are not considered, as the associated indirect sediment effects on benthic ecology will be insignificant at these greater distances.

Methodology

4.1.3.8 The assessment methodology has followed that outlined in the Moray Firth Offshore Wind Developers Group (MFOWDG) Discussion Document (see Appendix 1.3 D, MORL ES, 2012).

4.1.3.9 The foundations of the OSPs and associated scour and cable protection material of the modified OfTI will be placed within the boundaries of the three consented wind farms (Telford, Stevenson and MacColl). Under MFOWDG, a combined biotope map for both the BOWL and MORL sites was created to inform assessment of the potential incremental cumulative loss of benthic habitat (biotopes) following construction of both offshore wind farms (MORL, 2012).

4.1.3.10 A summary of the realistic worst case parameters of wind farm design for the MORL consented wind farms, the BOWL site as consented and MORL WDA in terms of benthic ecology are provided in Table 4.1-11, Table 4.1-12 and Table 4.1-13 respectively. The worst case parameters for the modified OfTI are provided in Table 4.1-6 above. Note that as the Telford, Stevenson, MacColl and BOWL sites are now consented, their worst case parameters are well understood and will be of a lower magnitude than that applied for. The worst case scenario for the MORL WDA, has assumed a maximum of 500 MW of installed capacity within this area. However, it should be noted that the overall MORL Zone capacity is capped at 1.5 GW as originally assessed in the MORL ES (2012). This means that should MORL successfully construct in excess of 1,000 MW in the three consented wind farm sites then the development in the WDA will be restricted accordingly to ensure the MORL Zone capacity is not exceeded. This restriction of the total capacity of the MORL Zone means that the effects from development in the three consented wind farms and WDA combined will be restricted also.

4.1.3.11 In the MORL ES, cumulative effects were assessed on the basis of a potential capacity of 1,500MW (3 x 500 MW) from the three MORL consented wind farms alone. The predicted effects of a 1,500MW offshore wind farm within the MORL Zone have thus already been assessed and reported (MORL, 2012). The conclusions from that assessment have been assumed in this ES to be representative of the effects of the three MORL consented wind farms and the WDA combined.

Table 4.1-11 Summary of MORL Consented Wind Farms Worst Case Parameters for Benthic Ecology

Realistic Worst Case Parameters	Scenario Assessed
Incremental Loss of Habitat and Habitat Change	
Installation of 186 turbines with gravity base foundations and associated scour material. GBS foundation and scour protection with combined permanent zone of influence of 11,690 m per foundation Cable protection associated with up to 4 J tubes per turbine assuming protection required up to 100 m distance from turbine and at 10 m width = 4,000 m^2 per turbine.	Total area of loss of original habitat and area of new hard substrata = 2.91 km^2
Temporary increases in SSCs and sediment deposition	
Installation of 186 gravity base foundations; Length of inter-array cables = approximately 572 km and trench width = 6 m.	Increases in suspended sediment concentrations arising from worst case parameters.

Table 4.1-12 Summary of BOWL Consented Wind Farm Worst Case Parameters for Benthic Ecology

Worst Case Parameters	Scenario Assessed
Incremental Loss of Habitat and Habitat Change	
Installation of 140 turbines (125 turbines consented as per conditions but with the potential for up to 140 turbines), plus 2 AC OSPs and 1 AC/DC substation GBS foundation and scour protection with combined permanent zone of influence of 11,690 m per foundation Cable protection associated with up to 4 J tubes per turbine assuming protection required up to 100 m distance from turbine and at 10 m width = 4,000 m^2 per turbine. Length of export cable = 65km (up to 3 trenches) requiring 0.26km^2 of cable protection.	Total area of loss of original habitat and area of new hard substrata = 2.49 km^2 equating to 2.04% of the BOWL (turbine site and cable site) development area.
Temporary Increases in SSCs and Sediment Deposition	
Installation of 143 GBS foundations (125 turbines consented as per conditions but with the potential for up to 140 turbines plus 3 OSPs); Length of inter-array cables = 260 km and trench width = 3 m. Length of export cable = 65 km (up to 3 trenches)	Increases in suspended sediment concentrations arising from worst case parameters.

Table 4.1-13 Summary of MORL WDA Worst Case Parameters for Benthic Ecology

Realistic Worst Case Parameters	Scenario Assessed
Incremental Loss of Habitat and Habitat Change	
Installation of 100 turbines and one AC OSP with gravity base foundations and associated scour material. GBS foundation and scour protection with combined permanent zone of influence of 11,690 m per foundation Cable protection associated with up to 100 m distance from turbine and at 10 m width = 2,000 m^2 per turbine.	Total area of loss of original habitat and area of new hard substrata = 2.57 km^2.
Temporary Increases in SSCs and Sediment Deposition	
Installation of 101 gravity base foundations (turbines and OSPs); Length of inter-array cables = approximately 130 km and trench width = 6 m.	Increases in suspended sediment concentrations arising from worst case parameters.

Other Developments

4.1.3.12 Parameters associated with other cable projects within the outer Moray Firth, including the SHE-T cable and the Suncor well installations remain unconfirmed and so individual and cumulative effects are unquantifiable at this stage. This cumulative assessment has therefore taken a more qualitative approach in defining likely effects relating to these developments and associated construction and operational elements. In these instances, it is assumed that other cable projects will result in temporary seabed disturbances including the raising of sediment plumes as a result of trenching or ploughing during installation. These cable projects are also assumed to contribute to the incremental loss of original benthic habitat and to habitat change in the outer Moray Firth as a result of the placement of protection material on the seabed, should this be required.

4.1.3.13 The Suncor well installations are also likely to temporarily disturb seabed sediments resulting in short term increases in suspended sediment concentrations and sediment deposition as a result of the action of the drilling equipment on the seabed. Given the very small size of the footprint of well heads on the seabed (in the order of a few metres), then any contribution to loss of original benthic habitat and habitat change is considered to be negligible.

Cumulative Assessment

4.1.3.14 Effects of EMF and heat emissions have been screened out of the cumulative assessment due to the highly localised spatial extent of the predicted effects around the export cables, the intended target burial depth of 1 m and the mobile nature of potentially sensitive species. Assessment of cumulative effects of EMF on mobile fish and crustaceans is presented in Chapter 4.2 (Fish and Shellfish Ecology).

4.1.3.15 The likely significant cumulative effects on benthic ecology considered include:

- Habitat loss;
- Raised suspended sediment concentrations (SSCs) and sediment deposition; and
- Change in habitat.

4.1.3.16 The receptors identified for consideration in this cumulative assessment are:

- Benthic habitats;
- Benthic species.

Habitat Loss

4.1.3.17 The modified OfTI is predicted to result in the cumulative incremental loss of 0.1 km^2 of original benthic habitat as a result of the placement of the OSP foundations, scour protection and cable protection on the seabed. This equates to just 3.09% of the original benthic habitat that is predicted to be lost as a result of the three MORL consented wind farms. The magnitude of effect is thus judged to be low. There are no habitats or species that are specific to the footprint of the three MORL consented wind farms and modified OfTI developments and so biotope and species diversity will not be reduced. The footprint of the predicted habitat loss is considered to be very small within the context of the benthic habitats available across the wider outer Moray Firth. Sensitivity is thus judged to be low and the effect is predicted to be **minor**.

4.1.3.18 The modified OfTI, MORL consented wind farms, the BOWL site and its associated offshore transmission infrastructure together with development within the WDA and any infrastructure associated with the SHE-T cable will also result in a cumulative incremental loss of seabed habitat in the outer Moray Firth as a result of the successive placements of turbine and OSP foundations and protection material on the seabed.

4.1.3.19 Collectively, the, MORL consented wind farms and MORL WDA turbine foundations, BOWL site and transmission infrastructure will occupy approximately 6.94 km^2 of seabed within the outer Moray Firth. In contrast, the modified OfTI is forecast to only occupy an additional area of 0.1 km^2 (worst case) equating to an additional 1.2 % of the predicted habitat loss. Note that the majority of this additional 1.2 % will actually result in a habitat change (i.e. not habitat loss) as it relates to the placement of rock cable protection material which can be subsequently colonised by local species. Given their, very small footprint on the seabed, the potential Suncor well installations are not expected to contribute to loss of original benthic habitat or habitat change.

4.1.3.20 The spatial extent of this cumulative effect is small within the context of other projects and the wider outer Moray Firth area. The significance of cumulative effects on biodiversity and ecosystem functioning is thus considered **minor**.

4.1.3.21 The maximum footprints of the components of the BOWL, MORL consented sites and WDA developments are understood and so uncertainty associated with this assessment is regarded as low.

Temporary Increases in SSCs and Sediment Deposition

4.1.3.22 Installation of the modified OfTI, the three consented wind farms, the BOWL site and associated OfTI together with the SHE-T and SHEFA offshore transmission infrastructure and the drilling the Suncor well installation will temporarily disturb fine muddy sand sediments resulting in increased SSCs and sediment deposition as assessed above. However, sediment plumes arising from simultaneous installation of the consented wind farms and the modified OfTI proposed are not forecast to interact significantly. This is because of the typically low suspended sediment concentrations (SSCs) predicted, the localised and temporary nature of the effect and the rapid dilution of dispersion of suspended sediments in the receiving waters and the general parallel pathways of plume dispersion so that they are not expected to converge or inter-mingle. Sediment communities are expected to be tolerant to temporary sediment effects as assessed above. The installation of the modified OfTI will not temporally coincide with the installation of the potential Suncor oil and gas wells.

4.1.3.23 Significant cumulative effects relating to temporary increases in SSCs and sediment deposition are therefore not anticipated because of the small spatial scale of the effects, the distances between potential developments, the parallel tidal movements of plumes and the general insensitivity of receiving habitats (see Table 4.1-8 above).

4.1.3.24 Significance of cumulative effects in this regard is therefore considered to be **not significant**.

4.1.3.25 Commercial fishing activities involving mobile demersal gears can also raise suspended sediments into the water column increasing local levels of SSCs. There is therefore the potential for further cumulative sediment effects to arise where this activity occurs within the footprint of indirect construction effects. The magnitude and spatial scale of potential cumulative effects are presently difficult to qualify as the footprint of commercial fishing varies spatially and temporally. However, given the generally rapid dispersion and dilution of raised SSCs, the low intolerance of receiving sediment habitats and the temporary nature of the disturbance, then the significance of any associated cumulative effects is considered to be **not significant**.

Change in Habitat

4.1.3.26 The introduction of new hard substrate in the form of the vertical surfaces of the OSPs and cable protection material in the outer Moray Firth has the potential to increase local species diversity as they will provide suitable areas for colonisation by a range of epifaunal populations. Additionally, scour material will increase the availability of refugia for larger, more mobile epibenthos such as fish and crabs, attracted by the greater availability of food resources (see Chapter 4.2 Fish and Shellfish Ecology). At the local level around each OSP, therefore, there is a potential for increases in biodiversity and productivity. However, at the wider, cumulative level, the perceived positive effects are less certain. This is because any colonising epifaunal populations will probably already be represented within the outer Moray Firth, for example attached to existing platforms within the Beatrice oil field. Consequently, any species colonising the new habitat will already have been recorded elsewhere within the wider area and overall effects on regional biodiversity will be marginal. Accordingly, the effects are judged to be localised and significant cumulative effects in this respect are not predicted.

4.1.3.27 New habitat associated with the two proposed OSPs also has potential for colonisation by marine invasive non-native species (MINNS). However, within the context of the new habitat, represented by existing oil and gas structures and future turbine foundations, scour and cable protection material) already consented in the outer Moray Firth, any contribution from the modified OfTI will be very low and the cumulative effect is considered to be **minor**.

4.1.4 References

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4 Biological Environment

4.6 Terrestrial Ecology and Ornithology

4.6.1 Baseline Information

Introduction

4.6.1.1 This chapter details the terrestrial ecology and ornithology baseline conditions present within the modified Onshore Transmission Infrastructure (OnTI) associated with the MORL three consented wind farms (Telford, Stevenson and MacColl), and provides an assessment of the potential effects the modified OnTI may have on such receptors. The chapter covers all issues relating to terrestrial ecology, including birds and freshwater habitats.

4.6.1.2 The study area comprises a number of environments, including urban, rural, agricultural, and coastal land. The study area is defined as a corridor of 550 m, taking into account a proposed working corridor and suitable surrounding buffer. This totals 18.3 km^2 and was used throughout the baseline field surveys. Proposed and refined OnTI cable route options can be seen in Figure 4.6-1.

4.6.1.3 The study consisted of the following aspects:

- Detailed desk study to establish the baseline conditions within the study area;
- Field surveys to inform the baseline assessment;
- Consideration of the relevant key legislative and planning information; and
- Consultation with relevant statutory and non-statutory bodies, including Scottish Natural Heritage (SNH), the North East Biological Records Centre (NESBReC), and the North East Raptor Study Group (NERSG).

4.6.1.4 A detailed account of this information is provided in:

- Technical Appendix 4.6 A – Terrestrial Ecology and Ornithology Technical Report; and
- Confidential Annex – Terrestrial Ecology and Ornithology Confidential Annex Report (Protected Species).

4.6.1.5 Within the vicinity of the modified OnTI several sites are designated for ornithological or ecological interests: Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Wetlands of International Importance (Ramsar sites) and Sites of Special Scientific Interest (SSSIs). Figure 4.6-2 shows the locations of all designated sites within 15 km of the modified OnTI.

Consultations

4.6.1.6 Table 4.6-1 below details the organisations consulted regarding the modified OnTI. Where relevant, consultations made before and during the 2012 submission (MORL ES, 2012) are also provided.

Table 4.6-1. Terrestrial Ecology and Ornithology Response

Organisation	Consultation Response	MORL Approach
Scottish Natural Heritage (2014)	The following advice was issued by SNH regarding the OnTI and information which should be provided in support of the ecological and ornithological interests within the area:	
	• Adequate detail of the cable laying technique(s) should be provided so that potential effects on sensitive species and habitats during the construction phase can be assessed;	Cable laying techniques are detailed in Chapter 2.2 (Project Description) and assessed in Section 4.6.2 of this chapter.
	• The route is not expected to impinge on any designated ornithological sites;	
	• Omission of winter bird surveys is acceptable if the timeline for construction specifies that the winter months will be avoided;	
	• Additional breeding bird surveys should be carried out immediately prior to construction to identify nesting attempts, particularly those of Schedule 1 species;	
	• SNH are content with the proposed list of protected species surveys outlined in section 5.2.6 of the scoping report;	
	• In addition to the scoping response received following submission of the scoping report, SNH confirmed in May that great crested newt survey work was not required;	
	• Relevant District Salmon Fishery Boards should be consulted regarding potential impacts to salmonids and other fish species at river crossings;	Consultation has been undertaken with the Spey and Deveron District Salmon Fishery Boards and is detailed in Chapter 4.2 (Fish and Shellfish Ecology).
	• Surveys for freshwater pearl mussels are not required provided adequate sediment management and pollution prevention plans are in place;	
	• SNH support the proposal to undertake Phase 1 surveys along the cable corridor route and buffer with the understanding that follow up National Vegetation Classification (NVC) work for important areas may be required. As set out in the scoping report, they also advise that this is also used to identify where protected species survey work is appropriate; and,	
	• Protected species pre-construction survey work revisiting the project footprint should be undertaken to ascertain any changes in the degree of wildlife activity as this could have implications for the level of mitigation required.	

Organisation	Consultation Response	MORL Approach
Scottish Environmental Protection Agency (2014)	The following response was received from SEPA regarding the development: • Approved of proposed Phase 1 Habitat and NVC (National Vegetation Classification) survey and recommended guidance to help identify wetlands 'A Functional Wetland Typology for Scotland'; • Site layout should avoid impacts on all wetlands, in particular active blanket bog. For areas where avoidance is impossible, details of how impacts upon wetlands including peatlands are minimised and mitigated should be provided. In particular impacts that should be considered include those from drainage, pollution and waste management; • Groundwater-dependent terrestrial ecosystems are protected under Water Framework Directive. Results of NVC survey and Appendix 2 of SEPA's Planning guidance on wind farm developments should be used to identify if wetlands are groundwater-dependent terrestrial ecosystems. If groundwater-dependent terrestrial ecosystems are located within radius of (i) 100m from roads, tracks and trenches, or (ii) 250 m from borrow pits and foundations, then any impacts will require further assessment. This assessment should be carried out whether or not features in (i) and (ii) occur inside or outside site boundary so that micro-siting does not necessitate further NVC surveys. Results and any mitigation should be provided; and, • Roads, tracks or trenches or other excavation work within 100m, or borrow pits within 250 m, of groundwater-dependent terrestrial ecosystems identified as highly sensitive (in Appendix 2 of SEPA's Planning Guidance on wind farm developments) should be reconsidered. Further studies will be required if infrastructure remains within buffer zones.	Potential effects on wetlands are assessed in Section 4.6.2 of this chapter and in Chapter 3.2 (Hydrology, Geology and Contaminated Land). Potential effects on wetlands are assessed in Section 4.6.2 of this chapter and in Chapter 3.2 (Hydrology, Geology and Contaminated Land). Potential effects on wetlands are assessed in Section 4.6.2 of this chapter and in Chapter 3.2 (Hydrology, Geology and Contaminated Land).
The River Deveron District Salmon Fisheries Board (RDDSFB) and the Deveron, Bogie & Isla Rivers Charitable Trust (DBIRCT) (2014)	The RDDSFB and DBIRCT were contacted regarding records of freshwater pearl mussels within the development corridor: • Some sporadic records of freshwater pearl mussel are present within the Deveron and low Deveron, along with historic records from 1976 upstream of Banff and around Turriff. • Bodies recommended that salmonids and their associated habitats are considered within the assessment as these are protected by European law.	Potential effects on salmonids are assessed in Chapter 4.2 (Fish and Shellfish Ecology).

Baseline Characteristics

4.6.1.7 The proposed modified OnTI passes through a landscape dominated by intensively managed arable and improved grassland fields, interspersed by pockets of semi-natural and plantation broadleaved and coniferous woodland. The area is criss-crossed by small watercourses and field boundaries demarcated by hedgerows and fence lines, with the wider area drained via the River Deveron which discharges into the Moray Firth at Banff. Scattered urban areas are present along the route, the

majority of these being single farms and associated agricultural outbuildings. However, the larger town of Banff is closely by-passed at the northern end of the route where the offshore transmission infrastructure (OfTI) will make landfall.

4.6.1.8 Desk and field based surveys have sought to quantify the terrestrial ecological interests within the OnTI cable route corridor and proposed location of the substations, creating a robust up to date baseline against which the potential effects associated with the modified OnTI can be assessed. Methodologies used to collate the baseline and complete results are detailed in full in Technical Appendix 4.6 A and Confidential Annex. A summary of the results compiled can be seen in Sections 4.6.1.11 to 4.6.1.24 below for both the desk and field based surveys.

Desktop Studies

Methods

4.6.1.9 The following sources of information were used to obtain historical and contemporary records of bird and protected mammal species, protected fish species and habitats in proximity to the proposed OnTI:

- Joint Nature Conservation Committee (JNCC) Seabird 2000;
- British Trust for Ornithology (BTO) Wetland Birds Survey (WeBS);
- National Biodiversity Network (NBN) (for British National Grid (BNG) squares NJ56, NJ66, NJ74, NJ75, NJ76, NJ84, NJ85 and NJ94);
- North East Raptor Study Group (NESRSG);
- Deveron, Bogie and Isla Rivers Charitable Trust;
- District Salmon Fisheries Boards;
- North East Scotland Biological Record Centre (NESBReC);
- Scottish Wildlife Trust (SWT);
- North East Scotland Bat Group;
- Saving Scotland's Red Squirrels (SSRS); and
- Botanical Society of Britain and Ireland (BSBI).

4.6.1.10 All species records were considered in the context of their legal protection and conservation status, taking cognisance of priority species on the North East Scotland Local Biodiversity Action Plan (NE LBAP) and the Scottish Biodiversity List (SBL). In total, there are 25 priority habitats and 48 priority bird and mammal species on the NE LBAP. For a list of these, see Table 10 and 11 in Technical Appendix 4.6 A. The full list of species and habitats on the SBL can be viewed at http://www.snh.gov.uk/protecting-scotlands-nature/biodiversity-scotland/scottish-biodiversity-list/.

Results

Seabird 2000

4.6.1.11 Two seabird colonies were identified within 3 km of the proposed landfall point at Boyndie Bay (Inverboyndie) using Seabird 2000 data. These colonies are relatively small in population with only herring gull noted as breeding at these locations.. The full results of the Seabird 2000 data search are presented in Table 2 of Technical Appendix 4.6 A.

Wetland Bird Survey

4.6.1.12 WeBS data was requested from one core count area in the River Deveron Estuary. A total of 30 species were recorded over the three year period May 2007 – November 2010, with herring gulls and great black-backed gulls being the most common species. The majority of species were recorded during the winter months, with numbers of all generally reduced during the breeding season (e.g. a peak count of 108 redshank in December 2009 compares to a peak breeding season count of 16 in May 2010). Full results of the WeBS data returned from the BTO are presented in Table 3 in Technical Appendix 4.6 A.

Raptors

4.6.1.13 At the time of writing this Chapter, June 19th 2014, no response had been returned by the NERSG. The project area and its habitats are not known to be associated with breeding Schedule 1 raptors, and the lack of a response is seen as an indication of low priority given by this body to raptor data in this area in relation to such a project.

Passerines

Corn Buntings

4.6.1.14 Corn bunting is a red-listed Bird of Conservation Concern (BoCC), listed on the Scottish Biodiversity List and noted as a NE LBAP priority species. The species is a scarce resident breeder in north east Scotland where it is at the northern extremity of its breeding range. There are an estimated 550-600 corn bunting territories in Aberdeenshire and Moray. This number comprises 64 % of the Scottish population and 6 % of the UK population. The northeast Scotland population has declined significantly in the past two decades. Most birds occur in the Buchan plain of Aberdeenshire, now the Scottish stronghold for the species, in several hotspots between Rattray and Rosehearty. Here, densities can reach 21 males/km^2 and the hotspots are therefore among the most densely populated areas of corn bunting in the UK (Francis and Cook, 2011). Extensive conservation work is being undertaken across Aberdeenshire to benefit this declining species (www.rspb.org.uk/ourwork/projects).

4.6.1.15 Corn buntings occur in open, lowland arable and mixed farmland. Nests are built on the ground within crops or in dense, grassy vegetation. A range of arable habitats are favoured by the species (Forrester *et al.*, 2007), most of which are typical of this area of rural Aberdeenshire.

4.6.1.16 Corn buntings typically rear two broods per year, first clutches are laid from late-May and second clutches are laid as late as mid-August, thus chicks can still be in the nest well into September (Forrester *et al.*, 2007). Early nests are usually built in autumn-sown cereals or grass managed for silage and later nests in spring-sown cereals. The chick diet is centred on insects (Francis and Cook, 2011).

4.6.1.17 Corn buntings are broadly sedentary and form flocks from late-October to early-May. In winter the flocks sometimes move locally when deep snow or ploughing of stubble reduces food supplies. The species has very similar breeding and winter distributions (Forrester *et al.*, 2007).

4.6.1.18 RSPB were consulted to provide any relevant information on corn bunting presence (Table 4.6-2). At the time of writing only the response from the previous 2012 submission is available, however this is deemed to still be relevant for the species.

Table 4.6-2. RSPB Corn Bunting Consultation

Organisation	Consultation response
RSPB Conservation Officers for North East Scotland	Hywel Maggs confirmed Aberdeenshire was remaining UK stronghold for the species. He agreed that potential construction impacts on the species would be low and of a temporary nature. It was verified that there is no ideal season for construction as corn bunting are present all year round (31 August 2011).

National Biodiversity Network

4.6.1.19 Records of a total of 79 bird species were obtained from the data search of the NBN (excluding green-listed birds of conservation concern which do not have other conservation designations associated with them). Of these 79, seven (corncrake, golden plover, kingfisher, little egret, red-backed shrike, sandwich tern and short-eared owl) are listed on Annex I of Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive'). In addition, six (corncrake, fieldfare, kingfisher, quail, red-backed shrike and redwing) are listed on Schedule 1 of the Wildlife and Countryside Act 1981. Records from the NBN do not clearly differentiate breeding or migrant species, and records relating to corncrake, red-backed shrike and little egret at least are believed to refer to passage migrants in the broader area rather than breeding species. The full list of species returned from the NBN data search is presented in Table 12 of Technical Appendix 4.6 A.

4.6.1.20 Records of a total of ten mammal species, and one fish species were obtained from the data search of the NBN. Of these eleven, six (otter, common pipistrelle, Daubenton's bat, soprano pipistrelle, unidentified bat species and wildcat) are listed on Schedule 2 of the Conservation (Natural Habitats &c.) Regulations 1994. These records included all relevant data held by SSRS.

4.6.1.21 The full list of species returned from the NBN data search is presented in Table 13 of Technical Appendix 4.6 A.

North East Scotland Biological Records Centre

4.6.1.22 Relevant bird, plant, mammal and fish records within the modified OnTI were sought from the NEBReC. These included all relevant records from the North East Bat Group. A total of 21 bird species were returned by NEBReC (excluding green-listed birds of conservation concern which do not have other conservation designations associated with them). These are presented with two associated conservation designations (Table 6 within Technical Appendix 4.6 A). Eight mammal species were found, these are also presented alongside five associated conservation designations (Table 7 of Technical Appendix 4.6 A). Fifty-one plant species of conservation concern were returned and these are presented alongside two associated conservation designations (Table 8 of Technical Appendix 4.6 A).

Botanical Society of Britain and Ireland

4.6.1.23 Plant records within the modified OnTI were sought from the BSBI. A total of 41 species were returned from the BSBI. These are presented alongside two associated conservation designations in Table 9 of Technical Appendix 4.6 A.

Scottish Biodiversity List and North east Local Biodiversity Action Plan

4.6.1.24 Priority habitats, birds and mammals with potential to occur along the length of the modified OnTI and surrounding area were sought from the SBL and NE LBAP. Twenty-five priority habitats and 48 priority bird and mammal species were identified. These are presented in Table 10 and Table 11 of Technical Appendix 4.6 A.

Site Specific Surveys

4.6.1.25 Baseline field surveys were carried out from April to May 2014 to quantify use of the modified OnTI by breeding birds and protected mammals, and to map habitats and assess their potential to support bats. The modified cable route corridor was defined as a 550 m wide band taking into account a proposed maximum construction area and suitable buffer area; this formed the 'ecology survey area', totalling 18.3 km^2 and was used throughout the baseline field surveys. This area also included all potential substation locations which were buffered by 250 m and included within the total survey area of 18.3 km^2. Of this 18.3 km^2, 4.9 km^2 was unable to be assessed during the course of the surveys due to a lack of permitted access by landowners. Details of areas surveyed can be seen in Figure 4.6-1 some surveys (breeding birds and Phase 1 Habitat Survey) are ongoing. This chapter has fully assessed the potential effects on these receptors using data collected to date. Breeding bird and coastal surveys have been conducted in May and June this year. It is considered that the bird count in May will disclose the peak potential breeding population as birds recorded singing and displaying at this time will not necessarily go on to make a breeding attempt. Whilst further surveys are being carried out in July, the assessment in this chapter has been based on these precautionary (likely worst case) May counts.

Winter Walkover Surveys

4.6.1.26 Three winter walkover surveys were carried out between November 2013 and March 2014 of a number of potential substation locations, including the proposed location within this application, and a subsequently-revised onshore cable route corridor (Figure 4.6-1). The requirement for winter walkover surveys was scoped out through consultation with SNH (Table 4.6-1) and so no further consideration is given to the results of these surveys in this chapter. The full list of species encountered during these surveys, including peak numbers for each, is presented in Table 14 of Technical Appendix 4.6 A, for reference purposes only.

Breeding Bird Surveys

Methods

4.6.1.27 At the time of writing, one breeding bird survey visit had been completed in May. Two further surveys will be carried out in June and July 2014, with the results of these surveys being provided in July. The surveys have been (and will be) undertaken according to the Common Bird Census (CBC) methodology (Gilbert *et al.*, 1998; Marchant, 1983). Surveys are carried out during periods of good weather (i.e. good visibility, no persistent rain or fog, avoiding excessive heat or cold or wind speeds exceeding Beaufort Force 4) from one hour before dawn to six hours after dawn. The location and behaviour of all birds are recorded directly onto 1:10,000 scale Ordnance Survey (OS) maps using standard BTO notation.

4.6.1.28 All records of birds are digitised using ArcGIS software and territory analysis will be carried out on completion of all surveys. Birds are assumed to be holding territory if one or more of the following behaviours are observed:

- Displaying or singing;
- Presence of a nest, eggs or young (including newly fledged birds);
- Agitated behaviour, specifically alarm calls or distraction display; and/or
- A territorial dispute.

4.6.1.29 In the absence of any of these behaviours, a pair observed together in suitable habitat is also considered to be holding a territory. Other records are considered to be of non-breeding birds.

Results

4.6.1.30 The results of the remaining two breeding bird surveys, and of the final territory analysis, will be submitted in July.

4.6.1.31 In summary, a total of 57 species were recorded during the May visit of the 2014 breeding bird surveys (Table 15 of Technical Appendix 4.6 A). A single osprey, which is listed on Annex I of the Birds Directive and on Schedule 1 of the Wildlife and Countryside Act 1981, was observed flying overhead during this survey. In addition, two flocks of golden plover (numbering 120 and 28 birds), which are listed on Annex I, were recorded flying high overhead. Six golden plover were also recorded on the ground but were not observed to be displaying any evidence of breeding, and habitat in the area is not conducive to this. A total of eighteen singing corn buntings were encountered, as shown in Figure 4.6-3. The remaining species are, in general, common and widespread.

Coastal Bird Surveys

Methods

4.6.1.32 Coastal bird surveys were undertaken at the proposed point of landfall for the TI export cables originating from the three consented wind farms at Inverboyndie. Three survey visits are proposed between May and July 2014. Data from the May surveys is present within this document; additional survey results will be report in July.

4.6.1.33 The survey area included the proposed landfall location and an additional 1 km buffer stretching east and west along the coastline. The coastline was buffered to a distance of 500 m offshore to include birds on the water or in flight above the sea. The coastal bird survey areas are shown in Figure 4.6-4. Surveyors walked the coast within the survey area from west to east, mapping all waterbird species (defined by the BTO as all divers, grebes, cormorants, herons, wildfowl, waders, gulls and terns) on a 1:5,000 scale OS map which had a north-south grid of 250 x 250 m cells placed across it to improve accuracy. Standard BTO codes were used in recording birds, with notes of behaviour also made (e.g. roosting, loafing, foraging).

4.6.1.34 Surveys were timed to be carried out across the survey programme at different times of the tidal cycle to ensure that all species and activities were captured. Surveys were timed as such:

- One survey commencing two hours prior to high tide;
- One survey commencing two hours prior to slack tide; and
- One survey commencing two hours prior to low tide.

Results

4.6.1.35 In summary, a total of twenty species were recorded at the Inverboyndie landfall point. The full list of species recorded is shown in Table 16 in Appendix 4.6 A. Four species (great northern diver, red-throated diver, sandwich tern and whimbrel) are listed on Annex I, while six (common scoter, great northern diver, long-tailed duck, red-throated diver, whimbrel and white-billed diver) are listed on Schedule 1 of the Wildlife and Countryside Act 1981. Great northern diver, common scoter and long-tailed duck were present in low numbers (represented by one, two and nine individuals, respectively). Relatively large numbers of red-throated divers were also present (fourteen individuals), suggesting that the wider coastal area is favoured by wintering / pre-breeding birds. The nine whimbrel recorded are passage migrants making only limited transitional use of the area. Large numbers of sandwich terns (65 individuals) were recorded; however, no breeding colony was identified via Seabird 2000 within 3 km of the landfall point (see Table 2 of Technical Appendix 4.6 A).

4.6.1.36 White-billed divers are very uncommon in British waters, with the area around Banff thought to be one of few known wintering grounds known for the species in the U.K (Baxter *et al*., 2013). For example, up to thirteen birds were recorded during boat surveys between Logie Head and Portsoy in April 2013 (Baxter *et al*., 2013). This number had, however, dropped to four by mid-May of 2013 and it is possible that birds use the area only during the spring moult before moving on to summer breeding grounds in Arctic Russia (Forrester *et al*., 2007). The area being used by white-billed divers is also apparently very restricted in size, with no birds found within several miles to the east and west of the Logie Head to Portsoy stretch of coast (Baxter *et al*., 2013).

Phase 1 Habitat Surveys

Methods

4.6.1.37 The Phase 1 Habitat survey was carried out from 5 to 16 May 2014. This survey defined Phase 1 Habitat types and extent across the 13.4 km^2 of the ecology survey area following standard JNCC (2010) guidelines. The Phase 1 Habitat classification and associated field survey technique provides a relatively rapid system to record semi-natural vegetation and other wildlife habitats. Each habitat type is defined by way of a brief description and is allocated a specific name, alpha-numeric code and unique mapping colour. The system has been widely used and continues to act as the standard phase 1 technique for habitat survey across the UK. The ecology survey area was walked, habitats were inspected and delineated directly onto 1:10,000 OS maps using standard Phase 1 alphanumeric notation. Target notes (TNs) were made to highlight features of interest or any aspect too small to be mapped; these were supported by photos and GPS coordinates. Target notes are referred to throughout the text and in figures by a sequential number prefixed with TN, e.g. TN17. Full details of target notes can be seen in Table 19 of Technical Appendix 4.6 A.

Results

4.6.1.38 Baseline field survey results (Figure 4.6-5) show that the habitat within the OnTI comprises an intensively managed, open landscape of predominantly arable land and improved grassland, with a small number of built up areas present, particularly surrounding the landfall location in the north. Pockets of both plantation and semi-natural woodland are scattered along the length of the OnTI. Field boundaries and woodland edges across the survey area form important linear features in the otherwise open, homogenous landscapes present. Native, species-rich hedgerows are widespread, comprising rowan, silver birch, hawthorn, hazel and elder.

4.6.1.39 A total of 23 Phase 1 Habitat types were recorded within the 13.4 km^2 of the cable route corridor surveyed. Habitats (and percentage coverage) within the OnTI can be summarised into the following categories:

- Arable land and grassland, 61.8 %;
- Woodland, 6.7 %;
- Built-up areas, 4.1 %
- Scrub, tall herb and fern, 0.4 %
- Water and wetland features, 0.2 %;
- Mire, 0.1 %; and,
- Rock and quarry, 0.1%.

4.6.1.40 No habitats were recorded which might be considered as ground-water dependent (SEPA 2012); consequently measures outlined in SEPA's scoping response (Table 4.6-1) are currently not required. For detailed results tables and descriptions of the habitats present please refer to Technical Appendix 4.6 A.

Protected Species (Mammal) Surveys

Methods

4.6.1.41 The protected species survey was carried out within the 13.4 km^2 of the OnTI available to be accessed between the 28 April and 22 May 2014. Field evidence of the following protected species was searched for across the survey area:

- Otter;
- Badger;
- Water vole;
- Red squirrel;
- Pine marten; and
- Wildcat.

4.6.1.42 A full description of the indicative field signs for each of these species is provided within Technical Appendix 4.6 A.

Results

4.6.1.43 Protected species evidence collected along the length of the modified OnTI shows the area is highly utilised by badgers, with 36 individual setts being recorded (these results can be seen in the Confidential Annex and the associated figure). Thirty of these setts were defined as main setts, with at least eleven of these exhibiting signs of current use. Well used runs, recently visited latrines, and snuffle holes and marks found along the corridor route similarly corroborate the high utilisation of the area by the species.

4.6.1.44 Use of watercourses by otters for foraging appears widespread with numerous couches and sprainting locations discovered during the course of the surveys. Much of the indicative evidence shows recent use of the area, and it is likely the species uses watercourses within the corridor as part of a number of wider territories.

4.6.1.45 Feeding signs of red squirrel were noted at a single location; however a sighting of an individual was recorded within the cable route corridor.

4.6.1.46 Water vole evidence was found throughout the survey area in habitats dominated by marshy grassland. Thirty-two burrows and five latrines were found across the ecological survey area.

4.6.1.47 No field signs of pine marten or wildcat were found during the field surveys despite small areas of suitable habitat being recorded for pine marten. The lack of any indicative sign for either species and the fragmented nature of sections of suitable habitat have led to these species being scoped out from further assessment. As such these species are not considered further within this document.

4.6.1.48 Full details of protected species presence, the signs found, and their location within the cable route corridor can be seen in the Technical Appendix 4.6 A and Figure 4.6-6. Badger sett records, due to the species' historical persecution and the sensitive nature of the information, are detailed in the Confidential Annex and Figure 4.6-7.

Bat Roost and habitat Suitability Surveys

Methods

4.6.1.49 The bat roost and habitat suitability survey was carried out from 5 to 16 May 2014 in parallel with the Phase 1 Habitat survey. Potential habitat suitability for bats was assessed across the 13.4 km^2 of the accessible modified OnTI.

4.6.1.50 As surveyors walked the ecology survey area recording Phase 1 Habitats, habitats were also considered for their potential suitability to support roosting, foraging or commuting bats. Surveyors categorised habitats to be of high, medium or low suitability for bats, based on roosting, foraging or commuting suitability criteria (Table 1 of Technical Appendix 4.6 A). Thus, potential bat roosts (buildings, bridges, mature trees), commuting routes (linear features such as hedgerows and lines of trees) and foraging habitat (water bodies, marshy grassland, cow fields) were classed to be of low, medium or high value. Photos, target notes and GPS coordinates were taken to support recordings made on maps.

Results

4.6.1.51 The modified OnTI's northerly latitude and managed, open landscape of predominantly arable land and improved grassland, lacking well-connected networks of different foraging habitats, suggests low numbers and diversity of bats. It is documented that the Grampian region supports at least five resident bat species (Haddow and Herman, 2000):

- Soprano pipistrelle;
- Common pipistrelle;
- Brown long-eared bat;
- Daubenton's bat; and
- Natterer's bat.

4.6.1.52 Soprano pipistrelles use a wide range of habitats and roost in various buildings and trees, however they strongly favour foraging over habitats associated with water, especially rivers and lochs with marginal woodlands, yet few such waterbodies exist within the modified OnTI. However, common pipistrelles are better adapted to agricultural landscapes with limited woodland and water, such as that within the modified OnTI. Daubenton's bat is a specialist of sheltered, calm water with a healthy chironomid midge population, whilst Brown long-eared and Natterer's bats favour foraging habitat of mixed landscapes with mature woodland, and roosting habitat in old, large buildings. Few such habitats for any of these species exist within the modified OnTI. As such, common pipistrelle is likely to be best adapted to the habitat found along the cable route.

4.6.1.53 A full list of areas suitable for roosting, foraging, or commuting are provided within Table 19 of Technical Appendix 4.6 A.

Legislative and Planning Framework

4.6.1.54 The legislation below was taken into account within the terrestrial ecology and ornithology assessment process:

- The European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive);
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011;
- The European Council Directive 2009/147/EC on the conservation of wild birds (EU Birds Directive);
- The European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (EU Habitats Directive);
- Ramsar Convention on Wetlands of International Importance 1971;
- Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979, as amended;
- Conservation of Habitats and Species Regulations 2010;
- Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007;
- Conservation (Natural Habitats, &c.) Regulations 1994;
- Wildlife and Countryside Act 1981, as amended;
- The Nature Conservation (Scotland) Act 2004; and
- The Protection of Badgers Act 1992.

4.6.1.55 In addition to the above legislation, the following guidance was also taken into account:

Birds of Conservation Concern

4.6.1.56 The population status of UK birds is reviewed every five years to provide an up-to-date assessment of conservation priorities. The 2009 review of Birds of Conservation Concern (BoCC) allocated 246 species onto red, amber or green lists. Seven quantitative criteria were used to assess population status: global conservation status, recent decline, historical decline, European conservation status, rare breeders, localised species and international importance.

Scottish Biodiversity List

4.6.1.57 The Scottish Biodiversity List (SBL), published in 2005, is a list of flora, fauna and habitats which Scottish Ministers consider to be important for Scottish biodiversity conservation. The list was developed by a partnership of organisations, specifically, the Scottish Biodiversity Forum as well as the Scottish public. The criteria include scientific criteria as well as a social criterion of culturally important species and habitats based on a survey of the Scottish public.

NE LBAP Priority Habitats and Species

4.6.1.58 The NE LBAP aims to protect and enhance local biodiversity across Aberdeen, Aberdeenshire and Moray. Formed in 1996, it is a partnership of statutory and voluntary agencies and individuals. The NE LBAP develops Local Action Plans which set out measures to conserve priority habitats.

4.6.2 Impact Assessment

4.6.2.1 Summary of Effects and Mitigation

Summary of Effects

4.6.2.2 This section details the evaluation of likely significant effects on terrestrial ecology and ornithology as a result of the proposed development and provides mitigation measures to address these effects. The assessment covers birds, habitats and protected mammal species.

4.6.2.3 The impact assessment was carried out on all valued ecological receptors (VERs). In assessing the residual effects to VERs the following standard mitigation was proposed:

- For terrestrial breeding bird VERs, during mid-March to July carry out pre-construction surveys to ensure effects to breeding birds are minimised;
- For habitat VERs, micro-site onshore cable route design to avoid sensitive habitats and employ CEMP (Construction Environmental Management Plan) and Construction Method Statements (CMS);
- For otter and badger VERs, cover all excavations when not in use (or provide a means of escape), avoid night works (or minimise light spill), cease works within 100 m of otter holts and badger setts 1hr before dusk and commence 1hr after dawn, micro-site onshore cable route design to avoid badger setts (if setts cannot be avoided then a licence will be required from SNH), set up a protection zone 30 m around setts and carry out preconstruction surveys;
- For the bat roost and habitat suitability VER, micro-site cable route design to avoid sensitive bat habitat features, carry out targeted baseline field surveys prior to construction once onshore cable route design has been confirmed to inform detailed mitigation, avoid dawn, dusk and overnight works near areas with bat roost potential and carry out preconstruction surveys; and
- For red squirrel and water vole VERs, micro-site cable route design to avoid sensitive red squirrel or water vole habitat features, carry out pre-construction surveys to confirm species absence from all potentially affected areas.

4.6.2.4 Following implementation of mitigation measures, residual effects of only negligible significance were predicted for all ornithological effects.

4.6.2.5 All habitat VERs were found to have residual effects of only negligible-minor significance.

4.6.2.6 Otter and badger VERs were found to have residual effects of only minor significance whilst red squirrel and water vole VERs were found to give residual effects of only **negligible–minor** significance. Likewise, the bat roost and habitat suitability VER was found to have residual effects of only negligible-minor significance. A summary of the impact assessment results is shown in Table 4.6-3.

Table 4.6-3. Impact Assessment Summary

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
Construction & Decommissioning				
Impacts on breeding and wintering coastal and terrestrial birds from habitat loss and disturbance / displacement	Terrestrial breeding birds	Minor	Conduct pre-construction surveys if works are ongoing March to July. Habitat restoration.	Negligible
	Coastal wintering birds	Minor	Avoid coastal works during winter months.	Negligible
Impacts to species from habitat loss and disturbance/ displacement	Otter	Moderate	Cover all excavations when not in use. Where excavations cannot be covered, provide means of escape. Avoid night working. When night working cannot be avoided, direct light onto work area only and minimise light spill. Works within 100 m of holts should cease 1hr before dusk and commence 1hr after dawn. Adhere to SEPA's PPGs. Enforce vehicle speed limits. ECoW present during works.	Minor
	Badger	Moderate	Micro-site cable route to avoid sett(s). If sett(s) cannot be avoided then obtain license from SNH to destroy sett(s). Impose protection zones 30 m from sett(s) and mark with brightly coloured tape. Cover all excavations >5 m deep when not in use. Pipes of diameter >20 cm should be capped nightly. Avoid night working. When night working cannot be avoided, direct light onto work area only and minimise light spill. Works within 100 m of sett(s) should cease 1 hr before dusk and commence 1 hr after dawn. Enforce vehicle speed limits. ECoW present during works. Carry out preconstruction survey. Employ best practice.	Minor
	Red Squirrel	Minor-moderate	Micro-site cable route to avoid sensitive habitat features.	Negligible-minor

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
	Water vole	Minor	Carry out preconstruction survey. Enforce vehicle speed limits. ECoW present during works. Carry out pre construction survey. Employ best practice.	Negligible-minor
Impacts from damage habitat	Bat roost and habitat suitability	Minor-moderate	Micro-site cable route to avoid sensitive habitat features. Targeted baseline field surveys to be carried out prior to construction, once cable route confirmed, to inform detailed mitigation actions; surveys to include roost searches, Anabat surveys, commuting surveys and control surveys, all May-September. Carry out preconstruction survey. ECoW present during works. Habitat restoration. Avoid dawn, dusk and overnight works near areas with bat roost potential.	Negligible-minor
Impacts on habitats and conservation designated sites from pollution, damage and disturbance	Wet modified bog	Minor	Adhere to SEPA's PPGs. Maintain vehicles and plant to avoid leaks. Avoid construction works in heavy rainfall. Delimit working areas to minimise zone of impact. Employ best practice. Enforce CEMP and construction method statements. Sediment control near burns. Avoid trenching alongside the River Deveron. Habitat restoration where onshore export cable has impacts.	Negligible
	Semi-improved and unimproved neutral grassland	Minor		Negligible
	Watercourses and standing water	Minor		Minor
	Marshy grassland	Minor		Negligible
	Waterbodies	Minor		Negligible
	Plantation and semi-natural woodlands	Minor		Negligible
	Arable land	Negligible		Negligible
	Improved grassland	Negligible		Negligible
	Tall ruderal herb and fern	Negligible		Negligible
	Amenity grassland	Negligible		Negligible

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
	Scattered and dense scrub	Negligible		Negligible
Operation				
Impacts on breeding and wintering coastal and terrestrial birds from habitat loss and disturbance / displacement	Terrestrial breeding birds	Minor	Habitat restoration. Carry out preconstruction surveys. ECoW present during works.	Negligible
	Coastal wintering birds	Minor - Negligible	Avoid coastal works during winter months.	Negligible
Impacts to species from habitat loss and disturbance/ displacement	Otter	Moderate	Cover all excavations when not in use. Where excavations cannot be covered, provide means of escape. Avoid night working. When night working cannot be avoided, direct light onto work area only and minimise light spill. Works within 100 m of holts should cease 1hr before dusk and commence 1hr after dawn. Adhere to SEPA's PPGs. Enforce vehicle speed limits. ECoW present during works.	Minor
	Badger	Moderate	Micro-site cable route to avoid sett(s). If sett(s) cannot be avoided then obtain license from SNH to destroy sett(s). Impose protection zones 30m from sett(s) and mark with brightly coloured tape. Cover all excavations >5 m deep when not in use. Pipes of diameter >20 cm should be capped nightly. Avoid night working. When night working cannot be avoided, direct light onto work area only and minimise light spill. Works within 100 m of sett(s) should cease 1 hr before dusk and commence 1 hr after dawn. Enforce vehicle speed limits. ECoW present during works. Carry out preconstruction survey. Employ best practice.	Minor
	Red Squirrel	Minor	Micro-site cable route to avoid sensitive habitat features.	Negligible-minor

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
	Water vole	Minor	Carry out preconstruction survey. ECoW present during works. Employ best practice.	Negligible-minor
Impacts from damage habitat	Bat roost and habitat suitability	Minor-moderate	Micro-site cable route to avoid sensitive habitat features. Targeted baseline field surveys to be carried out prior to construction, once cable route confirmed, to inform detailed mitigation actions; surveys to include roost searches, Anabat surveys, commuting surveys and control surveys, all May-September. Carry out preconstruction survey. ECoW present during works. Habitat restoration. Avoid dawn, dusk and overnight works near areas with bat roost potential.	Negligible-minor
Impacts on habitats and conservation designated sites from pollution, damage and disturbance	Wet modified bog	Minor	Adhere to SEPA's PPGs. Maintain vehicles and plant to avoid leaks. Avoid heavy rainfall. Delimit working areas to minimise zone of impact. Employ best practice. Enforce CEMP and construction method statements. Sediment control near burns. Avoid trenching alongside the River Deveron. Habitat restoration where onshore export cable has impacts.	Negligible
	Semi-improved and unimproved neutral grassland	Minor		Negligible
	Watercourses and standing water	Minor		Minor - Negligible
	Marshy grassland	Minor		Negligible
	Waterbodies	Minor		Negligible
	Plantation and semi-natural woodlands	Minor		Negligible
	Arable land	Negligible		Negligible
	Improved grassland	Negligible		Negligible
	Tall ruderal herb and fern	Negligible		Negligible
	Amenity grassland	Negligible		Negligible
	Scattered and dense scrub	Negligible		Negligible

Introduction to Impact Assessment

4.6.2.7 The area of the modified OnTI in north east Aberdeenshire comprises a managed, open landscape of arable land and improved grassland, inhabited by the protected species otter, badger and bats, and supporting a typical assemblage of farmland and coastal birds.

4.6.2.8 This section assesses the likely significant effects on terrestrial ecology and ornithology baseline conditions derived from desk study and contemporary field surveys (2014) as a result of the proposed development. Detailed terrestrial ecology and ornithology baseline conditions are provided in:

- Technical Appendix 4.6 A – Terrestrial Ecology and Ornithology Technical Report; and
- Confidential Annex – Terrestrial Ecology and Ornithology Confidential Annex.

4.6.2.9 This impact assessment is used to inform the terrestrial ecology and ornithology cumulative impact assessment provided in Section 4.6.3 of this chapter.

4.6.2.10 Within 15 km of the modified OnTI, 13 sites are designated for ornithological or ecological interests: SPAs, Ramsar sites, SACs and SSSIs (Figure 4.6-2). Although a number of these are within the locality of the modified export cable route, effects on these have been scoped out by SNH. As such no additional consideration is given to them within this Impact Assessment.

Rochdale Envelope Parameters Considered in the Assessment

4.6.2.11 The Rochdale Envelope, outlining the 'worst realistic case' effects for the impact assessment is summarised in Table 4.6-4 based on details in Chapter 2.2 - Project Description.

Table 4.6-4. Rochdale Envelope Parameters relevant to the Terrestrial Ecology and Ornithology Impact Assessment

Potential Effect	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Effects on breeding and wintering coastal and terrestrial birds from habitat loss and disturbance/ displacement **Effects on habitats and conservation designated sites from pollution, damage and disturbance** **Effects on otter, badger, red squirrel or water vole from habitat loss and disturbance/ displacement** **Impacts from damage to bat habitat**	Onshore AC cable: • Maximum number of cable trenches = four, each carrying three cables in a trefoil arrangement; • Cable installation method = cable plough at an estimated rate of 1km/day, directional drilling at landfall and water crossings at an estimated rate of <1 km/day, and open trenching at rate of 300 m/day at the landfall points if directional drilling is not possible; • Cable trench width = 4 m assuming one trench for each bundle, these may be installed in two separate phases (two trenches each time). Two 6 m wide trenches would be required if two bundles are buried together. For some very short sections it may be necessary to unbundle cable and install as single cables; • Cable trench target depth = 1 m, although slightly deeper burial of 1.2-1.5 m may be required in some areas; • Cable trench working width = 60 m maximum based on a worst case scenario of four trenches; and • Cable route length = 33 km from landfall site at Inverboyndie to the substation at New Deer. This is an approximate value; final length will be determined by final route design and micro-siting. • Transition Pits may be located above Mean High Water Springs). Size and dimensions of the pit is dependent on layout of subsea cables. Pits will be wide enough to accommodate one or two cables, plus a team of cable joiners (two – four people). • MORL AC substation: o Length, 270 m (plus temporary working area); o Width, 135 m (plus temporary working area); and o Height, 13 m. • Transmission owner AC substation: o Length, 270 m (plus temporary working area); o Width, 170 m (plus temporary working area); and o Height, 13 m.
Operation	
Impacts on breeding and wintering coastal and terrestrial birds from habitat loss and disturbance/ displacement **Impacts on habitats and conservation designated sites from pollution, damage and disturbance** **Impacts on otter and badger from habitat loss and disturbance/ displacement** **Impacts from damage to bat habitat**	• MORL AC substation: o Length, 270 m (plus temporary working area); o Width, 135 m (plus temporary working area); and o Height, 13 m. • Transmission owner AC substation: o Length, 270 m (plus temporary working area); o Width, 170 m (plus temporary working area); and o Height, 13 m.

EIA Methodology

4.6.2.12 Assessment of significance of effects on VERs was broadly based on the staged process in the Institute of Ecology and Environmental Management's (IEEM) (2006) guidelines. As such, effects were predicted and characterised and their significance in terms of EIA Regulations were determined. However unlike IEEMs (2006) guidelines, a matrix approach was used to determine levels of significance based on the conservation value of VERs and the predicted magnitude of effects. This matrix is the standard approach adopted in ecological and ornithological impact assessment and is used for consistency and clarity. Results are subject to expert judgement using IEEMs (2006) guidelines to ensure accuracy in predictions and avoid over-reliance on matrix output.

4.6.2.13 The stages in the assessment are as follows:

- Determination of the conservation value of VERs within the modified OnTI based on geographical scale;
- Identification of potential effects based on the nature of the modified OnTI;
- Determination of the scale and magnitude of those effects;
- Determination of the significance of those effects based on the magnitude and duration of effects on the vulnerability of the VERs affected;
- Identification and assessment of mitigation measures required to address significant adverse effects; and
- Determination of the significance of any residual effects once the benefits of the prescribed mitigation measures have been assessed.

4.6.2.14 The significance of effects is also determined by understanding how each species or habitat will be affected by construction, operation or decommissioning of the export cable and onshore substations. This takes into consideration the following:

- Habitat extent/population estimates within the modified OnTI;
- Population/habitat extent trends of each species/habitat at a national or regional level;
- Distribution of populations/habitats of each VER within the study area and at a wider scale;
- Vulnerability of each VER to particular effects; and
- Ecology and behaviour of each species.

Conservation Value of VERs

4.6.2.15 VERs were identified from baseline results summaries. VER sensitivity was first assessed in relation to the conservation value of the species over the full range of geographical scales listed below (Table 4.6-5).

Table 4.6-5. Defining the Conservation Value of VERs

Conservation value	Examples
International	Habitats or species that form part of the cited interest within an internationally protected site, such as those designated under the Habitats Directive (SACs, SPAs) or other international convention (e.g. Ramsar site). This also includes species listed in the Birds Directive when outside of areas designated for their protection, i.e. within the wider countryside, that may interact with the study area.
National	Habitats or species that form part of the cited interest within a nationally designated site, such as a SSSI, or a National Nature Reserve (NNR). A feature (e.g. habitat or population) which is either unique or sufficiently unusual to be considered as being one of the highest quality examples in a national/regional context for which the site could potentially be designated as a SSSI. Presence of SBL habitats or species, where the action plan states that all areas of representative habitat, or individuals of the species, should be protected. A species for which a significant proportion (>1 %) of the national population is found within the site. An ecologically-sensitive species (<300 breeding pairs in the UK).
Regional	Habitats or species that form part of the cited interest of a Local Nature Reserve (LNR), or some local-level designated sites depending on specific site conditions. A feature (e.g. habitat or population), which is either unique or sufficiently unusual to be considered as being of nature conservation value up to a district or county context. A species for which a significant proportion (>1 %) of the regional population is found within the site. Presence of LBAP habitats or species, where the action plan states that all areas of representative habitat, or individuals of the species, should be protected.
Local	Habitats or species that form part of the cited interest of a local-level designated site and may be designated as a non-statutory Site of Importance for Nature Conservation (SINC) or the equivalent, e.g. Local Wildlife Site, Ancient Woodland designation. A feature (e.g. habitat or population) that is of nature conservation value in a local context only, with insufficient value to merit a formal nature conservation designation.
Negligible	Commonplace feature of little or no habitat/historical significance. Loss of such a feature would not be seen as detrimental to the ecology of the area.

Impact Magnitude of Development

4.6.2.16 The magnitude of a potential effect is determined by understanding how a VER will be affected by the modified OnTI. The scale of potential effects is defined by the following:

- Potential duration, whether short-term (<5 yrs), medium-term (5-15 yrs) or long-term (15-25 yrs or longer); and,
- Reversibility, whether effects will be reversible in the short to medium-term.

4.6.2.17 The magnitude of change on each VER is defined in Table 4.6-6

Table 4.6-6 Defining the Impact Magnitude of a Development

Magnitude	Examples
Total / Near Total	Would cause the loss of a major proportion or whole feature/population, or cause sufficient damage to a feature to immediately affect its viability. Irreversible.
High	Major effects on the feature/population which would have a sufficient effect to alter the nature of the feature in the short to long-term and affect its long-term viability. For example, more than 20 % habitat loss or long-term damage, or more than 20 % loss of a species' population.
Medium	Effects that are detectable in short and medium-term, but which should not alter the long-term viability of the feature/population. For example, between 10-20 % habitat loss or 10-20 % reduction of a species' population.
Low	Minor effects, either of sufficiently small-scale or of short duration to cause no long-term harm to the habitat/population. For example, less than 10 % loss or damage.
Negligible	A potential effect that is not expected to affect the habitat/population

Significance of Effects

4.6.2.18 The significance of an effect on a VER is therefore determined by combining the conservation value of the VER with the effect magnitude of the modified OnTI (Table 4.6-7).

Table 4.6-7 The Significance of an Impact on a VER, as Defined by the Relationship Between Conservation Value and Impact Magnitude

Effect magnitude	Conservation value			
	International	**National**	**Regional**	**Local**
Total/near total	Major	Major	Major	Moderate
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

4.6.2.19 The significance of an effect generated from this matrix can be assessed against the likelihood of such predictions occurring, and the confidence level of the effect on a population, based on expert judgement and literature evidence. A scale of confidence, as recommended by the IPCC (Intergovernmental Panel on Climate Change) (2005) was used:

- Virtually certain, >99 % probability of occurrence;
- Very likely, >90 % probability;
- Likely, >66 % probability;
- About as likely as not, 33-66 % probability;

- Unlikely, <33 % probability;
- Very unlikely, <10 % probability; and
- Exceptionally unlikely, <1 % probability.

4.6.2.20 Using these criteria, and with rationales to explain the reasoning, the predicted level of significance can be altered either downwards (e.g. from major to moderate) or upwards (e.g. from minor to moderate) based on expert judgement and scientific evidence.

4.6.2.21 Impacts/residual effects determined as negligible or minor are not considered to be significant effects with regard to the EIA Regulations.

Impact Assessment: Modified OnTI

4.6.2.22 This section describes the likely significant effects on terrestrial ecology (including ornithology) which could arise in the absence of mitigation during the following phases of the modified OnTI:

- Construction;
- Operation; and
- Decommissioning.

4.6.2.23 Due to the nature of the site and the work to be undertaken, a number of effects may be similar for each phase of development. In particular, construction and decommissioning effects are likely to be similar in type, extent and duration. As such, decommissioning effects are not considered separately unless there is a requirement to differentiate likely effects.

4.6.2.24 The following VERs were derived from baseline desk study and field survey results (for detail refer to Section 4.6.1.11 to 4.6.1.24 of this chapter, Technical Appendix 4.6 A or Confidential Annex of the submission), and considered within this impact assessment:

- Terrestrial breeding birds;
- Coastal birds;
- Habitats;
- Protected mammals; and
- Bat roost and habitat suitability.

Ornithological VERs

Terrestrial Breeding Birds

4.6.2.25 At the time of writing this chapter, one of three rounds of breeding bird surveys had been undertaken. The further two visits will be completed between June and July 2014, with the results, including territory analysis, presented in a report to be submitted in July 2014.

4.6.2.26 This impact assessment has been undertaken using the results of the breeding bird surveys undertaken to date. The report to be submitted in July will detail the full results of the breeding bird surveys and, if necessary, will update this impact assessment to take account of the additional surveys. If the VERs identified are as surveyed thus far, the report will validate the impact assessment contained within this chapter.

4.6.2.27 The aim of the evaluation of effects on VERs is to report on 'likely' significant effects, based on EIA Regulations and IEEM guidance. As such, a number of species can be discounted from assessment as baseline field survey results indicate that significant effects are not likely to occur at a regional scale or above (for example if no breeding is recorded and site usage is rare). Consequently, such effects do not require assessment under the terms of the EIA Regulations.

4.6.2.28 During the process of identifying VERs, only species of conservation value have been considered. Amber-listed species not forming part of a NE LBAP action plan or listed within the SBL are discounted as their conservation status generally reflects a decline in numbers rather than rareness; they are still relatively common and widespread in the UK. Any species recorded flying in low numbers, not using the site for breeding, feeding or roosting, has been omitted from the assessment.

4.6.2.29 Based only on the single site visit, therefore, the species shown in Table 4.6-8, have been included in the impact assessment.

Table 4.6-8. Conservation Values of Bird Species Included in Impact Assessment for Breeding Bird

Species	Conservation Value
Golden plover	International
Corn bunting	National / Regional
Curlew	Regional
Dunnock	
Grey partridge	
Herring gull	
House sparrow	
Kestrel	
Lapwing	
Lesser redpoll	
Linnet	
Reed bunting	
Skylark	
Snipe	
Song thrush	
Starling	
Yellowhammer	

Coastal Birds

4.6.2.30 Relevant wetland bird count data were received from WeBS for the Deveron Estuary and a coastal bird survey undertaken at Inverboyndie Bay. For lists of species recorded to date, see Table 16 in Technical Appendix 4.6 A. As with breeding bird surveys, coastal bird surveys are currently on-going and as such, data collected subsequent to this report will be used to corroborate this Impact Assessment. This will be done on completion of the surveys and will be presented in the July report.

4.6.2.31 A total of twenty bird species were recorded during the first survey visit at Inverboyndie Bay; these include birds listed as Annex I and Schedule 1 species. For the purposes of the impact assessment, only the 17 species listed within Table 4.688 are included within the assessment. The numbers recorded during the first visit are unlikely to be matched in the remaining surveys, however, as, in general and away from seabird colonies, numbers reduce in the breeding season (e.g. red-throated diver numbers are unlikely to be as high as recorded in May).

Impact Assessment (Ornithology)

Construction (Ornithology)

4.6.2.32 Potential construction effects of the modified OnTI on the terrestrial breeding bird and coastal bird VERs are:

- Habitat loss; and
- Temporary, short-term disturbance and displacement due to increased noise and the presence of humans and machinery.
- Habitat Loss

Habitat Loss

4.6.2.33 Construction of the modified OnTI is likely to result in the temporary loss of potential breeding, feeding or roosting habitat, restricted to a 60 m wide corridor along the modified onshore export cable route. This is expected to affect any particular local stretch of cable route for no more than two non-consecutive breeding seasons (if, in the worst case, cable burial activities are undertaken in two separate activities), as habitat will be restored after cable installation. Construction of the substations will result in the short-term loss of habitat in the temporary working area and the long-term loss of habitat within the footprint of the substations (no more than 10 ha).

Terrestrial Breeding Birds

4.6.2.34 The magnitude of habitat loss for breeding birds found within the modified onshore export cable route depends on each species' population, foraging range, habitat preferences and flexibility to cope with any loss. A number of passerine territories are likely to be significantly affected by the construction of the export cable and substations. However this would be for a limited period of time, considered to be at most two (non-consecutive) breeding seasons, as the works footprint is re-instated post-cable installation and construction of the substations. Habitat loss within the substation footprint will, however, be long-term. Effects are unlikely to be significant at anything above local level for the majority of species, which should easily recover over the long-term.

4.6.2.35 In a worst case scenario, a number of territories of regionally-important species may be affected (Table 4.6.8) leading to an effect caused by the construction of the export cable and substations of low-medium magnitude on these VERs, and resulting in an indirect, short-term, temporary, negative effect of **minor significance** on their regional populations.

Coastal Birds

4.6.2.36 A very small amount of foraging or roosting habitat may be temporarily lost along the shoreline due to cable installation, potentially affecting wader species in particular, which may be specialised and rely on particular niches. However the magnitude of such effects is likely to be low considering the overall habitat available within potential foraging range and the mobility of birds outside the breeding season. Coastal birds will be unaffected by construction of the substations, as the buildings will be located at the inland end of the modified export cable route (Figure 4.6-1), more than 20 km from the coast. As the assemblage of species at the coastline is of regional conservation value, this will result in an indirect, short-term, temporary, negative effect caused by the construction of the export cable and substations of **minor significance** for any coastal bird species.

Disturbance / Displacement

4.6.2.37 Cabling works will result in temporarily increased noise and higher levels of human activity than currently experienced by birds within the modified export cable route, particularly intrusive works associated with cabling include drilling, trench digging and pulling the cable. Similar disturbance sources may result from construction of the substations.

Terrestrial Breeding Birds

4.6.2.38 Although works are scheduled to take place through the breeding season (March – July) for the modified OnTI, such operations will be of a relatively short duration with micrositing of the modified export cable route to avoid nesting birds wherever possible.

4.6.2.39 It is therefore predicted that, based on the construction methods proposed, there will be at most a low effect caused by the export cable and substation on VERs of regional conservation value, resulting in a negative effect of **minor significance.**

Coastal Birds

4.6.2.40 The distance away from a source of disturbance at which avoidance behaviour takes place varies between shoreline species, independent of site. Differences can also occur depending on local conditions, for example the availability of suitable habitat will influence response, with birds more likely to tolerate disturbance either if there is no alternative habitat, or the habitat within disturbance distance is of particularly high quality (Gill *et al*., 2001).

4.6.2.41 Smit and Visser (1993) recorded distances of up to 120 m for roosting waders and gulls taking flight in response to human activity. IECS (Institute of Estuarine and Coastal Studies) (2007) studied responses of shorebirds to flood defence works in the Humber Estuary and showed that birds continued to feed within 200 m of piling operations. During repair work along a pipeline, birds remained within 100 m when workers were active, and flocks returned to the nearby vicinity within 15 mins of activity ceasing. Construction activity using a mechanical digger caused birds to remain 100 m from the locality, but return within 30 mins of cessation.

4.6.2.42 A literature review of shorebird disturbance by Cutts *et al*. (2009) showed a minimal level of disturbance beyond 300 m from feeding or roosting birds, with curlew being the most sensitive up to the 300 m point, and common wader species showing responses out to 150 m.

4.6.2.43 It is therefore the case that any activities associated with cable installation will be unlikely to displace feeding or roosting shorebirds beyond a 300 m radius. These effects will also be short-term in nature. Whilst this may affect feeding activities, it is unlikely that any VER will be significantly affected over the course of a whole season

and no effect on mortality rate is predicted. Birds are likely to be able to feed in the vicinity of the modified OnTI soon after construction activity has ceased. Coastal birds will be unaffected by substation construction, as the buildings will be set at the inland end of the cable route, more than 20 km from the coast.

4.6.2.44 No more than a low magnitude effect is predicted for any VER, resulting in a direct, short-term, temporary, negative effect caused by construction of the OnTI of **minor significance** on regional populations.

Operation

4.6.2.45 As the cable will be installed approximately 1 m underground, and restoration of habitat affected during installation of the cable and jointing pits will take place immediately afterwards, operational effects of the modified OnTI on ornithological VERs are expected to be negligible. Exceptions to this may occur due to human activity associated with repair works along the cable route, however these are expected to occur very rarely, if at all. Operational effects of the substations will mostly relate to operational noise. Potential operational effects of the OnTI on ornithological VERs are:

- Export cable: temporary, short-term disturbance and displacement due to increased noise and presence of humans and machinery due to repair works; and
- Substation: long-term disturbance and displacement due to increased noise.

Terrestrial Breeding Birds

4.6.2.46 Due to the limited, local extent of any maintenance operations, only a small number of farmland bird territories would likely be affected by operation of the export cable. Noise from the substation however could interfere with territorial display. This is unlikely to be significant to any VER resulting in a negligible-low magnitude effect caused by the export cable, with at worst an indirect, short-term, temporary, negative effect of **minor significance** in a worst case scenario for rarer species such as quail or corn bunting.

Coastal Wintering Birds

4.6.2.47 As with breeding birds, the temporary displacement of shorebirds from feeding or roosting activity during operation of the export cable is unlikely to be significant to any VER, resulting in a negligible to low magnitude of effect. Coastal wintering birds will be unaffected by substation construction, as the buildings will be set at the inland end of the cable route, more than 20 km from the coast. This would result in an indirect, short-term, temporary, negative effect caused by the OnTI substation of **negligible - minor significance** on any species at a regional level.

Decommissioning (Ornithology)

4.6.2.48 Although the timing and duration of decommissioning works are unknown, it is likely that they will be of a similar nature to those during construction. The predicted significance of effects for ornithological VERs during construction outlined above are therefore also applicable to decommissioning of the export cable, jointing pits and substations, although the confidence in such predictions are lower due to the uncertainty of timing and also the possibility that species assemblage, numbers and distribution may change over the long-term.

Impact Assessment (Ecology)

Habitats VERs

4.6.2.49 This section assesses the conservation value and sensitivity of habitat VERs (Table 4.6-9). Habitats with the potential to overlap with Annex I habitats, SBL or NE LBAP priority habitats were selected.

Table 4.6-9 Conservation Value of Habitat VERs

Habitat VER	Status within onshore cable route and qualifying features	Conservation value (descending order)
Wet modified bog	Recorded in four areas within the modified OnTI. This habitat has been extensively disturbed, however the habitat is listed as an Annex 1 Habitat, on the SBL with bog habitats a priority within the NE LBAP.	Regional
Semi-improved and unimproved neutral grassland	Scattered across the modified OnTI, these habitats are listed with in the SBL and as NE LBAP priority habitats.	Regional
Watercourses and standing water	The River Deveron is the major watercourse crossing the modified OnTI, with a number of smaller burns also present. Large watercourses are listed as SBL habitats while smaller burns are listed as NE LBAP priority habitats.	Regional
Marshy grassland	This habitat is associated with a number of SBL habitats.	Local
Waterbodies	Waterbodies in the form of small ponds are present across the proposed OnTI cable route corridor and are listed as a priority habitat within the NE LBAP.	Local
Plantation and semi-natural woodlands	Woodland is included on both the SBL and the NE LBAP; however these areas of habitat are small and fragmented.	Local
Arable land	Farmland, field margins and boundary habitat are listed on the NE LBAP.	Local
Improved grassland	Farmland, field margins and boundary habitat are listed on the NE LBAP.	Local
Tall ruderal herb and fern	Field margins are listed on the NE LBAP.	Local
Amenity grassland	Amenity grassland is listed on the NE LBAP as important within an urban context for conservation throughout the area.	Local
Scattered and dense scrub	Both scattered and dense scrub are listed in a number of SBL habitats, however the fragmented nature of these habitats within the proposed OnTI cable route corridor lessens their importance within the national context.	Local

Construction

Pollution of Terrestrial Habitats

4.6.2.50 Pollution can arise in the form of fine sediment dusts associated with earthworks, track construction, borrow pit activities and transportation of construction material along temporary roads. Pollution of habitats may also occur from the release of environmentally hazardous chemicals, e.g. fuels and oils from construction plant. This has the potential to result in the loss of vegetation and/or alteration of substrate

chemistry through an increase in nutrients from either substances required to deal with chemical spills or the spills themselves. These have the potential to result in detrimental changes to vegetation communities in the long-term. Even in a worst case scenario however, a pollution event is only likely to affect a localised area. The effect magnitude is therefore low and effects caused by the OnTI on terrestrial habitat VERs of local-regional conservation value will be direct, medium-term, temporary, negative and range from negligible-minor significance.

Pollution of Freshwater Habitats

4.6.2.51 There is potential for watercourses to be affected by a variety of pollution types during construction. Potential effects include sediment run-off from earthworks and infrastructure giving rise to changes in water turbidity levels, oxygen saturation levels and water pH. There is also the potential for pollution to arise through chemical spills from hazardous materials, including fuels and oils. The magnitude of these effects is influenced by a variety of factors including flow levels within the watercourse, with pollution and sedimentation during low flows having a higher potential effect than during high flows when greater dilution occurs. Therefore, for the purpose of this chapter these effects have been assessed as a worst case scenario of pollution or sedimentation occurring during a period of low water flow.

4.6.2.52 For freshwater habitat VERs of local-regional conservation value, a worst case scenario of a medium effect magnitude (Table 4.6-6) caused by the OnTI would lead to a direct, medium-term, temporary, negative effect of minor significance.

Damage and Disturbance to Habitats

4.6.2.53 Construction will cause some damage to habitats and changes to community composition. Wet habitats such as wet modified bog are especially sensitive to damage (Table 4.6-10). Habitats at the landfall site will be left in as natural condition as possible; HDD will be the preferred method of installation, this method is technically feasible for distances of up to 1 km which is significantly greater than the length of any VER habitat present at the landfall location. If open trenching is used at the landfall point, the land will be restored to its original state as soon as construction is complete. HDD will also be used to cross major watercourses such as the Deveron to minimise effects upon these during construction.

4.6.2.54 For all habitat VERs, as conservation values range from local to regional and the effect magnitude of construction ranges from negligible to medium, the effect significance caused by the OnTI will therefore be direct, medium-term, temporary, negative and range from **negligible-minor significance**.

Table 4.6-10. Effect Significance of the Export Cable on Habitat VERs Caused by Damage and Disturbance during Construction

Habitat VER	Conservation value	Effect magnitude	Effect significance (descending order)
Wet Modified Bog	Regional	Low	Minor
Semi-improved and Unimproved Neutral Grassland	Regional	Low	Minor
Watercourses and Standing Water	Regional	Medium	Minor
Waterbodies	Local	Medium	Minor
Plantation and Semi-natural Woodlands	Local	Medium	Minor
Arable Land	Local	Medium	Minor
Marshy Grassland	Local	Low	Negligible
Improved Grassland	Local	Low	Negligible
Tall Ruderal Herb and Fern	Local	Low	Negligible
Amenity Grassland	Local	Negligible	Negligible
Dense/scattered Scrub	Local	Low	Negligible

Operation

Pollution or Damage to Terrestrial Habitats during Maintenance Activities

4.6.2.55 There is the potential for temporary damage and disturbance to habitats during maintenance operations and emergency works on the OnTI. This may lead to temporary habitat loss and/or permanent habitat degradation. Maintenance that requires use of machinery could result in a pollution incident adversely affecting surrounding terrestrial habitats. Due to the infrequent nature of these works there is a low likelihood of this damage occurring, however the possible emergency nature of these works and lack of an ECoW (Ecological Clerk of Works) during these times could lead to a medium level of damage in a localised area. Effect magnitude caused by the OnTI is likely to be medium, thus pollution or damage effects on terrestrial habitat VERs of local-regional conservation value will be direct, short-term, temporary, negative and of **minor significance**.

Pollution or Damage to Freshwater Habitats during Maintenance Activities

4.6.2.56 Maintenance activities during operation may result in pollution incidents affecting aquatic habitats and species. There is also the potential for these activities to result in the disturbance of fish species through noise and vibration generated through the operation of machinery. As maintenance activities will be carried out infrequently if at all during the lifespan of the OnTI, and are predicted to be of relatively short-duration, the risk of pollution events and disturbance is reduced in comparison to the construction phase. Effect magnitude caused by the OnTI is likely to be low-medium, thus pollution or damage-related effects on freshwater habitat VERs of local-regional conservation value will be direct, short-term, temporary, negative and of **negligible-minor significance**.

Decommissioning

4.6.2.57 Although the timing and duration of decommissioning works are unknown, it is likely that they will be of a similar nature to those during construction. The predicted significance of effects for habitats VERs during construction outlined above are therefore also applicable to decommissioning of the OnTI, although the confidence in such predictions are lower due to the uncertainty of timing and also the possibility that habitats may change over the long-term.

Protected Mammal VERs

Otter

4.6.2.58 Otters are a European protected species, thus any development with potential negative effects on otters may require a licence to proceed.

4.6.2.59 Baseline results confirm that otters inhabit the River Deveron and its tributaries with the majority of otter prints, spraints and couches found in this area. Further evidence was found along drainage ditches and by ponds.

Habitat Loss

4.6.2.60 HDD will be used for cable installation across large watercourses such as the River Deveron, for detail refer to Chapter 3.2 – Hydrology, Geology and Contaminated Land. HDD plans and procedures will be agreed in advance with SEPA. It is predicted that there will be no direct effects to otters in terms of habitat loss caused by the OnTI.

Disturbance

4.6.2.61 Otters are mainly active from dusk through the night to dawn and thus can be affected by early morning and late evening construction activities. During the longer nights of autumn and winter otters are also likely to be active during daily construction. However disturbance effects on active otters will be limited as construction activities will be relatively localised and short-term. Otter resting sites (holts and couches) are occupied through the day when most construction activity will occur; thus it is possible that otters may be affected within the modified export cable route corridor during construction.

4.6.2.62 As a VER of international conservation value, the magnitude of habitat loss and disturbance effects caused by the export cable and substation is predicted to be low, leading to an impact of direct and indirect, short-term, temporary, negative and **moderate significance** for otter.

Badger

4.6.2.63 Badgers are legally protected under the Protection of Badgers Act 1992. Baseline results show the modified OnTI to be highly utilised by the species with a large number of indicative signs and active setts located during field surveys.

Habitat Loss and Disturbance

4.6.2.64 Any habitat loss or damage within 30 m of a sett, or sett destruction itself, will require a licence from SNH.

4.6.2.65 Indirect effects may occur on badger populations as commuting paths and foraging areas may be lost or disrupted, and foraging habitat may be disturbed or temporarily fragmented. The increased levels of human and construction activity will also disturb badgers. Badgers are also at risk of becoming trapped in excavations or pipework left

open overnight. If a method of escape is not provided, injury or death can result. Standard procedures, specifically CEMP, will be in place to address this risk.

4.6.2.66 As a VER of national conservation value, the magnitude of habitat loss and disturbance caused by the modified OnTI is predicted to be medium, leading to an effect of direct and indirect, short-term, temporary, negative and **moderate significance** for badger.

Red Squirrel

4.6.2.67 Red squirrels are legally protected under the Wildlife and Countryside Act 1981 (as amended). Baseline results found feeding remains of the species in one location, with a single sighting recorded during the field surveys.

Habitat Loss and Disturbance

4.6.2.68 Direct habitat loss may occur from felling of forestry and woodland for the purposes of the OnTI, removing dreys for key denning habitats. Felling may also potentially fragment areas of suitable habitat decreasing the species ability to utilise the wider area.

4.6.2.69 Although the VER is of national conservation value, the magnitude of habitat loss and disturbance caused by the modified OnTI is predicted to be low, leading to an effect of direct and indirect, short-term, temporary, negative and **minor significance** for red squirrel.

Water vole

4.6.2.70 Water voles are protected under the Wildlife and Countryside Act 1981 (as amended). Baseline results found water vole present across the ecology survey area in areas of suitable habitat.

Habitat Loss

4.6.2.71 Direct habitat loss may occur from direct construction works, or indirectly from pollution events relating to both construction and operational activities. Such events would have an effect on the species within such areas.

4.6.2.72 Although the VER is of national conservation value; the magnitude of habitat loss and the likelihood of a pollution event occurring is assessed as low, leading to an effect of direct and indirect, short-term, temporary, negative and **minor significance** for red squirrel.

Bat Roost and Habitat Suitability VER

4.6.2.73 Bat habitat surveys identified that the proposed OnTI includes only small areas of high value bat habitat (mature deciduous woodlands with water and set in a connected landscape with buildings). There are few linear habitat features crossing the route which appear to connect areas of nearby high value habitat/roost potential. The substation location lies entirely within low value bat habitat. Thus, it is likely the main issues will be:

- A few areas of mature trees which might need to be felled and which could contain crevices suitable for bats to roost, thereby threatening bat roosts;
- A few connected linear elements where commuting or foraging bats may be disturbed by works, and where potential loss of the linear feature could affect population viability; and
- A few areas of high value bat habitat where loss of trees may reduce habitat connectivity, and/or reduce the amount of sheltered foraging habitat.

4.6.2.74 Although the conservation value of bats is high, the importance of Aberdeenshire populations within a UK context is low, and species biodiversity is also low. Without mitigation however, disturbance/displacement effects could have negative consequences on breeding, roosting or commuting bats in such sparse and marginal quality bat habitat.

4.6.2.75 The bat habitat is of local conservation value, however the species themselves are listed within both European and UK legislation, consequently, in the context of this impact assessment their conservation value is assesses as national within Table 4.6-5. The magnitude of habitat loss and disturbance/displacement impacts caused by the modified OnTI are medium; effects are both direct and indirect, short-term, temporary, negative, and thus the overall impact to these species is assessed as **minor-moderate significance**.

Proposed Monitoring and Mitigation

Ornithological VERs

Construction (Ornithology)

4.6.2.76 No effects of major or moderate significance on ornithological VERs were predicted from any aspect of construction. However, there is a need to follow best practice during construction to ensure compliance with legislation concerning disturbance to terrestrial breeding birds.

Terrestrial Breeding Birds

4.6.2.77 Under the Wildlife and Countryside Act 1981 as amended by the Nature Conservation (Scotland) Act 2004, it is an offence with only limited exceptions, to:

- Intentionally or recklessly take, interfere with, damage or destroy the nest of any wild bird whilst it is in use or being built;
- Intentionally or recklessly take, interfere with or destroy the egg of any wild bird; or
- Intentionally or recklessly disturb any wild bird listed on Schedule 1 while it is nest-building, or at (or near) a nest containing eggs or young, or disturb the dependent young of such a bird.

4.6.2.78 As a mitigation measure, the majority of construction activities will be timed to avoid the breeding bird season (mid-March – July, inclusive), however, where this is not possible, pre-construction surveys of the route will be conducted during the breeding period to guide micrositing of the route, avoiding any potential disturbance to breeding bird species. Furthermore, habitat restoration will be undertaken as quickly as possible following completion of construction activities to ensure that habitat loss is short-term in nature. Implementation of these measures will reduce all potential effects on breeding birds to **negligible significance** as the magnitude of all effects will be negligible.

Coastal Wintering Birds

4.6.2.79 No significant effects were predicted for coastal wintering birds and so no specific mitigation is required under the terms of the EIA Regulations. Nevertheless, numbers of coastal species will be higher in winter months, and so it would be advantageous for coastal work to take place outside this period. This will minimise effects on wintering birds and reduce all potential effects to **negligible significance** as the magnitude of all effects will be negligible.

Operation (Ornithology)

4.6.2.80 No significant effects were predicted during operation. However, routine maintenance or emergency works may have to comply with the Wildlife and Countryside Act 1981 legislation outlined above if works are to take place during the breeding season to avoid nest destruction and disturbance to terrestrial breeding birds.

4.6.2.81 An emergency works environmental action plan should be prepared to ensure minimal environmental impacts.

4.6.2.82 Further standard mitigation measures will also be implemented prior to any operational works:

- Compliance with the law will be achieved by appointment of a suitably experienced ornithologist as Ecological Clerk of Works (ECoW) to locate any active nests close to construction works shortly before these commence. There will be a clear line of responsibility for ensuring these measures are followed; and
- Pre-construction surveys will be undertaken to locate nesting birds in the vicinity of works to ensure nests are not disturbed. Works may be programmed to avoid disturbance, or an area can be cordoned off. If any Schedule 1 species is recorded breeding, buffer distances must be enforced to avoid committing an offence. In this case, and also if birds are nesting outside of controlled areas but in the opinion of the ECoW within possible disturbance zones, the work will either be re-scheduled or the nest site cordoned-off and destruction prevented. Buffer distances are species and site-specific, and will be agreed with SNH prior to works.

4.6.2.83 Implementation of the above measures will ensure all potential effects associated with the development will be of **negligible significance** as the magnitude of all effects will be negligible.

Decommissioning (Ornithology)

4.6.2.84 Decommissioning effects are deemed to be similar to those of construction. As such, refer to sections of the construction phase for mitigation.

Habitat VERs

Construction (Habitats)

<u>Pollution of Conservation Designated Sites</u>

4.6.2.85 Mitigation will be implemented through enforcement of CEMP and construction method statements, for detail refer to Chapter 3.2 – Hydrology, Geology and Contaminated. These include:

- Adhere to SEPA's PPGs, especially in relation to the safe storage of fuel, oils and chemicals;
- Maintain vehicles and plant to avoid leaks; and
- Time works to avoid heavy rainfall when the risk of fine sediment being transported from earthworks is significantly increased.

Pollution of Terrestrial Habitats

4.6.2.86 Mitigation will be implemented through enforcement of CEMP and construction method statements, for detail refer to Chapter 3.2 – Hydrology, Geology and Contaminated. These include:

- Adhere to SEPA's PPGs, especially in relation to the safe storage of fuel, oils and chemicals;
- Maintain vehicles and plant to avoid leaks;
- Time works to avoid heavy rainfall when the risk of fine sediment being transported from earthworks is significantly increased;
- Delimit working areas to minimise the zone of potential impact; and
- Employ best practice in relation to construction techniques.

4.6.2.87 Compliance with the law will be achieved by appointment of a suitably experienced ECoW to ensure works are carried out in accordance with construction method statements and CEMP.

Pollution of Freshwater Habitats

4.6.2.88 Export cable route design will minimise potential effects through identification of constraints and subsequent micro-siting;

- Careful sediment control near burns; and
- Avoid trenching alongside the River Deveron and its associated tributaries.

4.6.2.89 The implementation of the above measures with regards to potential effects on habitats will reduce these to a level of **minor–negligible significance** as the magnitude of all effects will be low - negligible.

Operation (Habitats)

Pollution or Damage to Terrestrial Habitats during Maintenance Activities

4.6.2.90 The proposed mitigation outlined above in relation to construction will also apply during operation.

Pollution or Damage to Freshwater Habitats during Maintenance Activities

4.6.2.91 The proposed mitigation outlined above in relation to construction will also apply during operation.

4.6.2.92 The implementation of the above measures with regards to potential effects on habitats will reduce these to a level of **minor-negligible significance** as the magnitude of all effects will be low - negligible following implementation of the proposed mitigation.

Decommissioning (Habitats)

4.6.2.93 The decommissioning effects of the onshore export cable are deemed to be similar to those of construction. As such, refer to sections of the construction phase for mitigation.

Protected Mammal VERs

Otter

Construction (Otter)

4.6.2.94 Baseline results (Section 4.6.1) confirm that otters inhabit the River Deveron and its tributaries. The following mitigation will be implemented to minimise effects on this species:

- Cover all excavations (trenches, trial pits, and pipelines) when not in use to prevent entry by otters;
- Where excavations cannot be covered, provide a means of escape (e.g. a plank);
- Avoid night working where possible;
- When night working cannot be avoided, lighting will be shuttered and focussed on the work area only, and directed away from watercourses using beam-deflectors to minimise light spill. Lighting will be kept to an absolute minimum of 100 m from holts or other resting places;
- Works within 100 m of holts or other resting places will cease 1hr before dusk and commence 1 hour after dawn to minimise disturbance during otters' main activity times;
- Adhere to SEPA's PPGs, especially in relation to the safe storage of fuel, oils and chemicals, these will be stored 10 m away from watercourses in bunded containers; and
- Speed limits will be restricted to 20 mph to minimise risk of collision with otters. This should be reduced to 15 mph within 25 m either side of any mammal paths identified by the ECoW as likely to be used by otters and which cross watercourses.

Operation (Otter)

4.6.2.95 The proposed mitigation outlined above in relation to construction will also apply during operation.

Decommissioning (Otter)

4.6.2.96 The decommissioning impacts of the onshore export cable are deemed to be similar to those of construction. As such, refer to sections of the construction phase for mitigation.

4.6.2.97 The implementation of the above measures with regards to potential effects on otters throughout all stages of the development will reduce these to a level of **minor significance** as the effect magnitude is anticipated as low.

Badger

Construction (Badger)

4.6.2.98 Baseline results (Section 4.6.1) confirm that badgers inhabit the OnTI. In accordance with SNH guidelines, construction cannot take place within 30 m of a badger sett without a development licence. If sett(s) cannot be avoided by micro-siting, they should be destroyed under license outside the badger breeding season (30 November to 1 July). An ECoW will be employed to ensure no significant effects on badgers occur, and that works are conducted in accordance with best practice. Sett location will be checked prior to construction. Toolbox talks will be given to construction staff and an emergency protocol given to contractors in the event of encountering a badger or sett. If new sett(s) are found within 30 m of the

construction footprint, micro-siting or an application to SNH will be required. The following mitigation is proposed to minimise effects on this species:

- Impose protection zones 30 m from sett(s) and mark with brightly coloured tape;
- Excavations more than 0.5 m deep will be fenced or covered when not in use to prevent entry by badgers;
- Pipes of diameter >20 cm will be capped nightly to prevent entry by badgers;
- Avoid night working where possible;
- When night working cannot be avoided, lighting will be shuttered and focussed on the work area only using beam-deflectors to minimise light spill. Lighting will be kept to an absolute minimum of 100m from sett(s);
- Works within 100 m of sett(s) will cease 1hr before dusk and commence 1hr after dawn to minimise disturbance during badgers' main activity times;
- Adhere to SEPA's PPGs, especially in relation to the safe storage of fuel, oils and chemicals; and
- Speed limits will be restricted to 15 mph to minimise the risk of collision with badgers.

Operation (Badger)

4.6.2.99 The proposed mitigation outlined above in relation to construction will also apply during operation.

Decommissioning (Badger)

4.6.2.100 The decommissioning effects of the onshore export cable are deemed to be similar to those of construction. As such, refer to sections of the construction phase for mitigation.

4.6.2.101 The implementation of the above measures with regards to potential effects on badgers throughout all stages of the development will reduce these to a level of **minor significance** as the effect magnitude is anticipated as low.

Red Squirrel

Construction (Red Squirrel)

4.6.2.102 Baseline results (Section 4.6.1) confirm that red squirrels inhabit the OnTI. Pre-construction surveys will be undertaken to assess all areas where felling of forestry is required for the presence of squirrel dreys. In accordance with SNH guidelines, felling of trees surrounding red squirrel dreys will leave a residual buffer of 10m of forestry. An escape route to allow individuals to move to areas out with those of construction or disturbance will be left. An ECoW will be employed to ensure no significant effects on red squirrels occur, and that works are conducted in accordance with best practice.

Operation (Red Squirrel)

4.6.2.103 The proposed mitigation outlined above in relation to construction will also apply during operation.

Decommissioning (Red Squirrel)

4.6.2.104 The decommissioning impacts of the OnTI are deemed to be similar to those of construction. As such, refer to sections of the construction phase for mitigation.

4.6.2.105 The implementation of the above measures with regards to potential effects on red squirrels throughout all stages of the development will reduce these to a level of **negligible-minor significance** as the effect magnitude is anticipated as **low-negligible**.

Water vole

Construction (Water vole)

4.6.2.106 Baseline results (Section 4.6.1) confirm that water voles inhabit the OnTI in areas of suitable habitat surrounding watercourses. Prior to construction within any habitat suitable for the species, pre-construction surveys should be undertaken by the ECoW to ensure water voles are not present. Where water voles are found, micrositing of the cable route will be employed under the supervision of the ECoW to create a 10 m buffer between construction areas and those occupied by the species. All construction works will adhere to SEPA's PPGs, especially in relation to the safe storage of fuel, oils and chemicals, these will be stored 10 m away from watercourses in bunded containers

Operation (Water vole)

4.6.2.107 The proposed mitigation outlined above in relation to construction will also apply during operation.

Decommissioning (Water vole)

4.6.2.108 The decommissioning effects of the OnTI are deemed to be similar to those of construction. As such, refer to sections of the construction phase for mitigation.

4.6.2.109 The implementation of the above measures with regards to potential effects on water vole throughout all stages of the development will reduce these to a level of **negligible-minor significance** as the effect magnitude is anticipated as **low-negligible**.

Bat Roost and Habitat Suitability VERs

4.6.2.110 The bat roost and habitat suitability assessment aimed to inform future, targeted baseline field surveys for bats. These surveys defined:

- Potential roosts in trees which may need to be felled; and
- Key commuting or foraging areas that may be subject to significant disturbance, e.g. where hedgerows, woodland or trees may be removed.

4.6.2.111 Pre-construction targeted field surveys for bats will be undertaken when a precise cable route has been designed. Given that construction is not due to commence until 2016, such surveys will be undertaken within an appropriate time period preceding commencement.

4.6.2.112 Targeted surveys will be undertaken during bats' active season, between May and September inclusive. Key periods for survey within this are maternity (June-July), when nursery colonies are most vulnerable and detectable, and dispersal-mating (August-September) when bats move to different roosts and males set up courtship roosts. Survey methods should include use of Anabat or similar passive remote bat detectors, dawn and dusk commuting watch surveys, tree inspections to assess roost potential and walked transects with detectors to establish bat use of any higher value habitat affected. Control surveys will gather reference data from nearby habitat to permit the effective interpretation of the survey data and guide mitigation. In a few cases internal and external building inspections may be required if a building lies very close to the cable route where a roost could be significantly

disturbed by works; such buildings may require dawn re-entry surveys to prove roosts, or dusk surveys to prove numbers and species. Hedges and trees should be maintained in their original condition as much as possible. Trees which have roosts or high risk of roosts may need climbing surveys, or exclusion under licence.

4.6.2.113 The implementation of the above measures with regards to potential effects on bat species will reduce these to a level of **negligible-minor significance** as the effect magnitude is anticipated as **low - negligible**.

4.6.3 Cumulative Impact Assessment

Summary

4.6.3.1 A summary of the likely significant cumulative effects is provided in Table 4.6-11. None of the individual effects on VERs identified in Section 4.6.2 were considered to increase due to potential cumulative effects, and hence no additional mitigation is required. In general terms it is considered that there is limited potential for cumulative effects to occur.

Table 4.6-11. Cumulative Impact Summary

Effect	Residual Significance Level for Modified OnTI	Whole Project Assessment: Modified TI +Telford, Stevenson and MacColl	Mitigation Method
Terrestrial breeding birds	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		
Coastal wintering birds	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		
Wet modified bog	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		
Semi-improved and unimproved neutral grassland	Negligible	Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Minor effect. Not significant.		

Effect	Residual Significance Level for Modified OnTI	Whole Project Assessment: Modified TI +Telford, Stevenson and MacColl	Mitigation Method
Running and standing water	Minor	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Minor effect. Not significant.		
Marshy grassland	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		
Waterbodies	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		
Plantation and semi-natural woodlands	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		
Arable land	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		
Improved grassland	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		

Effect	Residual Significance Level for Modified OnTI	Whole Project Assessment: Modified TI +Telford, Stevenson and MacColl	Mitigation Method
Tall ruderal herb and fern	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12***	Negligible effect. Not significant.		
Amenity Grassland	Negligible	Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Minor effect. Not significant.		
Dense / Scattered Scrub	Negligible	Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Minor effect. Not significant.		
Otter	Minor	Negligible-minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Minor effect. Not significant.		
Badger	Minor	Negligible-minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Minor effect. Not significant.		
Red Squirrel	Negligible-minor	Negligible-minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		

Effect	Residual Significance Level for Modified OnTI	Whole Project Assessment: Modified TI +Telford, Stevenson and MacColl	Mitigation Method
Water Vole	Negligible-minor	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		
Bat Roost and Habitat Suitability	Negligible-minor	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		
Terrestrial Breeding Birds	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible effect. Not significant.		
Coastal Wintering Birds	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible effect. Not significant.		
Wet Modified Bog	Negligible	Negligible	None required
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible effect. Not significant.		
Semi-improved and Unimproved Neutral Grasslands	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible effect. Not significant.		
Watercourses and Standing Water	Negligible	Negligible	None required beyond standard best practice

Effect	Residual Significance Level for Modified OnTI	Whole Project Assessment: Modified TI +Telford, Stevenson and MacColl	Mitigation Method
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible effect. Not significant.		
Marshy Grassland	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible effect. Not significant.		
Waterbodies	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible effect. Not significant.		
Plantation and Semi-Natural Woodlands	Negligible	Negligible	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible effect. Not significant.		
Arable Land	Negligible	Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Minor effect. Not significant.		
Improved Grassland	Negligible	Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Minor effect. Not significant.		
Tall Ruderal Herb and Fern	Negligible	Negligible-Minor	None required beyond standard best practice

Effect	Residual Significance Level for Modified OnTI	Whole Project Assessment: Modified TI +Telford, Stevenson and MacColl	Mitigation Method
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		
Amenity Grassland	Negligible	Negligible-Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		
Dense / Scattered Scrub	Negligible	Negligible-Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		
Otter	Minor	Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Minor effect. Not significant.		
Badger	Minor	Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Minor effect. Not significant.		
Red Squirrel	Negligible-Minor	Negligible-Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		
Water Vole	Negligible-Minor	Negligible-Minor	None required beyond standard best practice

Effect	Residual Significance Level for Modified OnTI	Whole Project Assessment: Modified TI +Telford, Stevenson and MacColl	Mitigation Method
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		
Bat Roost and Habitat Suitability	Negligible-Minor	Negligible-Minor	None required beyond standard best practice
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Table 4.6-12)***	Negligible-minor effect. Not significant.		

Assessment of Cumulative Effects

Methodology

4.6.3.2 This section presents the results of assessment of the potential cumulative effects upon Terrestrial Ecology (including ornithology) arising from the modified OnTI in conjunction with other existing or reasonably foreseeable developments and activities. A whole project assessment has also been undertaken for the likely significant cumulative effects of the modified TI in conjunction with the three consented wind farms (Telford, Stevenson and MacColl).

4.6.3.3 MORL's approach to the assessment of cumulative effects is described in Chapter 1.3: Environmental Impact Assessment and methodology used in this chapter has followed that outlined in the Moray Firth Offshore Wind Developers Group Discussion Document (ERM, 2011; see Appendix 1.3 D).

4.6.3.4 The scope of cumulative effects assessment for Terrestrial Ecology and Ornithology considered planned developments which match the following criteria:

- Within 5 km of the onshore cable route;
- For which sufficient information was available e.g. an Environmental Impact Assessment;
- Those which are current (expired applications were excluded); and
- Those which are live (withdrawn or refused applications were excluded).

4.6.3.5 The scope of cumulative effects assessment highlighted that no planned developments were required to be considered for potential cumulative effects on the VERs identified within Table 4.6-11. The developments and activities considered at the scoping stage of the cumulative impact assessment are listed in Table 4.6-12 below for clarity.

Table 4.6-12. Cumulative Impact Assessment Scope – Developments and Activities

Name	Details	Evidence	Planning Status	Construction Timescale
Cairnhill Farm (Turriff, Aberdeenshire, AB53 5TN)	Erection of 3 no Wind Turbines and Infrastructure. Application received 2007.	No significant impacts during the operational phase on relevant VERS.	Operational	N/A
Gairnieston Farm (Turriff, AB53 5RP)	Erection of Wind Turbine and Associated Infrastructure (1 turbine). Application received 2007.	Impacts on ornithological interests relate to collision risk therefore not relevant to this proposal. No significant impacts on any other relevant VERS.	Operational	N/A
Backhill of Yonderton (Craigston, Turriff AB53 5PT)	Erection of 2 no. Enercon E70 2.3 MW (4.6 MW) Wind Turbines on 64 m masts (Total Height 99.5 meters) and associated infrastructure. Application received 2010.	Very low significance of impacts on mammal species. No significant impacts on any other relevant VERS.	Approved	Duration 3 – 5 Months. No start date confirmed.
South Colleonard (Banff, AB45 3TP)	Full Planning Permission for Erection of 1 no. Wind Turbine, Hub Height 55.6 metres (Total Height 79.6 metres) and Associated Infrastructure. Application Received 2012.	No significant impacts on any relevant VERS.	Pending	No information available.
Knock Thunder Farm (Fiskaidly, Banff AB45 3AB)	Erection of 1 no. turbine of 77 m height and substation plus associated infrastructure. Application submitted 2013.	No significant impacts on any relevant VERS.	Pending	No information available.

Name	Details	Evidence	Planning Status	Construction Timescale
Overhead Line Deviation (Upper Mains of Asleid Turriff)	Overhead line deviation. Application submitted 2004	No impact assessment prepared – insufficient information.	Approved	No information available.
Overhead Line (Sprottyneuk, New Deer, Turriff, Aberdeenshire, AB53 6XX)	Erection of 11kV Overhead Line (Retrosepctive). Application submitted 2006.	No impact assessment prepared – insufficient information.	Approved	N/A
33 KV Line (Land at Strath of Brydock, Banff)	Installation of 33 KV Line. Application Granted 2008.	No impact assessment prepared – insufficient information.	Approved	No information available.
Reinforcement and Reinsulation of Existing Overhead Electricity Transmission Line (Land Rothienorman T Junction to Peterhead 275kV Electricity Sub Station)	Notification under Electricity Act 1989 for Section 37 Notification for Reinforcement and Reinsulation of Existing Overhead Electricity Transmission Line to Upgrade Voltage from 275kV to 400kV. Application granted 2013.	No significant impacts on any relevant VERS.	Approved	Works anticipated to commence 2016-2018.
Cairnhill Farm (Turiff, AB53 5TN)	Installation of 2.4 MW Solar Farm comprising PV Panels and Associated Infrastructure. Application granted 2013.	No significant impacts on any relevant VERS.	Approved	Duration: 2-3 weeks. No start date confirmed.

4.6.3.6 No further consideration of cumulative impacts is given within this chapter.

Habitats Regulations Appraisal

4.6.3.7 Habitats regulations appraisals (HRAs) seek to evaluate the likely significant effect that any development might have on a European designated site within its proximity (i.e. Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)). The assessment will evaluate the designating features of a site and the likely significant effects that a development might have on these.

4.6.3.8 For the purposes of the modified OnTI, an HRA of any designated site surrounding the development is not required. SNH in their scoping response (Table 4.6-1) detailed that the route is not expected to impinge on any ornithological designated sites, and no sites of ecological designation are in close enough proximity to be affected by the route (i.e. there is no ecological links with any of the SACs within the surrounding area).

4.6.4 References

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4 Biological Environment

4.5 Intertidal Ecology

4.5.1 Baseline Information

Introduction

4.5.1.1 This chapter explains the intertidal ecology at the modified export cable landfall site of the modified export cable at Inverboyndie and assesses the potential effects of the installation, operation and decommissioning of the modified offshore transmission infrastructure (OfTI) on sensitive intertidal benthic ecological receptors.

4.5.1.2 Intertidal benthic ecology refers to the coastal habitats and associated plants and animal species and communities present between the high and low mean spring tide marks. Information on the ecology of intertidal area at the study area was acquired from a biotope mapping survey conducted within the embayment at Inverboyndie Beach. Site specific survey and analysis methodologies were agreed with Marine Scotland Science (MSS) and followed JNCC Procedural Guidelines 3-1 (Wyn & Brazier, 2001). A detailed account of the site specific survey together with presentation of relevant physical and biological sample data and results is provided in Technical Appendix 4.5 A – Intertidal Ecology Characterisation. Note that the subtidal benthic ecology associated with the modified TI is described in Chapter 4.1: Benthic Ecology.

Consultations

4.5.1.3 Table 4.5-1 below provides a description of the only consultation relevant for the intertidal ecology assessment received to date.

Table 4.5-1 Summary of Consultations

Organisation	Consultation Response	MORL Approach
Marine Scotland Science (MSS)	Statutory agreement of site specific survey and analysis methodologies.	A Phase 1 intertidal habitat mapping survey was conducted over a low water spring tide occasion.

Baseline Characteristics

4.5.1.4 The following describes the baseline intertidal ecology of the export cable landfall and onshore cable route within the study area (Figure 4.5-1). Information presented in this baseline derives from desktop studies and site specific surveys as detailed below.

Desktop Studies

4.5.1.5 Terry & Sell (1986) categorise local beaches as exposed indicating the strong influence of wave action along northern facing shores in the outer Moray Firth. Rocky habitats are characterised by upper shore green and red ephemeral algae such as *Prasiola stipitata* and *Porphyra umbilicalis* with winkles (*Littorina saxatilis*), a mid shore barnacle (*Semibalanus balanoides*) dominated zone with bladderwrack (*Fucus vesiculosus*), blue mussels (*Mytilus edulis*), limpets(*Patella vulgata*) and dog whelk (*Nucella lapillus*) and mixed red algae species and a lower shore zone with a range of turf forming and crustose red algae, thong weed (*Himanthalia elongata*), kelp (*Alaria esculenta*) and a diverse range of cryptic amphipod and isopod crustaceans (Terry & Sell, 1986).

4.5.1.6 Local sediment shores may be regarded as high energy intertidal environments exhibiting a relatively steep profile and comprising moderate to well sorted mobile sands as defined by surveys at Fraserburgh at Rattray (Eletheriou & Robertson, 1988; MORL, 2012). The sediment fauna is naturally impoverished due to the dynamic nature of the sediments and is dominated by crustaceans typical of mobile sands.

4.5.1.7 The beach landfall site at Inverboyndie does not hold any statutory designation for nature conservation.

Site Specific Surveys

4.5.1.8 Field work was conducted in accordance with JNCC Procedural Guidelines 3-1 (Wyn & Brazier, 2001) and comprised the mapping of intertidal habitats between the mean high water spring tide mark (MHWS) and the mean low water spring tide mark (MLWS). Conspicuous plants and animals associated with each habitat were recorded. Both the habitat and species data were subsequently combined and used to classify biotopes.

4.5.1.9 The survey was conducted over one day (20/05/14). Survey comprised modified Phase I habitat mapping techniques within 250 m either side of the expected landfall location. In addition to the mapping of habitats, the surveys also included sediment dig over sampling for determination of faunal content and to assist biotope classification following guidance described in JNCC Procedural Guidelines 3-1 (Wyn & Brazier, 2001). A total of 30 sampling points were selected.

4.5.1.10 Six biotope classifications (Connor *et al*., 2004) were ascribed to the intertidal region of the landfall site. A biotope map for the foreshore at Inverboyndie is presented in Figure 4.5-2. A summary of the biotopes found is provided in Table 4.5-2. No species of nature conservation importance were recorded.

Table 4.5-2 Impact Assessment Summary

Biotope Classification and Community	Representative Beach Photograph	Description of Habitat
LS.LSa.MoSa Barren or amphipod-dominated mobile sand shores.		Extensive across the study area. Clean mobile sandy shores with no or very little infauna. May be duned or rippled due to wave action or tidal currents.
LS.LSa.FiSa.Po Polychaete/amphipod-dominated fine sand shores		Mid shore rippled clean sand biotope remaining damp throughout tidal cycle characterised by lugworms (*Arenicola marina*).
LR.FLR.Eph.Ent Ephemeral green or red seaweed communities (freshwater or sand-influenced)		Upper shore mixed sand and cobble biotope within influence of freshwater run off characterised by the green ephemeral alga *Enteromorpha* spp.

Biotope Classification and Community	Representative Beach Photograph	Description of Habitat
LR.FLR.Eph.EntPor Ephemeral green or red seaweed communities (freshwater or sand-influenced)		Mid to lower shore mixed sand and coble biotope present to the far west of the intertidal survey area and characterised by ephemeral green and red algae with lugworms.
LR.MLR.BF.Fser.R *Fucus serratus and red seaweeds on moderately exposed lower eulittoral rock*		Lower shore rocky biotope supporting barnacles, crustose and mixed foliose red and brown fucoid algae, limpets and whelks.
IR.MIR.KR.Ldig.Bo *Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders		Sublittoral fringe rock biotope supporting kelp, fucoid algae and mixed red algae.

4.5.1.11 Survey results are consistent with an exposed, high energy, clean sandy intertidal environment. Sediments contained little or no infauna which is likely a function of the dynamic environment and associated sediment mobility. Rock habitats supported a range of red, green and brown seaweeds together with common limpet, whelk and barnacle species typical of the region.

Important Habitats

4.5.1.12 Rocky boulder and bedrock communities, represented by the biotopes LR.FLR.Eph.EntPor, LR.MLR.BF.Fser.R and IR.MIR.KR.Ldig.Bo (see Table 4.5-2) are indicative of Annex I rocky reef habitats (Habitats Directive EEC/92/43). Intertidal rocky areas need to be connected to a sublittoral reef for the rocky aggregation to qualify as an Annex I rock reefs, as they tend to be subtidal.

4.5.1.13 Diverse under boulder communities, represented by the biotope IR.MIR.KR.Ldig.Bo, can be present under intertidal boulders therefore, the habitat is listed as a priority habitat for conservation under the UK Biodiversity Action Plan.

Legislative and Planning Framework

4.5.1.14 The legislation and guidance relevant to the intertidal ecology assessment is in line with that described in Chapter 4.1 Benthic Ecology.

4.5.2 Impact Assessment

Summary of Effects and Mitigation

4.5.2.1 This section assesses the likely significant effects of the installation, operation and decommissioning of the offshore export cable on intertidal ecology at the landfall location at Inverboyndie.

4.5.2.2 Potential effects of the installation and decommissioning of the modified OfTI on intertidal benthic ecology relate to temporary direct sediment disturbance and temporary raised suspended sediment concentrations and sediment deposition. Potential operational effects relate to EMF and heat emissions and habitat and associated community change. The following effects were assessed as being of **no significance** to benthic ecological receptors including habitats and species (collectively termed biotopes). This reflects the short duration, localised and infrequent nature of the effects and the tolerance and recoverability of receptors.

- Temporary direct intertidal habitat disturbance;
- Temporary increases in suspended sediment concentrations and sediment deposition;
- Heating and EMF effects; and
- Habitat and community change.

Summary of Impacts

4.5.2.3 The beach habitats and associated intertidal communities at Inverboyndie are indicative of highy dynamic (wave exposed) environmental conditions including regular sediment disturbance. The significance of the effect of sediment disturbance by the cable burial tool is therefore considered to be not significant as the local intertidal communities will already be tolerant to these effects and will be able to recover quickly. The spatial extent of the effect will be very small, of short duration and highly infrequent. Under boulder communities are illustrative of Biodiversity Action Plan (BAP) habitats. Significant direct disturbance to this habitat type was assessed to be of minor significance

4.5.2.4 Accidental spills of fuels or oils or other chemicals used during the construction, operation and decommissioning of the modified OfTI have the potential to adversely affect the intertidal ecology although adherence to an EMP will minimise associated risk and mitigate for potential effects.

4.5.2.5 The construction will mostly take place during low tide occasions so any suspension of sediment fines within the overlying water column will be very limited. Jointing pits will be constructed above MHWS and therefore will not contribute to this potential effect.

4.5.2.6 Effects of heat and EMF emissions on intertidal benthic ecology are considered to be of no significance due to the burial of the cables and the distance separation provided by cable protection material.

4.5.2.7 Rock material used for cable protection will likely serve a comparable function as the natural rock over which it is laid and will provide attachment surfaces for colonising encrusting and attaching fauna and flora from surrounding reproducing populations. Consequently, the effect of original habitat loss and habitat change is considered to be not significant.

Proposed Mitigation Measures and Residual Effects

4.5.2.8 Table 4.5-3 below summarises the mitigation for each identified effect. Significant effects arising from the modified OfTI on intertidal ecology are not predicted. As such, no specific mitigation is proposed. Best practice, however, would be to minimise the quantities of cable protection material (if used) to reduce the effect of loss of original habitat and habitat change.

Table 4.5-3 Impact Assessment Summary

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
Construction & Decommissioning				
Temporary Direct Intertidal Habitat Disturbances	Sand and rock biotopes	Not significant / minor	N / a	Not significant
Temporary Increased Suspended Sediment Concentrations and Sediment Deposition	Sand and rock biotopes	Not significant	N / a	Not significant
Operation				
Heating and EMF Effects	Sensitive and deep-burrowing species	Not significant	N / a	Not significant
Habitat and Community Changes	Rock habitat and species	Not significant	N / a	Not significant

Introduction to Impact Assessment

4.5.2.9 The installation of the offshore export cable has the potential to directly affect intertidal habitats as a result of the action of the cable burial tool during installation and indirectly affect adjacent areas through sediment re-suspension and deposition during the tidal cycle. However, it should be noted that BERR (2008) identify that *"Intertidal habitats that are more sensitive to the impacts of cable burial are generally those that have established in more sheltered conditions, where natural perturbations are lower and less frequent"*, whereas physical and biological indications are that the site is a high energy habitat prone to frequent natural perturbation.

Details of Impact Assessment

4.5.2.10 The methodology for the determination of impact significance is presented in Chapter 4.1 – Benthic Ecology and follows the methods applied during previous site investigations associated with the original cable route (MORL, 2012 Chapter 10.5 Intertidal Ecology).

4.5.2.11 Table 4.5-4 presents the project parameters used to define the realistic worst case scenario with respect to likely significant effects on intertidal ecology. It is considered that open cut cable trenching will result in the greatest disturbance to intertidal habitat and species (biotope) receptors.

4.5.2.12 Note that if horizontal directional drilling (HDD) was selected as the installation option then there would be no adverse effects on the intertidal benthic ecology as the cable would pass underneath the beach at a depth sufficient to avoid disturbance to any burrowing fauna.

Rochdale Envelope Parameters Considered in the Assessment

Table 4.5-4 Rochdale Envelope Parameters Considered in the Assessment

Potential Effect	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Temporary Direct Intertidal Habitat Disturbance	Total footprint = 7,200 m² based on • Beach width / cable length of 300 m • Affected width per trench: 6 m • Four trenches, to constructed two at a time at a minimum of 1 year apart. Equating to <0.1% of total beach area at Inverboyndie Beach
Temporary increases in suspended sediments and sediment deposition	Qualitative assessment based on the re- suspension of sandy sediments arising from the installation of export cable via trenching during in-coming tides. Sand material to be transported/dispersed by tidal currents and wave action
Operation	
EMF and heat emissions	Qualitative assessment based on theoretical avoidance of localised affected areas by sensitive benthic species.
Habitat and community change	Qualitative assessment based on the theoretical possibility of cable installation in intertidal rocky areas and use of concrete mattressing or rock protection material.
Cumulative	
No cumulative or in-combination effects identified (Section 4.5.3).	

EIA Methodology

4.5.2.13 Receptors considered within the assessment of the modified OfTI on intertidal ecology include the intertidal biotopes as classified and mapped during the site specific survey (see sections 4.5.1.8 to 4.5.1.10). Consideration of intertidal species is implicit within the assessment at biotope level.

Impact Assessment

Construction

Temporary direct intertidal habitat disturbance

4.5.2.14 Direct disturbances to intertidal habitats will occur as a result of the action of the cable burial tool and as well as the movement of construction plant and machinery over adjacent areas. In sedimentary habitats, this may cause crushing, abrasion, displacement and mortality of species resulting in a loss of species diversity abundance and biomass within the footprint. Trenching in rocky habitats would remove substrata and the fauna and flora attaching to it resulting in a permanent scar which may be subsequently in-filled with transient sediments.

4.5.2.15 The total area of disturbance is considered to be very small representing <0.1% of the total beach area. The effect will only occur once at any one location. Following cessation of the activity any disturbed sediments will be rapidly dispersed by successive in-coming tides with full recovery of the beach sediment structure expected within a few tidal cycles and after consolidation of the beach sediments to pre-construction conditions. The trenches will be constructed separately and at an interval of at least a year between the two construction events (worst case scenario). As such, full recovery of intertidal habitats following the initial construction activity is forecast to occur well before the onset of the second construction event. Consequently, the magnitude, frequency and duration of direct disturbances are therefore assessed to be very low

and this is likely to be similar regardless of the final installation technique. The uppermost layers of beach material are highly unstable; consequently few animals can survive in this environment, especially when it is coupled with being exposed to the air when the tide is out. Consequently, such shores are often devoid of visible life (Connor et al., 2004). The few animals that do live in this habitat are robust and highly mobile species that are specially adapted to a high degree of physical disturbance. The surfaces of cut rocks would be rapidly re-colonised by local fauna and flora from the surrounding reproducing populations.

4.5.2.16 Receptor sensitivity is therefore very low for the most part and minor / medium in relation to the under-boulder BAP habitat in light of its nature conservation value and the overall effect of habitat disturbance is therefore assessed to be **not significant / minor**.

4.5.2.17 Note that if HDD is employed (if found to be technically feasible) there will be no direct effect on the intertidal area as the cable will pass under it.

4.5.2.18 This assessment carries low uncertainty as the effects are quantifiable.

Temporary Increases In Suspended Sediment Concentrations and Sediment Deposition

4.5.2.19 The biotopes recorded at Inverboyndie are considered not to be sensitive to the effects of sediment re-suspension and smothering by 5 cm of sand (MarLIN benchmark), owing to the continual turbulence naturally occurring within these habitats due to storms and/or hydrodynamic exposure (e.g. tides and wave action) (Budd, 2008).

4.5.2.20 Cable installation within the intertidal area is likely to be undertaken during low tide periods therefore the potential for re-suspension of material due to construction activities and subsequent settlement is limited. The degree of sediment re-suspension likely to occur with the flooding tide is expected to be low due to the relatively coarse nature of the sediment (sand), which will settle back to the sea floor very rapidly and close to the site of initial disturbance. The spatial extent of any sediment settlement is therefore expected to be very localised and will occur over the short-term so that the overall magnitude of the effect will be very low. The sensitivity of the biotopes to the effect of temporary sediment disturbances and re-settlement is also considered very low as a result of the naturally perturbed environment at Inverboyndie and associated effects of sediment suspension, scour and deposition. Accordingly, the overall effect is assessed to be **not significant** with low uncertainty.

Operation

4.5.2.21 Generic effects of the export cable associated with the operation activities are considered to be minimal and include heating and EMF as well as physical disturbance associated with any maintenance. The placement of cable protection material may result in localised habitat and community change.

Heat emissions

4.5.2.22 As explained in section 4.5.2.6 above, the passage of electricity through a cable will generate heat. This heat will then be dissipated within the overlying water or surrounding sediment subject to installation method and physical environmental conditions.

4.5.2.23 Theoretical effects of a permanent increase of the seabed temperature relate to changes of physicochemical conditions of sedimentary substrates (Meißner and Sordyl, 2006). These in turn may affect the physiology, reproduction or even mortality of certain benthic species (OSPAR, 2009). This may result in de-oxygenation of the seabed leading to possible loss of fauna (Meißner and Sordyl, 2006). The temperature increase of the upper layer of the seabed depends on the burial depth of the cable but also factors such as sediment characteristics and cable parameters (OSPAR 2009).

4.5.2.24 The cable target burial depth is 1 m whereas sediment dwelling species, such as worms, bivalves and small amphipod crustaceans, typically reside within the uppermost few centimetres. As such, intertidal sediment species are unlikely to be directly exposed to a

permanent increase in sediment temperature. The presence of rock cable protection material (if used) provides a distance separation between species receptors and the export cable.

4.5.2.25 Furthermore, upper sediment layers on exposed beaches are subject to mobility as a result of the naturally energetic marine environment and so will remain well oxygenated. Although empirical data are generally lacking (OSPAR, 2009), the issue of seabed temperature rise as a result of buried cables has been considered during a project to bury a submarine HVDC cable between New England and Long Island, New York. The project estimated that the rise in temperature at the seabed immediately above the buried cable to be just 0.190C (BERR, 2008) and therefore well within the natural variation.

4.5.2.26 The duration of the effect will last throughout the operation of the modified OfTI but its spatial extent is expected to be highly localised. Effect magnitude is thus judged to be very low. The target burial depth and distance separation caused by the presence of cable protection material (if used) means that species are unlikely to be significantly exposed to increased heat effects. Furthermore, regular tidal inundation will maintain oxygenation of surface beach sediments significant physicochemical change and associated mortality of benthic fauna are not expected. Receptor sensitivity is thus considered to be very low. Accordingly, the significance of effects from heating from export cables within the intertidal area is assessed to be **not significant**.

4.5.2.27 This assessment carries low uncertainty due to the absence of significant effects from monitoring studies (MMO, 2014).

Electromagnetic fields (EMFs)

4.5.2.28 The effects of EMFs on benthic ecology have been described in section XXX above. Studies on the effects of EMFs on benthic invertebrate fauna are limited but those that do exist indicate that geomagnetic orientation occurs in molluscs (e.g., nudibranchs (Cain et al., 2005) and chitons (Bochert and Zettler, 2006)) and crustaceans (sandhoppers) (Bochert and Zettler, 2006).

4.5.2.29 The survival and physiology of selected species of prawns, crabs, starfish, marine worms and blue mussels, have been studied in relation to EMF levels corresponding to the intensity on the surface of ordinary sub-marine DC cables in the Baltic Sea. Results showed no significant effects for any of the species under consideration after three months of exposure (Bochert and Zettler, 2006). In addition, a visual survey of benthic communities on wind power cables and the peripheral areas, showed no differences in assemblage structure (Wilhelmsson et al.,, 2010).

4.5.2.30 In general, the occurrence of apparently healthy and diverse communities on existing offshore wind farm structures provides evidence that EMFs are unlikely to pose a significant threat to the colonising communities (Linley et al., 2007). However, in the absence of more comprehensive evidence, uncertainty remains when predicting potential impacts of EMFs on benthic invertebrate communities.

4.5.2.31 The offshore export cable will also be buried to a target depth of 1 m. Burial at this depth is likely to provide a degree of shielding reducing the potential for EMF to the effects. Effect magnitude is therefore considered to be low.

4.5.2.32 The overall effect of EMFs from export cables on marine benthic invertebrates is assessed to be **not significant** based on the small footprint of the impact and perceived insensitivity of the benthic invertebrates as discussed above.

4.5.2.33 This assessment carries medium uncertainty as the number of experimental field studies addressing invertebrate tolerance/sensitivity to EMF is currently rather limited. However, the offshore export cable will be buried so that potential EMF effects will be reduced.

Habitat and Community Change

4.5.2.34 In the event that burial of the export cable cannot be achieved due to the presence of rock for example, then the cable may be surface laid and protected by concrete matressing or rock protection material. Depending upon the nature of the final material used, its surfaces may be less complex than the surrounding natural rock with fewer micro-niches for colonisation by encrusting and attaching fauna and flora. Consequently, the mattressing and rock protection material may support a reduced diversity of intertidal species resulting in a change in the habitat and community relative to the pre-construction condition.

4.5.2.35 The effect will be highly localised to the actual protection material and will last for the duration of the operation of the modified OfTI and will be reversible upon decommissioning. Effect magnitude is thus judged to be **minor**. Diversity of intertidal species within the intertidal area at Inverboyndie is not predicted to be affected as a result of the placement of cable protection material and so receptor sensitivity is considered to **very low**. Accordingly, the effect is assessed to be **not significant**.

4.5.2.36 This assessment carries low uncertainty as the magnitude of effect is quantifiable. This assessment carries low uncertainty as the magnitude of effect is quantifiable.

Decommissioning

4.5.2.37 It is likely that the cables will be left in situ during decommissioning. However, the effects of removal of intertidal cables and jointing pits will be comparable to those that occur during construction and are therefore considered to be **not significant**.

Proposed Monitoring and Mitigation

Construction, Operation and Decommissioning

4.5.2.38 No mitigation required.

4.5.3 Cumulative Impact Assessment

Summary

4.5.3.1 It is considered that there is no potential for cumulative impacts on intertidal ecology.

4.5.3.2 Section 4.5.1.11 showed that there are no highly mobile or wide ranging intertidal ecology receptors at Inverboyndie (fish and shellfish are addressed in Chapter 4.2). Accordingly, the appropriate spatial scale for cumulative impact assessment in this regard is very local. Furthermore, likely significant direct and indirect effects of the installation and operation of the modified OfTI on intertidal ecology are predicted to be not significant.

4.5.3.3 Consultation with Aberdeenshire Council indicates that there are no foreseeable plans or projects within the vicinity of the modified offshore export cable landfall and therefore no interaction between scheme effects and those arising from other foreseeable projects. Cumulative impact assessment on intertidal ecology is therefore not appropriate.

4.5.3.4 Effects of the installation of separate cables at the landfall site have been assessed above. The two separate offshore export cable routes (in two separate trenches) will be installed at least one year apart and recovery of intertidal habitats is expected to be complete well within this intervening period. No spatial or temporal interaction of associated effects will therefore occur.

4.5.4 References

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4 Biological Environment

4.4 Marine Ornithology

4.4.1 Baseline Information

Introduction

4.4.1.1 This section provides a description of the ornithological baseline conditions within the proposed modified offshore transmission infrastructure (modified OfTI). Ornithological interests associated with the three consented wind farms and the onshore transmission infrastructure (modified OnTI) are provided separately in MORL (2012) Chapter 4.5 (Ornithology) and Chapter 4.7 (Terrestrial Ecology) of this ES respectively.

4.4.1.2 The baseline study consists of the following aspects:

- Consultation with relevant statutory and non-statutory bodies;
- Detailed desk study to establish the baseline conditions within the study area;
- Contemporary surveys (2009 to 2012) to inform the baseline assessment including
  - Boat-based surveys (2010 to 2012) and
  - Aerial surveys (2009 to 2010 and 2011); and
- Consideration of the relevant key legislative and planning information.

4.4.1.3 A more detailed account of all the information summarised in this chapter can be found in:

- MORL (2012) Technical Appendix 4.5 A (Ornithology Baseline and Impact Assessment); and
- MORL (2012) Technical Appendix 4.5 B (Aerial Ornithology Surveys for the Moray Firth Zone, Summer 2011).

4.4.1.4 This baseline is used to inform the ornithology impact assessment described in Sections 4.4.2 and 4.4.3.

4.4.1.5 The Moray Firth area holds internationally important numbers of breeding seabirds and over–wintering waterbirds (e.g. ducks, divers, grebes and waders). In addition, this area is also important during the spring and autumn migration periods as a flyway and feeding area for migratory species. The aim of this baseline assessment is to describe the use by ornithological interests of the areas in which modified OfTI is proposed.

4.4.1.6 Within the vicinity of the Moray Firth are several sites designated for ornithological interests: SPAs (Special Protection Areas), Ramsar sites, and SSSIs (Sites of Special Scientific Interest). Information on the designated sites in the area is provided in Section 1.3 of MORL (2012) Technical Appendix 4.5 A.

Consultations

4.4.1.7 A summary of the key consultation responses in relation to ornithological issues, specific to the modified OfTI, is included in Table 4.4-1 below.

Table 4.4-1 Summary of Key Ornithology Consultation Responses

Organisation	Consultation Response	MORL Approach
SNH / JNCC	JNCC & SNH consider that desk-based appraisal is sufficient to consider potential disturbance or indirect impacts on ornithological interests arising from the OfTI.	The effects of the modified OfTI on ornithological interests were based on desk–study as recommended by JNCC and SNH (desk–study results presented in the 'Baseline Characteristics' section).
	Potential disturbance to waterbirds is the key impact to address. Refer to JNCC survey data and WeBS count data.	Potential disturbance effects from the modified OfTI are considered in Section 4.4.2 below. To inform impact assessments for waterbirds, both JNCC and BTO survey data have been collated and referred to (desk-study results presented in the 'Baseline Characteristics' section and impact assessment Table 4.4-8).
RSPB	Consideration should be made of any potential implications of the proposal on white-billed divers.	White-billed divers are considered in the 'Baseline Characteristics' section below and in both the EIA and CIA of this document.

Baseline Characteristics

Desktop Studies

4.4.1.8 Desk–based literature reviews were carried out to collate the most up to date information on aspects of seabird and migratory species ecology, such as foraging ranges and behaviour, to determine the likely key species within the modified OfTI requiring assessment. Full details of these literature reviews are provided on a species–by–species basis in Section 4 of MORL (2012) Technical Appendix 4.5 A. A review of recent literature was undertaken to check for additional data that would further inform the impact assessment and the results are provided in Table 4.4-2 to Table 4.4-4 below. Bird foraging distances, taken from Thaxter *et al.* (2012), are summarised in Table 4.4-2 below.

Table 4.4-2 Summary of bird foraging distances, taken from Thaxter *et al.* (2012)

	Foraging distance (km)		
Species	**Maximum**	**Mean maximum**	**Mean**
Fulmar	580	400.0	47.5
Gannet	590	229.4	92.5
Cormorant	35	25.0	5.2
Shag	17	14.5	5.9
Arctic skua	75	62.5	6.4
Great skua	219	86.4	35.8
Puffin	200	105.4	4.0

	Foraging distance (km)		
Species	**Maximum**	**Mean maximum**	**Mean**
Razorbill	95	48.5	23.7
Guillemot	135	84.2	37.8
Common tern	30	15.2	4.5
Arctic tern	30	24.2	7.1
Kittiwake	120	60.0	24.8

4.4.1.9 For assessment of the modified OfTI, bird density data were taken from the literature to provide information for near–shore areas. These data were taken from an analysis of 26 years of ESAS surveys undertaken by JNCC (Kober *et al.* 2010), and are summarised in Table 4.4-3 below. For species occurring in near-shore areas where ESAS data are not available, peak count data were taken from the British Trust for Ornithology (BTO) Wetland Bird Survey (WeBS) for the Grampian / Moray region (Austin *et al.* 2014) and are presented in Table 4.4-4 below (see Section 5 of MORL (2012) Technical Appendix 4.5 A). Data from JNCC aerial surveys (Dean *et al.* 2004; Söhle *et al.* 2006; Wilson *et al.* 2008; Lewis *et al.* 2008, 2009) were also used to inform the baseline conditions.

4.4.1.10 The RSPB have identified white-billed diver as a species potentially at risk from the modified OfTI. This species has not been recorded during JNCC or BTO surveys and was previously considered a vagrant to the UK. However, low numbers of white-billed divers (peak count of 14 individuals) have been known to be present in near-shore areas of the Moray Firth since 2011 between March and May, predominantly in the Portsoy area (data available from e.g. www.birdguides.com).

Table 4.4-3 Density estimates (km²) for Moray Firth from Kober *et al.* (2010)

Species	Breeding season	Non-breeding season	Autumn
Fulmar	5 to 16	3 to 7	-
Sooty shearwater	0.14 to 1.48	-	-
Manx shearwater	0.1 to 3.7	-	-
Gannet	0.9 to 2.9	0.4 to 1	-
Cormorant	0.03 to 0.288	0 to 0.21	-
Shag	0 to 5.73	0 to 8	-
Arctic skua	0.019 to 0.21	-	0.014 to 1.112
Great skua	0.10 to 1.15	0.01 to 0.31	-
Puffin	0.1 to 14.8	0.1 to 3.8	-
Razorbill	0.1 to 22.0	0.1 to 15.8	0.1 to 30.5
Guillemot	0.1 to 713.4	0.1 to 62.7	0.1 to 254.8
Kittiwake	0.1 to 185.0	0.1 to 20.5	-

Species	Breeding season	Non-breeding season	Autumn
Common gull	0.01 to 0.19	0.1 to 1.1	-
Lesser black-backed gull	0.1 to 4.0	0.1 to 4.0	-
Herring gull	0.1 to 44.8	0.1 to 9.2	-
Great black-backed gull	0.01 to 0.81	0.01 to 1.21	-

Table 4.4-4 Count Data for Moray Firth from Austin *et al*. (2014)

Species	Five year mean	Peak count
Eider	478	939
Long-tailed duck	616	1,139
Common scoter	614	1,439
Velvet scoter	68	150
Red-throated diver	13	34
Great northern diver	1	2

Site-Specific Surveys

Boat-Based Surveys 2010 to 2012

4.4.1.11 Natural Power Consultants (NPC) were contracted to undertake 28 boat–based bird surveys between April 2010 and March 2012 for the three consented wind farm sites. The survey methodology followed the technique for ship–based seabird surveys outlined by Camphuysen *et al*. (2004) and the recommendations to improve this methodology outlined by MacLean *et al*. (2009). The survey followed a line–transect method with a strip width of 300 m on one side of the vessel. The 18 transects were 2 km apart, orientated in an east–west direction across the three consented wind farm sites plus a buffer of approximately 4 km (Figure 4.4-1 of Volume 3 of this ES). Three experienced ornithological observers were involved in each survey; this involved one acting as observer, one acting as scribe and a third available to rotate positions in order to reduce fatigue. The method was designed to enable distance sampling of ornithological data and calculation of densities. Full details of the methodology can be found in Section 2.1 of MORL (2012) Technical Appendix 4.5 A.

4.4.1.12 Where possible, distance sampling software (Distance version 6.1; Thomas *et al*. 2010) was used to calculate density and abundance estimates of birds on the sea (Table 4.4-5 below). Design–based methods were used to produce density estimates for all species with at least 80 observations so that robust detection functions could be fitted (Buckland *et al*. 2001). Density surface models (model–based methods) were produced for six species (fulmar, gannet, kittiwake, guillemot, razorbill and puffin) as data was sufficient to allow model convergence (see Section 2.1.6 of MORL (2012) Technical Appendix 4.5 A for full details of the methodology; Figures 4.5-2 to 4.5-7 of MORL (2012) Volume 6 b). For species with fewer than 80 observations, density estimates could not be produced; counts of all species recorded during the boat–based surveys can be found in Section 3.1.1 of MORL (2012) Technical Appendix 4.5 A.

Table 4.4-5 Density (birds per km²) and abundance estimates (birds on the sea) for species which were recorded at a sufficient frequency to allow model-based or design-based analysis, taken from 2010 to 2012 NPC boat-based survey data

Species	Breeding season				Non-breeding season				Model basis
	Density		Abundance		Density		Abundance		
	Site	Buffer	Site	Buffer	Site	Buffer	Site	Buffer	
Fulmar	2.77	1.91	782	750	0.25	0.20	197	189	Model
Gannet	0.66	0.46	100	86	0.04	0.05	23	20	Model
Great skua	0.34	0.17	101	62	N/A	N/A	N/A	N/A	Design
Puffin	6.55	5.55	1,916	1,971	0.75	1.05	450	463	Model
Razorbill	6.03	3.53	1,661	1,674	2.64	3.04	892	899	Model
Little auk	N/A	N/A	N/A	N/A	0.51	0.38	151	136	Design
Guillemot	25.57	18.60	6,732	6,943	2.84	3.47	990	1,021	Model
Guillemot & razorbill combined	9.20	5.10	2,732	1,815	2.39	2.78	711	989	Design
Arctic tern	0.77	5.35	229	1,903	N/A	N/A	N/A	N/A	Design
Kittiwake	7.90	4.69	1,963	1,532	0.79	0.29	261	204	Model
Herring gull	0.02	0.05	7	18	0.14	0.13	41	47	Design
Great black-backed gull	0.91	1.48	271	526	0.36	0.22	106	77	Design

Aerial Surveys 2009 to 2010

4.4.1.13 Seven aerial surveys were undertaken over the three consented wind farm sites in 2009 (May, June, August, November and December) and 2010 (two in February). The surveys covered the entire MORL Zone plus a 4 km buffer (Figure 4.5-8 of MORL (2012) Volume 6 b). The first three surveys were undertaken by HiDef Aerial Surveying (Hexter, 2009) using high definition video. The four surveys in winter 2009 / 2010 were carried out by WWT Consulting using traditional aerial survey methods (Camphuysen *et al*. 2004). Full details of the methodology can be found in MORL (2012) Technical Appendix 4.5 A. Density estimates were produced for the most numerous species (those with an estimate of > 10 birds / 100 km within the three consented wind farm sites in either the breeding or non-breeding season) by calculating the numbers of birds per 100 km of linear transect (Table 4.4-6 below).

Table 4.4-6 Density estimates (birds per 100 km of linear 2 km wide survey transect) of most numerous species recorded during the 2009 to 2010 aerial surveys within Telford, Stevenson and MacColl and the 4 km buffer area

	Breeding season		Non-breeding season	
Species	**Site**	**Buffer**	**Site**	**Buffer**
Fulmar	23.1	31.0	56.1	62.1
Gannet	11.9	15.3	1.0	0.5

	Breeding season		Non-breeding season	
Species	**Site**	**Buffer**	**Site**	**Buffer**
Kittiwake	96.0	76.7	20.4	7.9
Gulls	63.8	43.8	30.7	27.1
Auks	366.5	233.7	135.0	94.5

Aerial Surveys 2011

4.4.1.14 Additional aerial surveys, designed by NPC to put the site distributions into a wider context were undertaken by APEM Ltd. in summer 2011. These involved the collection of digital still images over Telford, Stevenson and MacColl sites and over a wider study area between the Troup, Pennan and Lion's Head SPA to the south and the East Caithness Cliffs and North Caithness Cliffs SPAs to the north (Figure 4.4-1 of Volume 3 of this ES). The survey aircraft was flown along transects 2 km apart from each other aligned in a NNE to SSE direction and images were captured every 250 m along each transect line at a resolution of 2 cm ground sample distance (GSD). The images were then quality assured in two stages. First, a sample of the images not containing birds was re–examined and then when all images containing birds had been isolated, a sample of these was taken and quality assured for identification.

4.4.1.15 Population estimates and smoothed density surface distribution maps for the surveyed area were also derived from these data for each of the six species which breed at more than one of the three closest SPAs (fulmar, great black-backed gull, kittiwake, guillemot, razorbill and puffin; Table 4.4-7 below). Species densities within the modified OfTI were low (see Figures 4.5-16 to 4.5-21 of MORL (2012) Volume 6 b). Full details of the methods and results are provided in MORL (2012) Technical Appendix 4.5 B.

Table 4.4-7 Population estimates from the APEM Ltd. aerial surveys

Species	Population estimate		Confidence intervals
Fulmar	Survey area	21,241	(20,973 to 21,541)
	Three sites	880	(872 to 887)
Puffin	Survey area	11,780	(11,686 to 11,874)
	Three sites	541	(537 to 544)
Razorbill	Survey area	59,846	(58,936 to 60,861)
	Three sites	2,517	(2,495 to 2,538)
Guillemot	Survey area	69,485	(68,801 to 70,247)
	Three sites	6,832	(6,774 to 6,893)
Guillemot & razorbill combined	Survey area	149,353	(147,161 to 151,610)
	Three sites	6,832	(6,774 to 6,893)
Kittiwake	Survey area	47,765	(46,484 to 48,993)

Species	Population estimate		Confidence intervals
	Three sites	1,225	(1,197 to 1,256)
Great black-backed gull	Survey area	950	(903 to 1,000)
	Three sites	5	(5 to 5)

Legislative and Planning Framework

4.4.1.16 The following legislation has been taken into account as part of the ornithological assessment process:

- The European Directive 2009/147/EC on the Conservation of Wild Birds (EU Birds Directive);
- Ramsar Convention on Wetlands of International Importance 1971;
- Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979, as amended;
- Conservation of Habitats and Species Regulations 2010;
- Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007;
- Conservation (Natural Habitats, &c.) Regulations 1994;
- Wildlife and Countryside Act 1981, as amended;
- The Nature Conservation (Scotland) Act 2004; and
- The Marine (Scotland) Act 2010.

4.4.1.17 The following guidance has also been taken into account as part of the ornithological assessment process:

- Camphuysen, C.J., Fox, T., Leopold, M.F. & Petersen, I.K. (2004). Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK. A report for COWRIE;
- Maclean, I.M.D., Wright, L.J., Showler, D.A. & Rehfisch, M.M. (2009). A review of assessment methodologies for offshore wind farms. A report for COWRIE;
- Walls, R., Pendlebury, C., Budgey, R., Brookes, K. & Thompson, P. (2009). Revised best practice guidance for the use of remote techniques for ornithological monitoring at offshore wind farms. A report for COWRIE;
- King, S., MacLean, I., Norman, T. & Prior, A. (2009). Developing guidance on ornithological cumulative impact assessments for offshore wind farm developers. A report for COWRIE;
- Institute of Ecology and Environmental Management (2010) Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal;
- Planning Advice Note 60 on Planning for Natural Heritage (2000); and
- Draft Scottish Planning Policy (SPP), 2013.

4.4.2 Impact Assessment

Summary of Effects and Mitigation

4.4.2.1 This section addresses the likely significant effects associated with the modified OfTI on ornithological receptors. Baseline conditions are presented for the following species: fulmar, gannet, shag, eider, long-tailed duck, common scoter, velvet scoter, white-billed diver, red-throated diver, great northern diver, kittiwake, herring gull, great black-backed gull, guillemot, razorbill, and puffin. Short-listing was undertaken based on numbers of species recorded on the site plus those present in relatively high numbers in near-shore areas of the modified OfTI (see Table 4.4-4 and MORL (2012) Technical Appendix 4.5 A). The likely significant effects on ornithological receptors associated with the three consented wind farms and the OnTI are assessed separately in MORL (2012) Chapter 7.4 (Ornithology) and Chapter 4.6 (Terrestrial Ecology) of this ES respectively.

4.4.2.2 Information supporting this assessment has been collected through desk-based review of the data for the area as explained in the 'Baseline Characteristics' section above.

Summary of Effects

4.4.2.3 The effects on ornithology receptors that were assessed for the modified OfTI include:

- Disturbance caused by increased vessel traffic, especially during construction and decommissioning;
- Displacement caused by the presence of the OSPs; and
- Indirect effects on prey species.

Summary of Proposed Mitigation Measures and Residual Effects

4.4.2.4 No significant effects on ornithological receptors are predicted to arise due to construction, operation and decommissioning of the modified OfTI.

4.4.2.5 As part of the existing commitments for the three consented wind farm sites, vessel traffic will be along set routes where possible, thus increasing the likelihood of habituation to disturbance. Further mitigation measures in addition to this embedded mitigation are not proposed.

4.4.2.6 A summary of the effects is provided in Table 4.4-8 below.

Table 4.4-8 Impact assessment summary

Effect	Receptor	Pre-mitigation effect	Mitigation	Post-mitigation effect
Construction & Decommissioning				
Disturbance, displacement & indirect effects	Fulmar Gannet Shag Eider Long-tailed duck Common scoter Velvet scoter Red-throated diver Great northern diver White-billed diver	Minor risk (probable; short-term, temporary). No significant effect predicted.	Wind farm and OfTI vessel corridors.	Not significant.

Effect	Receptor	Pre-mitigation effect	Mitigation	Post-mitigation effect
	Puffin Razorbill Guillemot Kittiwake Herring gull Great black-backed gull			
Operation				
Disturbance, displacement and indirect effects	Fulmar Gannet Shag Eider Long-tailed duck Common scoter Velvet scoter Red-throated diver Great northern diver White-billed diver Puffin Razorbill Guillemot Kittiwake Herring gull Great black-backed gull	Minor risk (probable; medium-term, temporary). No significant effect predicted.	Wind farm and OfTI vessel corridors.	Not significant.

Introduction to Impact Assessment

4.4.2.7 The following technical reports support this chapter:

- MORL (2012) Technical Appendix 4.5 A (Ornithology Baseline and Impact Assessment); and
- MORL (2012) Technical Appendix 4.5 B (Aerial Ornithology Survey for the Moray Firth Zone, Summer 2011).

Details of Impact Assessment

4.4.2.8 Full details of the Design Envelope for the modified OfTI are provided in Chapter 2.2 (Project Description) of this ES. The key components of the modified OfTI design for this ornithological impact assessment are the:

- Length and location of the export cable route;
- The location and number of offshore substation platforms (OSPs); and
- Duration, timing and intensity of construction / decommissioning activity.

Rochdale Envelope Parameters Considered in the Assessment

4.4.2.9 The Rochdale Envelope parameters that will be considered in this assessment are summarised in Table 4.4-9 below.

Table 4.4-9 Rochdale envelope parameters relevant to the ornithological impact assessment

Potential Effect	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Disturbance	• The offshore export cable route corridor (including the area of the three consented wind farms where the OSPs will be located) is shown in Figure 1.1-4 of Volume 3 of this ES. • The worst case scenario estimate for disturbance arising from installation and decommissioning of the OSPs and export cable is 1.67 km^2. • The number and type of vessels to be utilised in OSPs and export cable installation and decommissioning is yet to be confirmed but it is expected to be low in comparison to those normally using the Firth (see Chapter 5.2: Shipping and Navigation of this ES). Installation vessels will travel at slow speeds along predefined corridors.
Indirect Effects	• Piling for OSPs may have the potential to affect fish stocks locally and thus affect those ornithological receptors that prey upon them (see Chapter 4.2: Fish and Shellfish Ecology of this ES).
Operation	
Disturbance	• The number and type of vessels to be utilised in the OSPs operation and maintenance is yet to be decided but will not represent a significant increase in existing vessel activity within the Firth (see Chapter 5.2: Shipping and Navigation of this ES).
Displacement	• The worst case scenario estimate for displacement arising from the presence of OSPs is 0.02 km^2.
Indirect Effects	• Electro-magnetic fields (EMF) may have the potential to affect fish stocks locally and thus affect those ornithological receptors that prey upon them (see Chapter 4.2: Fish and Shellfish Ecology of this ES).

EIA Methodology

4.4.2.10 The impact assessment methodology used for ornithology is that recommended by CIEEM (Chartered Institute of Ecology and Environmental Management) for marine and coastal developments (IEEM, 2010).

4.4.2.11 The basis of this assessment process is as follows:

- Identification of the activities associated with the development of the modified OfTI that may result in effects on ornithological receptors;
- Identification of potential ornithological receptors;
- Identification of likely significant effects on the ornithological receptors during construction, operation and decommissioning of the modified OfTI;
- Description of development activity in terms of whether the effect is likely to be positive or negative, along with its magnitude, extent, duration, reversibility, timing and frequency;
- Characterisation of effect, including the risk / likelihood of its occurrence;
- Assessment of whether the likely (pre-mitigation) effects are ecologically significant and the geographical scale at which they are predicted to occur, including an indication of certainty in the predictions made;
- Provision of details of proposed mitigation (if applicable);

- Assessment of whether the residual (with mitigation) effects are ecologically significant and the geographical scale at which they are predicted to occur, including an indication of certainty in the predictions made; and
- Assessment of cumulative effects (with mitigation where applicable) as outlined in Section 4.4.3.

4.4.2.12 Ecological significance, in the context of the EIA Regulations, is used to describe the relative importance of a potential effect on a feature of importance. An ecologically significant effect is an effect that has an effect on the integrity of the site or ecosystem. A significant effect in the context of this marine ornithology assessment has been considered to be above moderate.

4.4.2.13 Further details regarding the impact assessment methodology are provided in paragraph 7.4.4 of MORL (2012) Chapter 7.4 (Ornithology).

Description of Key Risks to Ornithological Receptors

Disturbance

4.4.2.14 Disturbance effects could operate by denying ornithological receptors the use of suitable or preferred habitat. During construction, disturbance has the potential to arise as a result of the presence of vessels, equipment, noise and vibration. There is also the potential for disturbance effects to continue into the operation phase due to operation / maintenance activities.

4.4.2.15 Different species show differing sensitivities to disturbance. Short-listing species of birds sensitive to disturbance was based upon: the number of each species on the sites; their estimated sensitivities to vessel presence (Furness *et al*. 2013; Table 4.4-10); whether their distribution over the wider area was highly localised or widespread; their reliance on specific habitat types (Furness *et al*. 2013; Table 4.4-10); and any known rates of habituation. For further details, please see Section 2.5 of MORL (2012) Technical Appendix 4.5 A. It is worth noting that the species concern index for great northern diver in Table 4.4-10 is based upon that for red-throated divers. In practice, great northern divers appear far less sensitive to disturbance from vessel and helicopter traffic than red-throated divers, with regular sightings in harbours and shipping lanes along the east coast of the USA.

Table 4.4-10 Ranked species concern in the context of disturbance and/or displacement from habitat (disturbance score x habitat flexibility score x conservation importance score; taken from Furness *et al*. 2013).

Species	Disturbance by ship and helicopter traffic	Habitat use flexibility	Conservation importance score	Species concern index value
Fulmar	1	1	16	2
Gannet	2	1	17	3
Shag	3	3	15	14
Eider	3	4	13	16
Long-tailed duck	3	4	8	10
Common scoter	5	4	12	24
Velvet scoter	5	3	11	16
Red-throated diver	5	4	16	32
Great northern diver	5	3	18	27

Species	Disturbance by ship and helicopter traffic	Habitat use flexibility	Conservation importance score	Species concern index value
White-billed diver	-	-	-	-
Puffin	2	3	16	10
Razorbill	3	3	16	14
Guillemot	3	3	16	14
Kittiwake	2	2	14	6
Herring gull	2	1	16	3
Great black-backed gull	2	2	15	6

Displacement

4.4.2.16 There is the potential for displacement to arise during the operation phase from the presence of up to two OSPs. Given the relatively small footprint of the infrastructure, (0.02 km^2 as detailed in Table 4.4-9 above) effects on all ornithological receptors are predicted to be negligible and are not considered further in this impact assessment.

Indirect Effects

4.4.2.17 There may also be effects upon prey species, which then go on to have effects on the populations that prey upon them. Full details of prey species are provided in MORL (2012) Technical Appendix 4.5 A. Activities such as piling during the construction phase and electro-magnetic fields (EMF) during operation have the potential to affect fish stocks locally, thus affecting those species of birds that prey on them (the assessment of likely significant effects of the modified OfTI on fish and shellfish are presented in Chapter 4.2: Fish and Shellfish Ecology of this ES, and cross references have been made to this chapter where relevant.

Impact Assessment

4.4.2.18 A list of the relevant ornithological receptors for consideration in the impact assessment, along with their legislative and conservation statuses, is provided in Table 4.4-11 below.

4.4.2.19 The short-list was determined by inclusion of species short-listed for the offshore generating station (MORL (2012) Chapter 7.4: Ornithology) plus species considered as being regularly present in near-shore waters (Kober *et al*. 2010). A summary of each of these receptors, (based on the ornithology baseline described in MORL (2012) Chapter 4.5 (Ornithology) and associated MORL (2012) Technical Appendices 4.5 A, 4.5 B and 4.5 C) is provided in Table 4.4-12 below. Density calculations for each species are estimates of the mean densities within the three consented wind farm sites, obtained from density surface modelling (Table 25, MORL (2012) Technical Appendix 4.5 A). Based on the results of desktop literature reviews (see 'Baseline Characteristics' section above) these estimates are not expected to be higher for the offshore export cable route and OSPs.

Table 4.4-11 Summary of legislative / conservation statuses for relevant ornithological receptors

Species	Legislative status	Distribution	Importance
Fulmar	SPA feature	Common and widespread UK breeder, except around the south-east coast.	International

Gannet	SPA feature	Breeds in large colonies around the UK, most numerous in Scotland.	International
Shag	SPA feature	Present along UK coasts year-round. Breeds in colonies around the UK, most numerous in Scotland.	International
Eider	SPA feature	Locally common breeder around Scotland. Large wintering concentrations around all Scottish coasts.	International
Long-tailed duck	SPA feature	Winter visitor, largest concentrations on northern and eastern coasts.	International
Common scoter	SPA feature	Very rare breeding species. Winter and summer moult aggregations on eastern coasts.	International
Velvet scoter	SPA feature	Non-breeding visitor. Winter and summer moult aggregations on eastern coasts.	International
Red-throated diver	SPA feature	Very rare breeding species. Winter and passage aggregations on eastern coasts.	International
Great northern diver	Birds Directive Annex I	Winter visitor. Largest aggregations on northern and western coasts.	National
White-billed diver	IUCN Near Threatened	Rare spring visitor. Concentrations recorded along northern coasts.	National
Puffin	SPA feature	Locally common breeder around Scotland, less common elsewhere and not breeding around south-east coast.	International
Razorbill	SPA feature	Locally common, widespread UK breeder, except around south-east coast.	International
Guillemot	SPA feature	Common and widespread UK breeder, except around south-east coast.	International
Kittiwake	SPA feature	Common and widespread UK breeder, particularly around north-eastern areas.	International
Herring gull	SPA feature	Common and widespread breeder around UK, though less abundant around the south-east coast.	International
Great black-backed gull	SPA feature	Common breeder around north and west Scotland, less common elsewhere and largely absent from south-east coast.	International

Table 4.4-12 Summary of baseline conditions of relevant ornithological receptors

Species	Summary
Fulmar	**Seasonality:** present in all months; highest numbers in spring. **Distribution:** evenly distributed throughout the Moray Firth. **Mean monthly density estimates (birds km²):** 2.77 in breeding season and 0.25 in non-breeding season within the three consented wind farm sites (see 'Baseline Characteristics' section); 5 to 16 in breeding season and 3 to 7 in non-breeding season in wider Moray Firth (Kober *et al.* 2010).

Species	Summary
Gannet	**Seasonality:** present in all months; highest numbers in spring. **Distribution:** evenly distributed throughout the Moray Firth. **Mean monthly density estimates (birds km²):** 0.66 in breeding season and 0.04 in non-breeding season within the three consented wind farm sites (see 'Baseline Characteristics' section); 0.9 to 2.9 in breeding season and 0.4 to 1.0 in non-breeding season in wider Moray Firth (Kober *et al*. 2010).
Shag	**Seasonality:** present in all months; highest numbers in spring. **Distribution:** distributed throughout the Moray Firth, with highest densities in inshore areas. In winter, highest densities of birds tend to be coastal. **Mean monthly density estimates (birds km²):** 0 to 5.73 in breeding season and 0 to 8.0 in non-breeding season in wider Moray Firth (Kober *et al*. 2010).
Eider	**Seasonality:** present in all months. **Distribution:** restricted to coastal areas, with highest densities in western parts. **Mean monthly density estimates (birds km²):** too low for estimates to be made.
Long-tailed duck	**Seasonality:** present in winter and early spring. **Distribution:** restricted to coastal areas, with highest densities in western parts. Observer-based aerial surveys have shown concentrations along the Morayshire coast and in the inner Moray Firth, particularly around Spey and Burghead Bays. Of 524 birds recorded on aerial surveys during January and February 2006, a minimum of 396 were in the Spey Bay area, with the majority of these within the 20 m isobath (Dean *et al*. 2004; Söhle *et al*. 2006; Wilson *et al.* 2008; Lewis *et al.* 2008, 2009). **Mean monthly density estimates (birds km²):** too low for estimates to be made.
Common scoter	**Seasonality:** present in all months, peaking in summer. **Distribution:** restricted to coastal areas, with highest densities in western parts. Observer-based aerial surveys have shown concentrations of these birds in Spey and Burghead Bays, off Culbin Sands and in the great Dornoch Firth. All records were within the 20 m isobath (Dean *et al*. 2004; Söhle *et al*. 2006; Wilson *et al.* 2008; Lewis *et al.* 2008, 2009). **Mean monthly density estimates (birds km²):** too low for estimates to be made.
Velvet scoter	**Seasonality:** present in all months, peaking in summer and autumn. **Distribution:** restricted to coastal areas, with highest densities in western parts. Observer-based aerial surveys have shown concentrations can occur in Spey Bay. All records were from within the 20 m isobath (Dean *et al*. 2004; Söhle *et al*. 2006; Wilson *et al.* 2008; Lewis *et al.* 2008, 2009). **Mean monthly density estimates (birds km²):** too low for estimates to be made.
Red-throated diver	**Seasonality:** present during the winter months, peaking in late spring. **Distribution:** restricted to coastal areas, with highest densities in western parts within the 20 m isobath (Dean *et al*. 2004; Söhle *et al*. 2006; Wilson *et al.* 2008; Lewis *et al.* 2008, 2009). **Mean monthly density estimates (birds km²):** too low for estimates to be made.
Great northern diver	**Seasonality:** present during the winter months. **Distribution:** this species is less restricted to areas within the 20 m isobath, but is generally restricted to to areas within the 50 m isobath (Dean *et al*. 2004; Söhle *et al*. 2006; Wilson *et al.* 2008; Lewis *et al.* 2008, 2009). **Mean monthly density estimates (birds km²):** too low for estimates to be made.

Species	Summary
White-billed diver	**Seasonality:** present during the spring months in recent years. **Distribution:** restricted to coastal areas, predominantly in the Portsoy area (data available from e.g. www.birdguides.com). **Mean monthly density estimates (birds km²):** too low for estimates to be made.
Guillemot	**Seasonality:** present in all months with peaks in early summer. **Distribution:** distributed throughout the Moray Firth, with highest densities in inshore areas and western parts. In winter, highest densities of birds tend to be coastal. **Mean monthly density estimates (birds km²):** 25.57 in breeding season and 2.84 in non-breeding season within the three consented wind farm sites (see 'Baseline Characteristics' section); 0.1 to 713.4 (highest densities at colonies) in breeding season and 0.1 to 15.8 in non-breeding season in wider Moray Firth (Kober *et al*. 2010).
Razorbill	**Seasonality:** present in all months with peaks in late spring / early summer. **Distribution:** distributed throughout the Moray Firth, with highest densities in inshore areas and western parts. In winter, highest densities of birds tend to be coastal. **Mean monthly density estimates (birds km²):** 6.03 in breeding season and 2.64 in non-breeding season within the three consented wind farm sites (see 'Baseline Characteristics' section); 0.1 to 22.0 (highest densities at colonies) in breeding season and 0.1 to 15.8 in non-breeding season in wider Moray Firth (Kober *et al*. 2010).
Puffin	**Seasonality:** present in all months with peaks in spring and summer. **Distribution:** distributed throughout the Moray Firth, with highest winter densities in eastern areas. **Mean monthly density estimates (birds km²):** 6.55 in breeding season and 0.75 in non-breeding season within the three consented wind farm sites (see 'Baseline Characteristics' section); 0.1 to 14.8 (highest densities at colonies) in breeding season and 0.1 to 3.8 in non-breeding season in wider Moray Firth (Kober *et al*. 2010).
Kittiwake	**Seasonality:** small peak in winter: present in small numbers at other times. **Distribution:** distributed throughout the Moray Firth, with highest densities in western parts. **Mean monthly density estimates (birds km²):** 7.90 in breeding season and 0.79 in non-breeding season within the three consented wind farm sites (see 'Baseline Characteristics' section); 0.1 to 85 (highest densities at colonies) in breeding season and 0.1 to 20.5 in non-breeding season in wider Moray Firth (Kober *et al*. 2010).
Herring gull	**Seasonality:** present in all months; small peak in winter. **Distribution:** distributed throughout the Moray Firth, with highest densities in inshore areas and western parts. **Mean monthly density estimates (birds km²):** 0.02 in breeding season and 0.14 in non-breeding season within the three consented wind farm sites (see 'Baseline Characteristics' section); 0.1 to 44.8 in breeding season and 0.1 to 9.2 in non-breeding season in wider Moray Firth (Kober *et al*. 2010).
Great black-backed gull	**Seasonality:** present in all months. **Distribution:** distributed throughout the Moray Firth, with highest densities in inshore areas and western parts. **Mean monthly density estimates (birds km²):** 0.91 in breeding season and 0.36 in non-breeding season within the three consented wind farm sites (see 'Baseline Characteristics section); 0.01 to 0.81 in breeding season and 0.01 to 1.21 in non-breeding season in wider Moray Firth (Kober *et al*. 2010).

Construction

Disturbance

4.4.2.20 Likely effects are predicted to be limited to disturbance. These will depend on the intensity of vessel traffic and construction strategy (see Chapter 5.2: Shipping and Navigation of this ES) and are expected to be of short-term duration and reversible. Disturbance effects are predicted to be of **minor risk (probable)**, due mainly to the short-term duration of the construction period.

Indirect Effects

4.4.2.21 Indirect effects on benthic and fish populations resulting from piling have been assessed in Chapter 4.1 (Benthic Ecology) and 4.2 (Fish and Shellfish Ecology) of this ES and effects have been judged to be of **minor risk (probable)** for all prey species considered.

Significance

4.4.2.22 Given the small scale and duration of the likely effects during the construction period, they are predicted to be **minor risk (probable)** for all bird species, and considered to be **not significant**.

Operation

Disturbance

4.4.2.23 Likely effects are predicted to be limited to disturbance caused by maintenance vessels, and displacement caused by the presence of up to two OSPs (see Chapter 5.2: Shipping and Navigation of this ES). These are expected to be of short-term duration and reversible. Disturbance effects are predicted to be of **minor risk (probable)**, due to potential disturbance being limited to maintenance vessels during this period, with the number of vessels involved not representing a significant increase over the current situation.

Indirect Effects

4.4.2.24 Indirect effects resulting from EMF effects on benthic and fish populations have been assessed in Chapters 4.1 (Benthic Ecology) and 4.2 (Fish and Shellfish Ecology of this ES) and effects have been judged to be of **minor risk (probable)** for all prey species considered.

Significance

4.4.2.25 Given the small scale and duration of the likely significant effects during the operation period, they are predicted to be **minor risk (probable)** for all species, and considered to be **not significant**.

Decommissioning

Disturbance

4.4.2.26 Likely effects are predicted to be limited to disturbance. These are expected to be of short-term duration and reversible. The timing of the decommissioning will dictate the magnitude of the effect due to seasonal variation in bird numbers. Disturbance effects are predicted to be of **minor risk (probable)**, due mainly to the short-term duration of the decommissioning period.

Indirect Effects

4.4.2.27 Indirect effects on benthic and fish populations resulting from decommissioning have been assessed in Chapter 4.1 (Benthic Ecology) and 4.2 (Fish and Shellfish Ecology) of this ES and effects have been judged to be of **minor risk (probable)** for all prey species considered.

Significance

4.4.2.28 Given the small scale and duration of the likely significant effects during the decommissioning period, they are predicted to be **minor risk (probable)** for all species, and considered to be **not significant**.

Proposed Monitoring and Mitigation

Construction, Operation & Decommissioning

4.4.2.29 As part of existing commitments for the three consented MORL wind farm sites (Scottish Government 2014) vessel traffic will be along set routes during all phases where possible, thus increasing the likelihood of habituation to disturbance. Further mitigation and monitoring measures in addition to this embedded mitigation are not proposed. Since all potential effects were considered to be **not significant**, this is still the case post-mitigation.

4.4.3 Cumulative Impact Assessment

Summary of Effects

4.4.3.1 This section presents the results of assessment of the potential cumulative effects upon ornithology arising from the proposed modified OfTI in conjunction with other existing or reasonably foreseeable marine coastal developments and activities. MORL's approach to the assessment of cumulative effects is described in Chapter 1.3 (Environmental Impact Assessment) of this ES.

4.4.3.2 A summary of the impact assessment when cumulative effects are taken into account is provided in Table 4.4-13 below.

Summary of Residual Effects and Mitigation

No mitigation specific to cumulative effects on ornithology has been proposed, in addition to that described for the three consented wind farms (MORL (2012) Chapter 7.4: Ornithology).

Primary mitigation includes best-practice in terms of setting standard wind farm vessel corridors in order to minimise any potential disturbance. Operational monitoring requirements will be agreed with regulators and Statutory Nature Conservation Bodies (SNCBs).

Table 4.4-13 Cumulative Impact Summary

Effect/Receptor	Residual significance level for modified TI	Whole project assessment: Modified TI + Stevenson, Telford and MacColl	Mitigation Method
Construction & Decommissioning			
Fulmar	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Gannet	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		

Effect/Receptor	Residual significance level for modified TI	Whole project assessment: Modified TI + Stevenson, Telford and MacColl	Mitigation Method
Shag	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Eider	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Long-tailed duck	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Common scoter	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Velvet scoter	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Red-throated diver	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Great northern diver	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
White-billed diver	No effect Not significant	No effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4

Effect/Receptor	Residual significance level for modified TI	Whole project assessment: Modified TI + Stevenson, Telford and MacColl	Mitigation Method
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	No effect. Not significant		
Puffin	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Razorbill	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Guillemot	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Kittiwake	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Herring gull	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Great black-backed gull	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Operation			
Fulmar	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		

Effect/Receptor	Residual significance level for modified TI	Whole project assessment: Modified TI + Stevenson, Telford and MacColl	Mitigation Method
Gannet	Minor effect Not significant	Moderate effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Moderate effect. Not significant		
Shag	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Eider	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Long-tailed duck	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Common scoter	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Velvet scoter	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Red-throated diver	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Great northern diver	Minor effect Not significant	Negligible effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4

Effect/Receptor	Residual significance level for modified TI	Whole project assessment: Modified TI + Stevenson, Telford and MacColl	Mitigation Method
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
White-billed diver	No effect Not significant	No effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	No effect. Not significant		
Puffin	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Razorbill	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Guillemot	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Kittiwake	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		
Herring gull	Minor effect Not significant	Moderate effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Moderate effect. Not significant		
Great black-backed gull	Minor effect Not significant	Minor effect Not significant	None additional to that outlined in MORL (2012) Chapter 7.4
Total Cumulative Impact Assessment (Whole project plus those developments listed in Section 4.4.3.3)	Minor effect. Not significant		

Assessment of Cumulative Effects

4.4.3.3 The developments and activities considered in detail within this cumulative impact assessment are listed below.

- MORL Telford, Stevenson and MacColl wind farms;
- MORL Western Development Area (WDA);
- Beatrice Offshore Wind Farm (BOWL) and associated infrastructure;
- European Offshore Wind Deployment Centre (EOWDC);
- MeyGen Tidal Stream Project;
- Nigg Energy Park; and
- Port of Ardersier.

4.4.3.4 It should be noted that the number of turbines consented for the MORL and BOWL wind farms are reduced, and the turbine design changed in comparison to the WCS assessed in the MORL and BOWL ES Chapters (MORL, 2012; BOWL, 2012 and 2013), such that predicted effects are likely to be reduced.

4.4.3.5 The geographical scope of the cumulative assessment is principally focused in the Moray Firth area. It is, however, recognised that some mobile species may spend varying periods of time outside the Moray Firth and, as a result, there is potential for these to be affected by other activities / developments further afield. It is considered that the proposed Firth of Forth wind farm projects (Neart Na Gaoithe, Inch Cape and Seagreen) are outwith the area that should be considered as part of the CIA for the modified OfTI.

4.4.3.6 In addition, the following developments have been identified which may have cumulative effects over the life of the Project (including the three consented wind farms and associated transmission infrastructure) but where there is insufficient information available for a detailed assessment of cumulative effects to be carried out:

- Dredging and sea disposal in the Moray Firth;
- Port and harbour developments in the Moray Firth;
- Oil and gas developments;
- Hywind pilot park project;
- Kincardine offshore wind project; and
- Additional marine energy developments in the Pentland Firth and Orkney waters.

4.4.3.7 Aggregate dredging and port / harbour developments are not included since there are currently none planned in the vicinity of three consented wind farm sites or the transmission infrastructure.

4.4.3.8 The OnTI is not included in this assessment as no cumulative effects are predicted to occur from this development.

Methodology

4.4.3.9 The impact assessments presented for the three consented MORL wind farms (Telford, Stevenson and MacColl), the MORL WDA, the consented BOWL wind farm and associated transmission infrastructure, EOWDC, the MeyGen tidal stream project, Nigg Bay Energy Park and the Port of Ardersier are taken directly from the appropriate ESs. The predictions for the MORL WDA are taken from the MORL ES (MORL, 2012).

MORL Telford, Stevenson and MacColl wind farms

4.4.3.10 The three consented MORL wind farms (Telford, Stevenson and MacColl) are situated within the Eastern Development Area (EDA) in the Outer Moray Firth, approximately 22 km from the Caithness coastline. MORL has been granted a maximum of 1,116 MW for the three consented wind farm sites, with each site generating 372 MW.

MORL WDA

4.4.3.11 The MORL WDA comprises part of the MORL Zone and is adjacent to the MORL EDA are located. The maximum capacity to be installed in the entire Zone is 1.5 GW and MORL has been granted a maximum of 1.116 MW for the three consented wind farm sites in the EDA. The WDA will comprise a maximum capacity of 500 MW subject to the overall 1.5 GW cap for the Zone.

BOWL wind farm and OfTI

4.4.3.12 The BOWL wind farm will be located in the Outer Moray Firth, adjacent to the MORL EDA and covering an approximate area of 131.5 km2. Consent has been granted for the installation of up to 140 x 8 MW wind turbines, with a maximum capacity of up to 750 MW.

EOWDC

4.4.3.13 The EOWDC will be located in Aberdeen Bay, approximately 2 km east of Blackdog, Aberdeenshire. Consent has been granted for 11 wind turbines with a maximum capacity of up to 100 MW.

MeyGen Tidal Stream Project

4.4.3.14 The MeyGen tidal stream project covers an area of 3.5 km^2 in the channel between the island of Stroma and the north-eastern tip of the Scottish mainland. The Agreement for Lease is for 398 MW of installed capacity and will be consented in two separate phases. Phase 1 will involve the installation of up to 86 tidal turbines, with a maximum capacity of 86 MW.

Nigg Energy Park

4.4.3.15 The works comprise of an extension to the south quayside harbour and berthing facilities at Nigg Yard with the construction of a closed sheet piled quay structure. The construction will extend the south quayside some 135 m to 155 m into the adjacent Cromarty Firth. To accommodate future vessel traffic, the seabed local to the extension will be dredged to depths of approximately -10 m to -16 m.

Port of Ardersier

4.4.3.16 The works are sited on the former McDermott Fabrication Yard, which lies some 7.5 km to the west of Nairn, 18 km north-east of Inverness. The site is bounded by the Moray Firth to the north and extends to some 307 hectares.

Other Developments

4.4.3.17 Developments that are at an earlier stage, and for which there are limited development details at this stage, are also considered. Detailed cumulative impact assessment of these developments is not possible as insufficient information is available. Instead, a commentary on the potential for cumulative effects on the basis of the information available is presented, but no quantitative conclusions on the likely significance of any effects can be drawn.

4.4.3.18 All marine renewable projects considered in the CIA are shown in Figure 1.3-1 of MORL (2012) Volume 6 a.

Cumulative Assessment

4.4.3.19 The likely significant effects that will be considered in this CIA on ornithological receptors are:

- Disturbance and displacement caused by the presence of turbines, OSPs and other offshore infrastructure together with increased vessel traffic, especially during construction and decommissioning; and
- Indirect habitat effects due to changes in prey availability associated with construction, operation and decommissioning of offshore developments.

4.4.3.20 There is the potential for disturbance (including indirect effects) to arise from the three consented MORL wind farms, MORL WDA, BOWL, EOWDC, MeyGen, Nigg Energy Park and Port of Ardersier. Estimates of this risk from these sites are provided in Table 4.4-14 below.

4.4.3.21 For MORL, cumulative assessment has been undertaken to assess disturbance for: fulmar, gannet, kittiwake, great black-backed gull, herring gull, guillemot, razorbill and puffin (MORL (2012) Chapter 7.4: Ornithology). For these species the potential effect was predicted to be **minor or negligible** (Table 4.4-14 below).

4.4.3.22 For BOWL, cumulative assessment has been undertaken to assess disturbance for: fulmar, gannet, kittiwake, great black-backed gull, herring gull, guillemot, razorbill and puffin (BOWL, 2012). For these species the potential effect was predicted to be **minor or negligible** (Table 4.4-14 below).

4.4.3.23 For EOWDC, cumulative assessment has been undertaken to assess disturbance for three species: guillemot, razorbill, and puffin (Bloor, 2011). For these species the potential effect was predicted to be **negligible** (Table 4.4-14 below).

4.4.3.24 For MeyGen, cumulative disturbance effects on all species assessed were predicted to be **minor or negligible** for all species.

4.4.3.25 For Nigg Bay Energy Park, cumulative disturbance effects on all species assessed were predicted to be **minor or negligible** for all species.

4.4.3.26 For the Port of Ardersier, cumulative disturbance effects on all species assessed were predicted to be **minor or negligible** for all species.

Table 4.4-14 Summary of cumulative disturbance effects (including indirect effects)

Species	Summary
Fulmar	Telford, Stevenson and MacColl wind farms: 97 breeding individuals during summer – minor effect. Modified OfTI: minor effect. BOWL wind farm: a mean of 345 individuals during the summer – minor effect. EOWDC: negligible effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.

Species	Summary
Gannet	Telford, Stevenson and MacColl wind farms: 13 breeding individuals during summer – moderate effect. Modified OfTI: minor effect. BOWL wind farm: a mean of 49 individuals during the summer – minor effect. EOWDC: moderate effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **moderate effect**.
Shag	Telford, Stevenson and MacColl wind farms: negligible effect. Modified OfTI: minor effect. BOWL wind farm: negligible effect EOWDC: negligible effect. MeyGen: minor effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.
Eider	Telford, Stevenson and MacColl wind farms: negligible effect. Modified OfTI: minor effect. BOWL wind farm: negligible effect EOWDC: minor effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.
Long-tailed duck	Telford, Stevenson and MacColl wind farms: negligible effect. Modified OfTI: minor effect. BOWL wind farm: minor effect EOWDC: negligible effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.

Species	Summary
Common scoter	Telford, Stevenson and MacColl wind farms: negligible effect. Modified OfTI: minor effect. BOWL wind farm: minor effect EOWDC: negligible effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.
Velvet scoter	Telford, Stevenson and MacColl wind farms: negligible effect. Modified OfTI: minor effect. BOWL wind farm: negligible effect EOWDC: negligible effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.
Red-throated diver	Telford, Stevenson and MacColl wind farms: negligible effect. Modified OfTI: minor effect. BOWL wind farm: negligible effect EOWDC: negligible effect. MeyGen: minor effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.
Great northern diver	Telford, Stevenson and MacColl wind farms: negligible effect. Modified OfTI: minor effect. BOWL wind farm: negligible effect EOWDC: negligible effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.
White-billed diver	Telford, Stevenson and MacColl wind farms: no effect. Modified OfTI: no effect. BOWL wind farm: no effect EOWDC: no effect. MeyGen: no effect. Nigg Energy Park: no effect. Port of Ardersier: no effect. Cumulative: **no effect**.

Species	Summary
Puffin	Telford, Stevenson and MacColl wind farms: 479 breeding individuals during summer – minor effect. Modified OfTI: minor effect. BOWL wind farm: a mean of 368 individuals during the summer – minor effect. EOWDC: peak of 342 birds – minor effect, and different populations involved. MeyGen: minor effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.
Razorbill	Telford, Stevenson and MacColl wind farms: 415 breeding individuals during summer – minor effect. Modified OfTI: minor effect. BOWL wind farm: a mean of 404 individuals during the summer – minor effect. EOWDC: peak of 241 birds – minor effect, and different populations involved. MeyGen: minor effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.
Guillemot	Telford, Stevenson and MacColl wind farms: 1,683 breeding individuals during summer – minor effect. Modified OfTI: minor effect. BOWL wind farm: a mean of 2,655 individuals during the summer – minor effect. EOWDC: peak of 1,355 birds – minor effect, and different populations involved. MeyGen: minor effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**
Kittiwake	Telford, Stevenson and MacColl wind farms: 98 breeding individuals during summer – minor effect. Modified OfTI: minor effect. BOWL wind farm: a mean of 260 individuals during the summer – minor effect. EOWDC: negligible effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**

Species	Summary
Herring gull	Telford, Stevenson and MacColl wind farms: too low to model – moderate effect. Modified OfTI: minor effect. BOWL wind farm: a mean of 5 individuals during the summer – minor effect. EOWDC: moderate effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **moderate effect**.
Great black-backed gull	Telford, Stevenson and MacColl wind farms: 14 breeding individuals during summer – minor effect. Modified OfTI: minor effect. BOWL wind farm: a mean of 35 individuals during the summer – minor effect. EOWDC: minor effect. MeyGen: negligible effect. Nigg Energy Park: negligible effect. Port of Ardersier: negligible effect. Cumulative: **minor effect**.

4.4.3.27 In conclusion, **no significant effects** are predicted as a result of the inclusion of the MORL modified OfTI to the above cumulative disturbance assessment (including indirect effects).

4.4.4 Habitats Regulations Appraisal

4.4.4.1 The assessment and conclusions set out in this chapter have been used to inform an assessment of whether or not the potential impacts on birds, resulting from the modified OfTI, could, alone or in combination, lead to a significant effect on any European Site. On the basis of the assessment undertaken and the minor predicted effects on relevant bird species (and taking account of the conservation objectives of the SPAs listed within Section 14.4.7 of the MORL ES (2012) and Section 1.3 of Technical Appendix 4.5A of the MORL ES (2012)) it is concluded that there is no likely significant effect on any European Site as a result of the potential impact on birds of the modified OfTI either alone or in combination with other plans or projects. An Appropriate Assessment in relation to this topic area is therefore not considered to be required.

4.4.5 References

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4 Biological Environment

4.3 Marine Mammals

4.3.1 Baseline Information

Introduction

4.3.1.1 This section provides a brief summary of baseline marine mammal conditions for the Moray Firth for the proposed modified offshore transmission infrastructure (modified OfTI). Marine mammal considerations that are associated with the three consented wind farms are provided separately in MORL ES (2012) Chapter 4.4 (Marine Mammals).

4.3.1.2 This baseline study considers the following:

- The responses from key statutory and non-statutory stakeholders to MORLs scoping requests in relation to the modified OfTI;
- Information gathered from a desk top study of available data; and
- A summary of data collection and modelling (conducted by Aberdeen University and SMRU Ltd.) that has been undertaken to provide a baseline description of the use of the Moray Firth by marine mammals (MORL ES (2012) Chapter 4.4).

4.3.1.3 Additionally, Natural Power Consultants were commissioned for a two year boat-based study of the three consented wind farm sites to provide up-to-date, site specific data on marine mammal distribution and relative abundance. It should be noted that due to the mobile nature of the species in question, the ecological zone of impact is considered to be the entire Moray Firth for the impact assessment.

4.3.1.4 A more detailed account of this baseline information can be found in MORL ES (2012) Technical Appendix 4.4 A (Marine Mammals Baseline). The impact assessment undertaken for the construction, operation and decommissioning of the three consented offshore wind farms and modified OfTI is provided in the following sections:

- MORL ES (2012) Chapters 7.3 (Marine Mammals),
- Section 4.3.2 Impact Assessment and section 4.3.3 CIA for this modified OfTI impact assessment.

Consultations

4.3.1.5 Table 4.3-1 below summarises the consultation responses received with regards to marine mammals for the modified OfTI:

Table 4.3-1 Summary of Modified OfTI Consultation Responses

Organisation	Consultation Response	MORL Approach
Marine Scotland, JNCC (Joint Nature Concervation Committee) and SNH (Scottish Natural Heritage)	Recommend contacting the Cetacean Research and Rescue Unit and WDC regarding minke whales in the area due to the potential MPA. States that the coast is important to bottlenose dolphin especially within 3 km of the shore. Agree with the scope of impacts considered for marine mammals. Highlight the likelihood of cumulative impacts on marine mammals and will need to be addressed for the OfTI.	MORL welcome agreement of the scope of the impact assessment proposed.
WDC	Overall agree with what has been 'scoped in' for the marine mammal assessment. Recommend including corkscrew injuries Suggests including developments outside the Moray Firth in the Cumulative Impacts Assessment section which include: Aberdeen harbour, Neart na Gaoithe OWF, Inch Cape OWF, Seagreen OWF.	MORL welcome agreement of the scope of the impact assessment proposed. MORL agree to include cumulative assessments for the projects listed.

Baseline Characteristics

4.3.1.6 At least 14 species of cetacean (whale, dolphin and porpoise) have been recorded within the Moray Firth along with two species of seals. For a full review of all the species recorded in the Moray Firth area, see MORL ES (2012) Technical Appendix 4.4 A (Marine Mammals Baseline).

4.3.1.7 Table 4.3-2 provides a summary of species commonly recorded within the Moray Firth.

Table 4.3-2 List of Marine Mammals Commonly Recorded within the Moray Firth, Adapted From a Variety of Sources including Reid *et al.*, (2003), Robinson *et al.*, (2007) and Thompson *et al.*, (2010)

Species	Latin Name	Occurrence
Pinnipeds		
Harbour (common) seal	*Phoca vitulina*	Common, all year
A number of haul-out sites for harbour seals are located within the Moray Firth, primarily in the Beauly, Cromarty and Dornoch Firths (Thompson *et al.*, 1996b; SCOS, 2010). The harbour seal population in the Moray Firth has declined by 40 % compared to numbers recorded in the mid 1990s, with the population being relatively stable in recent years (SCOS, 2010). Harbour seals occur throughout the year in these areas, with peak numbers at haul-out sites between June and August when they are used as breeding sites (Thompson & Miller, 1990; Thompson *et al.*, 1996a). Seals within the Moray Firth are found to forage in waters of 10 to 50 m deep over areas with predominantly sandy sea beds. Tagging studies within the Firth have found that harbour seals generally travel no more than 60 km from their haul-out sites (Thompson *et al.*, 1996b), with a tendency to forage slightly further afield in the winter and with seasonal differences in the areas used (Thompson *et al.*, 1996a).		
Grey seal	Halichoerus grypus	Common, all year
Grey seals within the Moray Firth are predominantly observed during the summer although smaller numbers are present throughout the year. Non-breeding grey seals have been observed at intertidal sites within the Firth, also used by harbour seals. Breeding grey seals are mostly found at the rocky beaches and caves to the north of the Moray Firth (Thompson *et al.*, 1996b). It is thought that grey seals travel into the Moray Firth from different breeding sites (such as Orkney, Firth of Forth and Farne Islands) and use the area for food and non-breeding haul-out (Thompson *et al.*, 1996b). Tagging studies within the Moray Firth have identified grey seals foraging over a much wider area than the harbour seal, with great variation between individuals (Thompson *et al.*, 1996b).		
Cetaceans		
Harbour porpoise	*Phocoena phocoena*	Common, all year
Harbour porpoises are distributed throughout the Moray Firth (Hastie *et al.*, 2003b; Robinson *et al.*, 2007; Thompson *et al.*, 2010). Although the original SCANS surveys (Small Cetaceans in the European Atlantic and North Sea) did not encompass the Moray Firth, estimates of porpoise density for the closest surveyed regions were 0.36 and 0.78 animals / km2 (Hammond *et al.*, 2002) with spatially smoothed predictions of porpoise density suggesting relatively high densities within the Moray Firth (1.2 animals / km2). The SCANS II survey did include the Moray Firth (Hammond *et al.*, 2013) which estimated harbour porpoise densities within the ranges of the original SCANS estimates but lower than the smoothed prediction for the Moray Firth (0.4 to 0.6 animals / km2). Data collected from the outer Moray Firth through a DECC and Industry funded project conducted by Aberdeen University assessing the impact of seismic surveys on marine mammals, supports the relatively high occurrence of porpoises throughout the Firth with high detection rates of porpoises using autonomous passive acoustic detectors (CPODs)(Bailey *et al.*, 2010; Thompson *et al.*, 2010).		
Bottlenose dolphin	*Tursiops truncatus*	Common, all year
The most recent population estimate of dolphin abundance around the northeast coast of Scotland is 195 individuals (95 % probability interval 162 to 245; Thompson *et al.*, 2011). Although the majority of the population (71 to 111 individuals) appear to regularly utilise the Moray Firth SAC (95 % CI: 66 to 161), it is clear that a relatively high number of individuals also frequently utilise areas outside the SAC (Thompson *et al.*, 2006; 2009). The distribution of bottlenose dolphin sightings within the Moray Firth appear to be coastal, with the majority occurring in the inner Moray Firth and along the southern coast, generally in waters of less than 25 m deep (Hastie *et al.*, 2003a; Robinson *et al.*, 2007). Parts of the population exhibit movement patterns between the Moray Firth and other areas. For example bottlenose dolphins from the Moray Firth SAC are regularly sighted in the Tay (Thompson *et al.*, 2011) and the Firth of Forth and Tay Offshore Wind Developers Group (FTOWDG) commissioned a piece of work from SMRU Ltd that confirmed this connectivity, using the most up-to-date photography records of bottlenose dolphins known to be residing in the Moray Firth that have also been recorded within the Firth of Tay. (Quick and Cheney, 2011).		

Common dolphin	*Delphinus delphis*	Common, seasonal
Predominantly found in the continental shelf waters in the Celtic Sea and the western approach to the English Channel. They have been frequently seen in the Sea of Hebrides during the summer and occasionally in the North Sea, primarily in the Moray Firth region, with sightings becoming regular here during the summer months since 2006 (Robinson *et al*., 2010). No common dolphins were recorded in the North Sea during the SCANS II surveys (Hammond *et al*., 2013).		
White-Beaked dolphin	*Lagenorhynchus albirostris*	Common, seasonal
UK sightings predominantly recorded from around Scotland and the east coast of England (Northridge *et al*., 1995; Reid *et al*., 2003), although sightings within the Moray Firth are low compared to other areas. They have been recorded in UK waters all year round, with an increase in sighting frequency in coastal waters during the summer months when the animals appear to move inshore (Evans, 1992; Northridge *et al*., 1995; Weir *et al*., 2007). The SCANS II Survey (2007) gave an overall abundance estimate for white-beaked dolphins of 22,664 (95 % CI = 10,341 to 49,670) and a density estimate for the Moray Firth, Orkney and Shetland areas combined of 0.018 animals per km2 (0.86 CV).		
Minke whale	*Balaenoptera acutorostrata*	Common, seasonal
Minke whales are the most abundant baleen whale species within the Moray Firth, with sightings being reported throughout the area (Reid *et al*., 2003; Robinson *et al*., 2007; Thompson *et al*., 2010). Much of the research has concentrated on the southern coast and deeper trench waters, with observations most commonly occurring in deeper waters further from the shore (Robinson *et al*., 2007; Eisfeld *et al*., 2009). Data indicates that minke whales visit the Moray Firth in late summer in order to forage (Bailey & Thompson, 2009). Hammond *et al.* (2013) gave an overall abundance estimate for minke whale of 18,614 (95 % CI = 10,445 to 33,171) and a density estimate for the Moray Firth, Orkney and Shetland areas combined of 0.022 animals per km2 (1.02 CV).		

4.3.1.8 In addition further information is available in Figures 4.3-1 and 4.3-2 to illustrate key information on grey seal distribuition.

Summary

Harbour Seal

4.3.1.9 Harbour seal is the most common seal species observed within the Moray Firth, with parts of the Inner Moray Firth designated a SAC for their protection. Counts made during the breeding season indicate a decline in numbers within the SAC in recent years but an increase in numbers across the Moray Firth as a whole. Tagging studies found the highest rates of occurrence for the harbour seal were within 30 km of their haul-out sites. Habitat association models highlighted areas of preferred habitat, primarily within the inner Firth, plus some areas close to the consented developments (MORL and BOWL) in the north-eastern part of the Firth. Some preference was also shown for small areas of the south-east Firth in the vicinity of the proposed cable land-fall site at Inverboyndie. Modelling suggests some areas may contain up to 0.5 animals per km^2.

Grey Seal

4.3.1.10 Telemetry studies showed that grey seals regularly travel between the Moray Firth and haul-out sites outside the area. Areas with the highest usage within the Moray Firth included the Dornoch Firths. Lower levels of usage (between one and five animals per 4 km grid square) were estimated for the three consented wind farm sites. Areas of low usage are also predicted for the proposed land-fall site.

Harbour Porpoise

4.3.1.11 Passive acoustic monitoring indicates that harbour porpoise can be found throughout the Moray Firth. Harbour porpoise habitat models showed a preference for intermediate depths with increasing levels of sand and gravel, such as the Smith Bank. The boat-surveys supported this modelling, with the highest numbers of porpoises recorded in the south-east part of the survey area. Numbers predicted in the models for coastal areas were low.

4.3.1.12 There are relative density estimates available from boat-based surveys undertaken at the three consented wind farm sites combined (Technical Appendix 4.4 A of MORL ES (2012), SCANS (I and II) for the wider Moray Firth, and the aerial surveys. These density estimates are 0.72 animals / km^2, 0.4 to 0.6 animals / km^2 and 0.81 animals /km^2 respectively. It should be noted, however, that these aerial surveys coincide with the months during which the highest number of porpoise were recorded during the boat-based surveys (refer to Figure 5.31 in MORL ES (2012) Technical Appendix 4.4 A (Marine Mammals Baseline)).

Bottlenose Dolphins

4.3.1.13 A resident population of bottlenose dolphins can be found within the Moray Firth, for which an SAC has been designated. Passive acoustic monitoring (which cannot differentiate between dolphin species) indicates that dolphins can be found throughout the Moray Firth. The EARs data (which does allow differentiation between species) suggest that t this species being restricted to coastal waters.

4.3.1.14 The most recent estimate of the abundance of bottlenose dolphins along the whole of the east coast of Scotland is based on co-ordinated photo-identification studies in 2006 and 2007, which produced an estimate of 195 (95 % highest posterior density intervals (HPDI): 162 to 253) (Cheney *et al.,* 2013). More detailed annual surveys within the Moray Firth SAC between 2002 and 2010, indicate that around 50 % of these animals use the SAC in each year, with estimates ranging from 68 to 114 individuals; (mean = 93.3) but with overlapping confidence limits (Cheney *et al.,* 2012).

Other Cetacean Species

4.3.1.15 Of the other cetacean species observed within the Moray Firth, the minke whale is the most abundant. They have been shown to prefer sandbanks, as was shown by their distribution recorded during the boat-based surveys. The SCANS II surveys estimated 0.022 animals per km2 for the Moray Firth, Orkney and Shetland combined, higher than the 0.01 animals per km2 calculated from the boat-based surveys, although the small sample size needs to be taken into account when interpreting these results.

4.3.1.16 White-beaked and common dolphins have been recorded within the Moray Firth but detailed information on their abundance is lacking. Both species were recorded during the boat-based surveys but in low numbers.

Legislative and Planning Framework

4.3.1.17 Marine mammals in UK territorial waters are protected by both European and National Legislation (see MORL ES (2012) Chapter 4.1: Designated Sites). All cetaceans are listed on Annex IV of Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') and therefore classed as European Protected Species and are fully protected under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) and the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended).

4.3.1.18 Four species of marine mammal relevant to this development are also listed on Annex II of the Habitats Directive which requires the designation of Special Areas of Conservation:

- Bottlenose dolphin (*Tursiops truncatus*);
- Harbour porpoise (*Phocoena phocoena*);
- Grey seal (Halichoerus grypus); and
- Harbour seal (*Phoca vitulina*).

4.3.1.19 Two SACs have been designated within the Moray Firth for marine mammals (Figure 4.3-3, and Table 4.3-3 below):

- Moray Firth SAC – designated for bottlenose dolphin; and
- Dornoch Firth and Morrich More SAC – designated for harbour seals.

4.3.1.20 In addition to the above legislation, the following plans or agreements also apply to marine mammals:

- UK Biodiversity Action Plan (UK BAP);
- Marine (Scotland) Act 2010;
- Scottish Priority Marine Feature List;
- Draft Scottish Planning Policy (SPP), 2013;
- Wildlife and Countryside Act 1981 (Amendment) (Scotland) Regulations 2004;
- Nature Conservation Act 2004;
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention);
- OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic; and
- Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas 1994 (ASCOBANS).

4.3.1.21 The three consented wind farm sites and much of the remaining modified OfTI area are outwith the 12 nm limit, and thus potentially impacted marine mammal populations are protected under Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (Amendment) 2012. The inshore modified export cable route corridoor and modified export cable landfall are within Scottish Territorial Waters, and thus potential impacted marine mammal populations are covered by Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) legislation).

Table 4.3-3 Designated Areas within the Moray Firth Listing Marine Mammals as Qualifying Interest Features

	Status	Area (ha)	Relevant Notified Feature (s)
Dornoch Firth and Morrich More	SAC	8,700.53	Harbour seal and otter[1]
Moray Firth	SAC	151,347.17	Bottlenose dolphin

[1] Otters forage in inshore waters, out to approximately 10 m water depth. They are not considered further within the assessment as the OfTI cable corridor does not pass within proximity to the SAC.

4.3.1.22 The following guidance documents have also been taken into account as part of the marine mammal assessment process:

- Seal Assessment Framework Document (Thompson *et al.,* 2011) (This document is provided in MORL ES (2012) Technical Appendix 7.3 B (Marine Mammals Environmental Imapact Assessment));
- The deliberate disturbance of marine European Protected Species. Guidance for English and Welsh territorial waters and the UK offshore marine area (2008) (http://jncc.defra.gov.uk/PDF/consultation_epsGuidanceDisturbance_all.pdf);
- The protection of Marine European Protection Species from injury and disturbance. Guidance for Scottish Inshore Waters. Marine Scotland, March 2014 (http://www.scotland.gov.uk/Resource/0044/00446679.pdf);

- The protection of marine European Protected Species from injury and disturbance, JNCC (2010);
- Methodologies for measuring and assessing potential changes in marine mammal behaviour, abundance or distribution arising from the construction, operation and decommissioning of offshore wind farms, by BioConsult SH (2008);
- Assessment and costing of potential engineering solutions for the mitigation of the impacts of underwater noise arising from the construction of offshore wind farms, by BioConsult SH (2008);
- Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal Institute of Ecology and Environmental Management, 2010; and
- Greening blue energy: Identifying and managing the biodiversity risks and opportunities of offshore renewable energy (Wilhelmsson *et al.,* 2010).

4.3.2 Impact Assessment

Summary of Effects and Mitigation

4.3.1.23 Effects on marine mammal receptors have been assessed during the construction, operation and decommissioning phases of the modified OfTI.

4.3.1.24 Significant medium term effects on marine mammal receptors are predicted from piling noise associated with Offshore Substation Platform (OSP) foundations, but no long term population level effects are assessed to be likely. No other significant effects are predicted.

4.3.1.25 The assessment process has used noise propagation and impact analysis to quantify the risks of physical injury and displacement due to piling noise for all species potentially effected, and used population analysis to assess the potential effects at the population level for harbour seals. The assessment incorporates a series of conservative assumptions about the potential impacts of noise on marine mammals. If these assumptions are confirmed, the assessment represents likely significant effects.

4.3.1.26 The assessment also considers current guidelines from the Joint Nature Conservation Committee (JNCC) regarding the use of ducted propellers and potential risk of corkscrew injury to seals. Likely effects are considered small due to distance to nearest breeding seal colony.

Summary of Effects

4.3.1.27 The effects on marine mammals that have been assessed include:

- Temporary displacement caused by increased noise levels during construction, in particular during piling activity for the two OSPs;
- Permanent hearing damage resulting from increased noise levels, in particular during piling activity;
- Risk of collision with vessels and ducted propellers;
- Long term avoidance resulting from operation and maintenance activity;
- Secondary effects associated with changes to prey availability;
- Risk of stranding associated with electromagnetic field (EMF) generation; and
- Impacts of non-toxic and toxic contamination.

Summary of Mitigation Measures and Residual Effects

4.3.1.28 Primary mitigation during construction will include adherence to the JNCC protocol for minimising the risk of injury to marine mammals from piling noise. Currently, this protocol involves the use of marine mammal observers and 'soft start' piling procedures. All effects assessed within this chapter assume these best practice guidelines are implemented. In addition, to minimise the risk of collision with vessels involved in the construction, operation and decommissioning of the OfTI infrastructure, all vessels will operate within designated routes, ensuring predictable vessel movement. This has also been assumed for the purposes of the assessments in this chapter.

4.3.1.29 Table 4.3-4 below summarises the predicted residual effects on marine mammal receptors.

Table 4.3-4 Impact Assessment Summary

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
Construction				
Hearing Damage	Harbour seal Grey seal Harbour porpoise Bottlenose dolphin Minke whale	The modelling on which the assessment is based has been undertaken including mitigation measures (JNCC protocol and designated vessel routes) and therefore pre-mitigation effects are not separately identified)	None additional to JNCC protocol for minimising the risks to marine mammals. Designated vessel routes	No significant long term impact
Displacement/Disturbance				No significant long term impact
Collision Risk (including risk of corkscrew injury from ducted propellers)				No significant long term impact
Reduction in Prey Sources				No significant long term impact
Reduction in Foraging Ability				No significant long term impact
Toxic Contamination				No significant long term impact
Operation				
Collision Risk (including risk of corkscrew injury from ducted propellers)	Harbour seal Grey seal Harbour porpoise Bottlenose dolphin Minke whale	Not significant	Designated vessel routes	Not significant
Stranding due to Electromagnetic Fields		Not significant		Not significant
Long Term Changes in Prey Availability		Not significant		Not significant
Toxic Contamination		Not significant		Not significant

Decommissioning				
Hearing Damage	Harbour seal Grey seal Harbour porpoise Bottlenose dolphin Minke whale	The modelling on which the assessment is based has been undertaken including mitigation measures (JNCC protocol and designated vessel routes) and therefore pre-mitigation effects are not separately identified)	None additional to JNCC protocol for minimising the risks to marine mammals. Designated vessel routes	Not significant
Displacement/Disturbance				Not significant
Collision Risk (including risk of corkscrew injury from ducted propellers)				Not significant
Reduction in Prey Sources				Not significant
Reduction in Foraging Ability				Not significant

Introduction to Impact Assessment

4.3.1.30 The aim of this assessment is to describe the potential significant effects that specific activities associated with the installation of the modified OfTI may have on marine mammal populations within the Moray Firth. It concentrates on the connection between the three consented offshore wind farm sites and the modified export cable landfall site at Inverboyndie, including the construction of two offshore OSPs which will be located within the area of the three consented wind farms.

4.3.1.31 A full review of potential significant effects on marine mammals and the methodologies used in this assessment can be found in the following technical appendices (MORL ES, 2012):

- Technical Appendix 7.3 A (Marine Mammals: Environmental Impact Assessment);
- Technical Appendix 7.3 B (Framework for assessing the impacts of pile-driving noise from offshore wind farm construction on Moray Firth harbour seal populations);
- Technical Appendix 7.3 C (MORL SAFESIMM noise impact assessment for seals and cetaceans);
- Technical Appendix 7.3 D (A comparison of behavioural responses by harbour porpoise and bottlenose dolphins to noise implications for wind farm risk assessments);
- Technical Appendix 7.3 E (Identification of appropriate noise exposure criteria for assessing auditory injury for pinnipeds using offshore wind farm sites);
- Technical Appendix 7.3 F (Noise propagation and SAFESIMM model outputs);
- Technical Appendix 7.3 G (Habitat Regulations Appraisal: Marine Mammals – Two SAC's listing marine mammals as qualifying features can be found within the Moray Firth. For the purpose of Appropriate Assessment, an appraisal under the Habitats Regulations is presented within this appendix); and
- Technical Appendix 7.3 H (EPS Assessment: Supplementary Information – All cetaceans present within the Moray Firth are European Protected Species (EPS)). MORL recognises that an EPS licence will be required during the construction phase of the modified OfTI works. A preliminary assessment is presented, which will be revised once construction parameters have been finalised.

4.3.1.32 Additional supporting information on underwater noise modelling activities can be found in MORL ES (2012) Chapter 3.6: Underwater Noise and Technical Appendix 3.6 A (Underwater Noise Technical Report).

4.3.1.33 The marine mammal assessment interacts with assessments for the following receptors and where relevant, linkages have been made:

- Chapter 4.2 (Fish and Shellfish Ecology);
- Chapter 4.1 Benthic Ecology); and
- Chapter 5.2 (Shipping and Navigation).

4.3.1.34 The species assessed in this section are:

- Grey seal;
- Harbour seal;
- Harbour porpoise;
- Bottlenose dolphin; and
- Minke whale.

4.3.1.35 Key effects on marine mammals assessed are summarised in Table 4.3-5 below.

Table 4.3-5 Summary of the Potential Key Impacts on Marine Mammals Assessed within this Chapter

Risk	Associated Activity	Effect
Permanent Hearing Damage	Increased noise levels, associated with piling.	Reduction in ability to find prey, avoid predators and socially interact.
Temporary Disturbance / Displacement	Increased vessel movements; Increased noise levels, associated with piling and non-piling activities.	Restricted access to food sources, breeding grounds or migration routes leading to reduced fitness.
Collision	Vessel movements, including those with ducted propellers.	Physical injury and reduced viability.
Long Term Avoidance	Disturbance related to OSPs and cable installation; Operation and Maintenance related vessel movement.	Habitat disturbance leading to reduction in prey source; restricted access to food sources, breeding grounds or migration routes leading to reduced fitness.
Reduction in Prey Availability	Secondary effect resulting from increased noise and / or vibration (including electromagnetic fields), habitat disturbance or the physical presence of the turbines.	Reduction in fitness.
Toxic / Non-Toxic Contamination	General construction activities leading to increased sediment; sacrificial anodes and antifouling paints.	Contamination of food chain leading to reduced fitness.

Rochdale Envelope Parameters Considered in the Assessment

4.3.1.36 Full details of the Rochdale Envelope for the modified OfTI are provided in Chapter 2.2 (Project Description) of this ES. The key components of the project design for this marine mammal impact assessment are described in Table 4.3-6 below.

4.3.1.37 Key components of the modified OfTI design relevant for this impact assessment on marine mammals are:

- Duration and timing of construction activities;
- Associated vessels;
- Number of OSPs and type of foundation structures; and
- Extent and route of export cable route to Inverboyndie.

Table 4.3-6 Rochdale Envelope Parameters Relevant to the Marine Mammal Impact Assessment

Potential effect	Rochdale Envelope Scenario Assessed
Construction	
Permanent Threshold Shift (PTS – hearing damage)	Greatest potential cause of auditory damage will be from piling noise during construction. Worst case (as modelled) is 32 x 3 m piles from two substations (16 piles per OSP for jack-up foundation type).
Disturbance/Displacement	Greatest potential cause of disturbance / displacement will be increased noise, in particular from piling, created during construction. Worst case (as modelled) is 32 x 3 m piles from two substations (16 piles per OSP for jack-up foundation type).
Collision Risk	An assessment will be undertaken with respect to anticipated increased vessel traffic around the offshore transmission works, taking account of the use of standard vessel routes which will help to localise effects. A separate review of ducted propeller related injury from vessel movement near haul-out sites will be undertaken as part of the impact assessment as described below. It is assumed for this assessment that all vessels associated with the installation of the cable and OSPs will utilise ducted propellers.
Risk of Corkscrew Injury from use of Ducted Propellers	The Rochdale Envelope scenario assessed assumes that vessels with ducted propellers will be used.
Reduction in Prey Availability	Secondary impacts as a result of changes in prey distribution or density. Worst case, maximum 70 km of cable for inter platform cables and cabling up to the boundary of the three consented wind farms. Corridor length from the boundary of the three consented wind farms of 52 km; maximum of four trenches; maximum corridor width 1,200 m, 1 m width per trench with associated loss of habitat and impacts of piling on prey availability (32 x 3 m piles for two substations). Refer to Chapter 2.2: Project Description of this ES for details.
Reduction in Foraging Ability	Secondary effect due to increased suspended sediment associated with construction activities i.e. piling or trenching. Refer to Chapter 3.1: Hydrodynamics, Sedimentary and Coastal Processes of this ES for details.
Toxic Contamination	Potential for non-toxic and toxic contamination through accidental spillages and pollution incidents. It is assumed all offshore vessels/installations will use sacrificial anodes and/or anti fouling coatings.
Operation	
Increased Vessel Use - Collision Risk and Barrier to Movement	Increased vessel movements associated with maintenance of the cable and OSPs.
Increased Vessel Movement – Ducted Propellers	The Rochdale Envelope scenario assessed assumes that vessels with ducted propellers will be used.
Electromagnetic Fields	70 km of 220 kV HVAC cable for inter-platform cables and cabling up to the boundary of the three consented wind frams; and a maximum of 52 km of 220 kV HVAC export cable corridor length from the boundary of the three consented wind farms. Target trench depth of 1 m.

Potential effect	Rochdale Envelope Scenario Assessed
Changes in Prey Availability (habitat loss)	Secondary impacts due to changes in prey distribution or density as a result of loss or gains in habitat (refer to Chapter 4.1: Benthic Ecology and 4.2: Fish & Shellfish Ecology of this ES for details) due to presence of EMF. Maximum 70 km of cable for interplatform cables and cabling up to the boundary of the three consented wind farms. Corridor length from the boundary of the three consented wind farms of 52 km from the boundary of the three consented wind farms; maximum of four trenches; maximum corridor width 1,200 m, 1 m width per trench.
Toxic Contamination	Potential for non-toxic and toxic contamination through accidental spillages and pollution incidents. It is assumed all offshore vessels/installations will use sacrificial anodes and/or anti fouling coatings.
Decommissioning	
The decommissioning programme has not yet been finalised, therefore a detailed assessment is not possible at this stage. The decommissioning of the OSPs and export cable may involve the use of cutting tools and / or other methods if appropriate. Impacts from decommissioning are prediceted to be broadly similar to or less than those from construction. The greatest impact is likely to be due to increased anthropogenic noise associated with removal of the OSP's.	

EIA Methodology

4.3.1.38 The assessment methodology used for marine mammals is based on methodologies recommended by the Chartered Institute of Ecology and Environmental Management (IEEM, 2010). Some additional definitions are provided by Wihelmsson *et al.* (2010) in a review of potential effects of offshore wind developments. For full details of methodology used in this assessment, including details of modelling undertaken to assess the impacts of piling and the conservatism in the assessment, refer to MORL ES (2012) Chapter 7.3 (Marine Mammals) and Technical Appendix 7.3 A: Marine Mammals Environmental Impact Assessment (MORL ES, 2012).

4.3.1.39 The basic assessment steps are as follows:

- Identification of potential receptors and description of baseline conditions;
- Prediction of activities during the different stages of the development that may result in potential effects;
- Characterisation of potential effects including likelihood of occurrence;
- Assessment of whether effects are ecologically significant and the geographical scale at which they may occur;
- Proposed mitigation if applicable;
- Assessment of whether residual effects (after mitigation) are ecologically significant; and
- Assessment of cumulative / in-combination effects.

4.3.1.40 A list of defining terms used in this assessment can be found in Table 4.3-7 below. The geographical scale at which the ecological significance of a potential effect may occur is defined as:

- **Local:** receptors of local importance;
- **Regional**: receptors of regional importance;
- **National**: receptors are a feature of a UK designated site, i.e. Site of Special Scientific Interest (SSSI), UK Biodiversity Action Plan (UK BAP) species or Marine Protected Areas; and
- **International**: receptors are a feature of European designated sites, i.e. Special Area of Conservation (SAC).

4.3.1.41 Certainties in predictions for this assessment follow the criteria described below in Table 4.3-8, based on IEEM guidance (IEEM, 2010).

4.3.1.42 Given the level of legal protection afforded all of the marine mammals likely to be encountered within the Moray Firth, all species of marine mammal are considered to be of high sensitivity in this assessment.

Table 4.3-7 Definitions of terms used in assessment

Term	Definition
Magnitude	Size of potential effect (e.g. number of individuals predicted to be affected). For the purposes of this impact assessment, low has been termed as < 10 % of the reference population considered, medium as between 10 to 20 %, and high as over 20 % of the reference population considered.
Extent	Area over which effect predicted to occur. For this assessment, the extent has been considered as the Moray Firth.
Duration	Time period over which effect predicted to occur. For example: short term (occur over days or weeks within the construction phase); medium term (occur over complete construction phase); or long term (detectable after 25 years).
Reversibility	Likelihood of effect to be reversed (either though natural processes or mitigation).
Timing	Period of the year that activity would need to occur to result in potential effect. It has been assumed for this assessment that construction activities occur throughout the year and do not exhibit seasonality.
Frequency	Frequency of activity leading to potential effect.
Risk	Likelihood potential effect will occur.

Table **4.3-8 Criteria used for predicting certainty in predictions during the assessment**

Term	Definition
Certain	Interactions are well understood and documented, i.e. receptor sensitivity investigated in relation to potential effect, data have comprehensive spatial coverage / resolution and predictions relating to effect magnitude modelled and / or quantified. Probability estimated at > 95 %.
Probable	Interactions are understood using some documented evidence, i.e. receptor sensitivity is derived from sources that consider the likely effects of the potential effect, data have a relatively moderate spatial coverage / resolution, and predictions relating to effect magnitude have been modelled but not validated. Probability estimated at 50 to 95 %.
Uncertain	Interactions are poorly understood and not documented, i.e. predictions relating to effect magnitude have not been modelled and are based on expert interpretation using little or no quantitative data. Probability estimated at < 50 %.

4.3.1.43 A magnitude scale (see Table 4.3-9 below) was determined through consultation with scientific experts, and guided by comparison of predicted changes in population size against likely baseline trends. This also considered whether predicted change could be detected in these marine systems. A high magnitude change in distribution or population size should be measureable within the Moray Firth given the robust baseline information for this area. Medium or low magnitude change may remain undetected due to high levels of background variation and sampling variability. The duration of effect described has been agreed through consultation with Marine Scotland, SNH and JNCC.

4.3.1.44 Technical Appendix 7.3 B (MORL ES, 2012) provides the rationale for using a 25 year period to predict the long term consequences of these construction activities. In this context, it is suggested that “long term” be considered to be a 25 year time-scale. First, this is the time-scale typically considered by the International Union for Conservation of Nature (IUCN) when assessing conservation status. Second, it is equivalent to approximately one to two times the generation time for key marine mammal receptors, and thus seems an appropriate period for assessing longer term population change.

Table 4.3-9 Criteria used for predicting significance from magnitude of effect and duration

	Duration		
Magnitude	**Short term (days)**	**Medium Term (construction years)**	**Long Term (25 years)**
High (>20% of population)	Major significance	Major significance	Major significance
Medium (>10% pf population)	Minor significance	Moderate significance	Moderate significance
Low (<10% of population)	Negligible significance	Minor significance	Minor significance

Impact Assessment

4.3.1.45 All marine mammal species that may be encountered in the vicinity of the proposed works are considered target species due to the fact that all cetaceans are listed on Annex IV of the Habitats Directive and the bottlenose dolphin, harbour porpoise, harbour seal and grey seal are listed on Annex II. This assessment will concentrate on the key species highlighted in the Baseline Information section 4.3.1 above, (and associated MORL ES (2012) Technical Appendix 4.4 A) (Marine Mammals Baseline). The key species to be discussed are:

- Grey seal;
- Harbour seal;
- Harbour porpoise;
- Bottlenose dolphin; and
- Minke whale.

Construction

Increased Anthropogenic Noise (Non-Piling Activities)

4.3.1.46 Ambient noise in the ocean is sound that is always present and cannot be attributed to an identifiable localised source. Anthropogenic (man-made) noises which are now a constant in the marine environment, for example shipping, come from all directions, but will vary in magnitude, frequency, direction and depth. The propagation of noise through the water column is dependent on a number of factors including the depth of the water, with noise travelling further through deeper water. Sound travels much further underwater than in air and anthropogenic noise has the potential to affect marine mammals at relatively large distances from the source.

4.3.1.47 As piling is generally accepted as providing the greatest potential for impact to marine mammals, increases in anthropogenic noise due to piling are discussed separately (see next section which is titled “Increased anthropogenic noise (piling)”). During periods when no impact piling is occurring, marine mammals may react to other sources of construction noise such as vessel noise, trenching, cable laying, dredging or rock placement.

4.3.1.48 Simple Propagation Estimator and Ranking (SPEAR) modelling was conducted by Subacoustech Environmental Ltd. to demonstrate the level of noise produced by different construction activities. Underwater measurements of background noise taken within the Moray Firth suggest that levels of background noise within the Moray Firth are typical for UK waters (see MORL ES (2012) Section 7 of Technical Appendix 3.6 (Underwater Noise Technical Report) for details).

4.3.1.49 The results showed that the primary source of noise during installation of the OfTI infrastructure (and therefore the greatest effect on marine mammals) will be from piling for the OSPs. This is illustrated below in Plate 4.3-1, and explored in detail in MORL ES (2012) Technical Appendix 7.3 A (Marine Mammals Environmental Impact Assessment). Plate 4.3-1 below illustrates the range at which noise from different OfTI construction related activities reaches 90 dBht for harbour porpoises from the noise source. It should be noted that the Y-axis of this graph is plotted using a log scale, illustrating that the impact range of piling associated noise is several orders of magnitude larger than other construction related activities.

4.3.1.50 As shown in Table 4.3-10 below, SPEAR modelling for other marine mammal species shows very similar impact ranges from the modelled construction activities to those of harbour porpoises (see MORL ES (2012) Section 4.1.2 of Technical Appendix 7.3 A (Marine Mammals Environmental Impact Assessment) full details of SPEAR modelling undertaken).

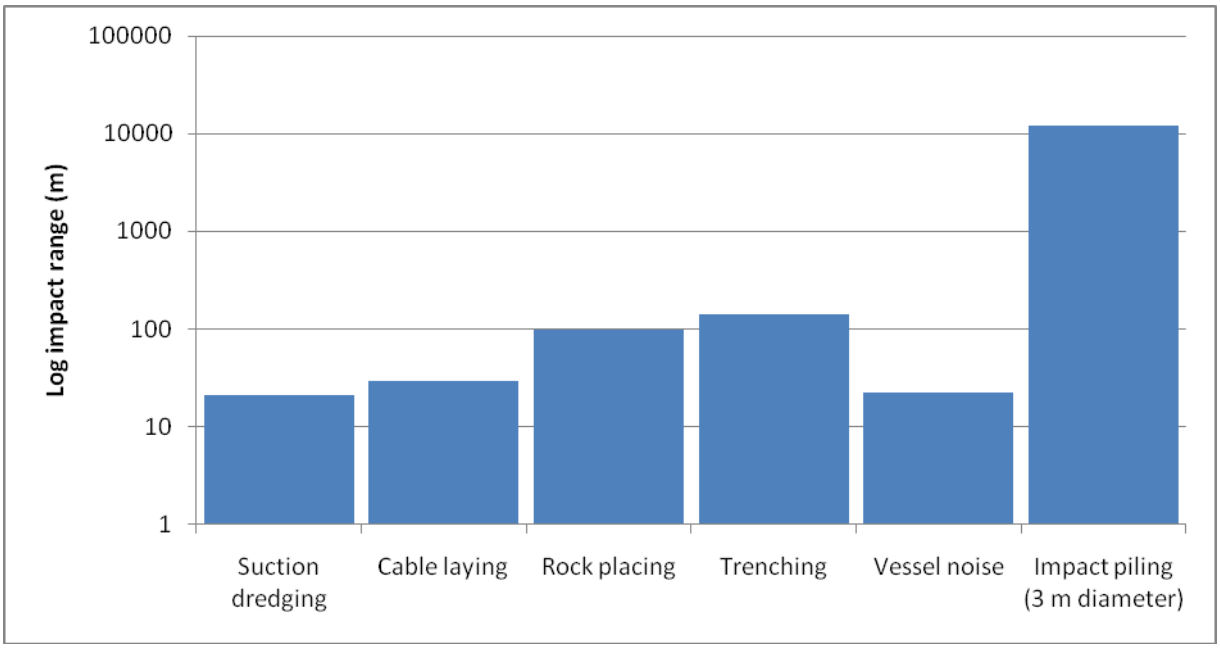

Plate 4.3-1 Extent of effect of various construction activities (90 dB_{ht}) on harbour porpoise

Table 4.3-10 Numerical Output from SPEAR Model Predicting and Comparing the Modelled Noise Effects of the Different Construction Activities on Marine Mammals

Construction Activity	Effect Range (m)							
	Minke Whale		Bottlenose Dolphin		Harbour Porpoise		Harbour Seal	
	90 dB_{ht}	75 dB_{ht}	90 dB_{ht}	75 dB_{ht}	90 dB_{ht}	75 dB_{ht}	90 dB_{ht}	75 dB_{ht}
Suction Dredging	16	180	21	72	21	200	2	26
Cable Laying	18	180	9	75	29	220	2	29
Rock Placing	70	390	31	170	99	550	17	99
Trenching	59	390	81	350	140	640	12	87
Vessel Noise	6	130	12	110	22	200	<1	11
Impact Piling (3 m diameter)	12,000	24,000	7,700	15,000	12,000	21,000	5,400	14,000

4.3.1.51 The results of this study showed that the primary source of noise during construction (and therefore exerting the greatest potential effect on marine mammals) will be from piling.

4.3.1.52 Based on the SPEAR model outputs above, it was concluded that the effects of these additional non-piling construction activities associated with the modified OfTI would be minimal due to their local influence and the fact that more distant effects would be masked by the noise produced from piling of the OSPs. During periods when no piling is occurring, strong reactions to the activities modelled are unlikely to occur at distances of greater than 140 m (Table 4.3-10 above) from the source and so any impacts effects would be of low magnitude.

4.3.1.53 Disturbance to animals due to non-piling related Works associated with the OfTI installation or decommissioning is deemed to constitute a direct negative impact on animals, for a short duration (months) and of a temporary nature (for the period of construction and decommissioning and only within a very small distance from the activity), and is therefore considered to be of minor significance (see Table 4.3-11). As the number of OSPs has been reduced from eight to two this will decreases the potential short term effects compared to the MORL ES (2012) assessment.

Increased Anthropogenic Noise (Piling)

4.3.1.54 It is generally accepted that underwater noise associated with piling generates the most noise compared to other construction activities. The level of noise produced is related to blow energies required to pile the foundation, with the required blow energy dependent on a number of factors including pile design and diameter, seabed characteristics and water depth (Diederichs *et al.* 2008). The propagation of noise produced through the water column is also dependent on a number of factors including the depth of the water.

4.3.1.55 Marine mammals are sensitive to increased underwater noise (e.g. Koschinski *et al.,* 2003; Thomsen *et al.,* 2006; Madsen *et al.,* 2006; Skeate *et al.,* 2012; Kastelein *et al.,* 2013). They have good underwater hearing and rely heavily on sound to feed, navigate, and conduct social interactions.

4.3.1.56 Impacts of pile driving noise on marine mammals can be broadly categorised into three effects:

- Lethal Effects and Physical Injury;
- Auditory Injury/PTS onset; and
- Behavioural avoidance/displacement.

4.3.1.57 For the modified OfTI, the proposed infrastructure will include two AC OSPs. A number of foundation types are currently under consideration including jackets and jack ups (platform with jack-up legs) secured with pin piles, which would require piling (see Chapter 2.2: Project Description for more details). The maximum number of piling events envisaged are 32 pin piles for the two OSPs in total at 260 minutes per pile. This is a conservative estimate as it is based on the longest estimated piling duration.

4.3.1.58 The OSPs are predicted to be installed during the overall offshore wind farm turbine installation phase of the three consented wind farms and have therefore been assessed as part of the marine mammal impact assessment MORL ES (2012) Chapter 7.3 (Marine Mammals). Location 2 to the southeastern corner of the three consented wind farms (see Figure 01 in Technical Appendix 7.3 F of MORL ES (2012)) represented the closest location to the offshore export cable route corridor assessed in the MORL ES (2012) and thus the most representative for the proposed OSPs. While it is recognised that for the modified OfTI the OSPs can be located in multiple locations within the EDA, and so closer to the seal haul out sites, this piling will be undertaken within the same periods as that of the wind turbine foundations, as described above, and so has been assessed in this context. Location 2 is still considered to represent an appropriate worst case scenario with regards to proximity to the bottlenose dolphins travelling along the southern Moray Firth coast.

4.3.1.59 Modelling was undertaken for 3 m pin piles in the MORL ES (2012), in which the parameters have remained the same for the modified OfTI. This includes area affected by PTS and behavioural displacement. However, since the consent of the wind farm, the number of OSPs have been reduced from eight to two, which has significantly reduced the piling duration and will therefore likewise reduce the potential piling impact.

4.3.1.60 The OfTI assessed as part of the MORL ES (2012) has been awarded a Marine Licence based on eight OSPs. The new Rochdale envelope now has only two OSPs. As eight OSPs are deemed aceptable (due to being consented), two OSPs have been deemed to be acceptable and have therefore been assessed qualitatively in this assessment.

4.3.1.61 The assessment above indicates that the potential for PTS and displacement effects on minke whale and bottlenose dolphin is low to medium magnitude respectively; for harbour porpoise and grey seal the potential effects have the potential to be low to high magnitude and for harbour seal to be medium to high magnitude effects during the period of piling of OSPs.

4.3.1.62 Given the very short duration (weeks) of the proposed OSP installation, the potential effect of piling two OSPs on all marine mammal species is considered to be of **minor significance**.

Table 4.3-11 Summary of Potential Effects from Piling Noise during OSP Construction on Relevant Marine Mammal Receptors

Species	Predicted Effect
Harbour Seal	Major significance over short duration (piling phase each year) with minor significance for long term effects.
Grey Seal	Major significance over short duration (piling phase each year) with minor significance for long term effects.
Harbour Porpoise	Major significance over short duration (piling phase each year) with minor significance for long term effects.
Bottlenose Dolphin	Moderate significance over short duration (piling phase each year) with minor significance for long term effects.
Minke Whale	Moderate significance over short duration (piling phase) with minor significance for long term effects.

Changes in Prey Availability

4.3.1.63 Sources of anthropogenic noise that may affect marine mammal behaviour may also alter the behaviour of potential prey species (e.g. fish). As for marine mammals, the primary source of such disturbance is predicted to be from piling associated with the installation of the OSPs.

4.3.1.64 Noise modelling (based on a 3 m diameter pile at Location 2 to the southeastern corner of the three consented wind farms; Figure 01 in MORL ES (2012) Technical Appendix 7.3 F) was conducted to predict impact ranges from piling noise associated with the OSPs on key fish species (see Chapter 4.2 (Fish and Shellfish Ecology) of this ES and Chapter 3.6 (Underwater Noise) of MORL ES (2012)). Impact ranges were found to be similar to those derived from the worst case scenarios for the three consented wind farm sites (e.g. 90 dB_{ht} impact range of within 40 km for hearing specialist species, herring).

4.3.1.65 Though the potential impact on prey species is predicted to be up to 40 km for hearing specialists such as herring, the significance of impact is predicted to be minor or no significance for all fish species assessed overall, therefore the potential impact on marine mammals is predicted to be of **low** magnitude.

4.3.1.66 The potential effects from piling noise were predicted to be of minor or no significance for all fish species assessed (Chapter 4.2 (Fish and Shellfish Ecology)).

4.3.1.67 The effects from noise during construction on potential marine mammal prey species within the OfTI area are therefore considered to be of low magnitude of short duration and therefore of **minor significance.**

Increased vessel use - Collision Risk and Barrier to Movement

4.3.1.68 While vessel strikes are a known cause of mortality in marine mammals (Pace *et al.* 2006, Laist *et al*. 2001,) the extent of vessel strike related mortality is likely to be under-recorded (David 2006). A review reported that vessel strikes accounted for between 12 and 47% of reported marine mammal deaths (Carter 2007). Reported collisions between vessels and large whales are generally lethal (Laist *et al.* 2001). However, non-lethal collisions have also been documented in both large and small cetaceans species, based on observations of individuals with injuries or scars characteristic with vessel strikes (Van Waerebeek *et al.* 2007) suggesting that cetaceans can survive such collisions. Most published data regarding collision risk have focused on large whale species (Knowlton and Kraus 2001, Jensen and Silber 2004, Douglas *et al.* 2008, Panigada *et al.* 2006) as injuries to smaller species are less likely to be noticed or reported (International Whaling Commission: http://iwc.int/ship-strikes).

4.3.1.69 Marine mammals will show some degree of habituation to additional vessel movements. Though there will be some response to additional vessel movement associated with the modified OfTI construction, this is likely to be of short duration and restricted due to vessels using a pre-defined vessel corridor, therefore effect magnitude is predicted to be **low**.

4.3.1.70 Based on the Shipping and Navigation Impact Assessment (Chapter 5.2 of this ES), it was concluded that any vessel traffic would be slow moving in a predictable manner (along a predefined corridor). As a result, the effects of increased vessel traffic on marine mammals (of all species) are considered probable in the immediate vicinity of the vessel but, overall, effects would be of low magnitude, short duration, direct and temporary and of **minor significance**, which is consistent with the MORL ES (2012).

Increased Vessel Movement – Ducted Propellers

4.3.1.71 Ducted propellers are propellers with non-rotating nozzles which are encased by a duct or passageway. These are used for the dynamic positioning enabling vessels to maintain their position by repeatedly starting or reversing. This may increase the opportunity for animals to approach and be drawn into propellers (Thompson *et al.,* 2010). Their use has been prevalent in the shipping industry since the 1930s and such propellers are common to a wide range of vessels including tugs, self-propelled barges, rigs, offshore support vessels and research boats.

4.3.1.72 Fatal injuries to seals that are consistent with animals potentially being pulled through ducted propellers have been observed on carcasses washed up in eastern Scotland, along the north Norfolk coast and around Strangford Lough in Northern Ireland (Bexton *et al.,* 2012; Thompson *et al.,* 2013a). Harbour seals appear to be predominantly affected with 88% of carcasses to date identified as this species. The phenomenon is commonly referred to as 'corkscrew seal injury'

4.3.1.73 The JNCC (endorsed by the Statutory Natural Conservation Bodies, SNCBs) has provided advice relating to potential for corkscrew injury and proposed developments as a result of the concerns over the potential for corkscrew injury from the use of ducted propellers, details of which can be found in Table 4.3-12 below. There is currently some commissioned work to investigate potential causes of 'corkscrew seal injury' fatalities, in particular work being undertaken by the Sea Mammal Research Unit (SMRU). However, results are not expected to be available until later in 2014 and are therefore not available for use in this assessment.

Table 4.3-12 JNCC Advice in Relation to Potential for Corkscrew Injury Associated with the Use of Ducted Propellers (from JNCC 2012)

Risk	Activity	Recommendations
High	Activity proposed to take place within 4 nm of a harbour seal SAC and areas where the harbour seal population is in significant decline.	- Consider alternatives to using ducted propellers or, - Avoid the breeding season; and - (If avoiding the breeding season or using alternatives to ducted propellers are not possible then a Seal Corkscrew Injury Monitoring Scheme should be considered).
Medium	Activity proposed to take place between 4 and 30 nm of a harbour seal SAC and not covered above.	- Consider alternatives to using ducted propellers. - Avoid the breeding season if possible.
	Activity proposed to take place within 4 nm of a grey seal SAC.	- Consider alternatives to using ducted propellers. - Avoid the breeding season if possible.
Low	Activity proposed to take place beyond 30 nm distance from a harbour seal SAC.	None
	Activity proposed to take place beyond 4 nm distance from a grey seal SAC.	None

4.3.1.74 The Dornoch Firth and Morrich More SAC is approximately 43 nm away from the proposed land-fall site at Inverboyndie, and therefore seals associated with these haul-out sites are considered to be at low risk from ducted propellers on vessels associated with installing the offshore transmission cables. A smaller number of harbour seals are known to haul-out in the vicinity of Peterhead (SCOS, 2011; Duck *et al.,* 2011), approximately 36 nm away from the modified export cable landfall site, suggesting these individuals are also at a low risk from activities relating to the offshore transmission cables. As a result, the risk to harbour seals from vessels equipped with ducted propellers associated with the installation of the offshore export cables and OSPs is considered to be of **low**.

4.3.1.75 A number of grey seal haul-out sites have been identified around the Fraserburgh area (approximately 20 nm from Inverboyndie) and south towards Cruden Bay (SCOS, 2011; Duck, 2012). Based on the JNCC guidance, grey seals associated with these haul-out sites are considered to be at low risk from ducted propellers on vessels associated with installing the offshore transmission cables and OSPs.

4.3.1.76 As effects are predicted to be of low magnitude, of short duration, direct, permanent and negative should they occur, and following JNCC guidance as detailed in Table 4.3-12 above, overall significance of effect is deemed to be **minor significance**.

Reduction in Foraging Ability (Increased Suspended Sediment)

4.3.1.77 Increased turbidity (suspended sediment) as a result of construction activities could affect foraging or social interactions of marine mammals. Chapter 3.1 Hydrodynamics, Sedimentary and Coastal Processes of this ES discusses the effects construction activities may have on local sedimentary processes.

4.3.1.78 Increased turbidity may disturb and displace mobile marine mammal prey species, however cetaceans do not rely on visual cues to hunt (they use echolocation) and seals are sensitive to hydrodynamic stimuli through their whiskers (Dehnhardt *et al.,* 1998; 2001) rather than relying solely on sight and sound. Due to the natural dispersal of sediments in the marine environment, it is likely that this impact will be localised and of a temporary nature, with fast dispersal of suspended sediments.

4.3.1.79 Throughout the construction phase, several activities such as trenching, dredging and cable-laying may result in an increase of suspended sediments throughout the water column, primarily due to disturbance of the sea bed. This may result in increased turbidity, particularly in habitats located in close proximity to the modified OfTI. Given the footprint of the disturbance expected within the context of the available habitat of the Moray Firth, the magnitude of effect is considered to be **low** and of a short duration.

4.3.1.80 Marine mammals are often recorded foraging in areas where sediment suspension levels are high, such as in estuaries and may in fact target such areas for foraging. It is therefore expected that marine mammals will continue to forage in areas of increased sediment load, relying on sensory cues other than visual ones. Changes in suspended sediment levels are therefore considered unlikely to result in a change in prey availability.

4.3.1.81 Increased suspended sediment concentration is predicted to be of minor significance to mobile fish species (see Chapter 3.1 Hydrodynamics, Sedimentary and Coastal Processes of this ES) and therefore the secondary effects to marine mammals (in the context of effects on prey species) is also considered to be unlikely, of low magnitude, short duration and **negligible significance**, which is less than what was found within MORL ES (2012) due to the reduction in the number of OSPs and construction time.

Toxic Contamination

4.3.1.82 Leaching of compounds (in particular heavy metals) from sacrificial anodes or antifouling paints on OSPs and associated vessels has the potential to contaminate marine mammals and their food supply.

4.3.1.83 Given that such systems are likely to be present on most (if not all) shipping vessels already present within the Moray Firth and taking into account the tidal regime around the consented sites (see MORL ES (2012) Chapter 3.4 (Hydrodynamics – Wave Climate and Tidal Regime), it is not considered there will be any detectable increase in metal concentrations within the Moray Firth should these systems be applied.

4.3.1.84 The change from using DC to AC cabling will have no significance to the above assessment. As a result of the above, effects on marine mammals are considered to be unlikely and **not significant**.

Operation

4.3.1.85 A summary of the consideration of these effects on marine mammals are provided below. For more details on the predicted effects during operation, see MORL ES (2012) Technical Appendix 7.3 A (Marine Mammals Impact Assessment). Publicly available information was reviewed with respect to the potential impacts to marine mammals.

Changes in Prey Availability (Habitat Loss)

4.3.1.86 The effects of habitat loss due to the OfTI are considered very low in the context of fish habitat (see Table 4.3-6 Rochdale Envelope Parameters above) and therefore have not been considered in detail in Chapter 4.2 of this ES (Fish and Shellfish Ecology). As a result, the indirect effects of habitat loss (leading to a reduction in available prey species) upon marine mammals are considered of low magnitude, of long term duration and therefore of **minor significance**, which is in line with findings from the MORL ES (2012).

Increased Vessel Movement - Collision Risk and Ducted Propellers

4.3.1.87 Vessel movement associated with the maintenance programme of the OSPs could also potentially affect marine mammals during the operational phase of the consented developments.

4.3.1.88 The potential impacts from an increase in vessel traffic have been detailed above in section 4.3.2.46 and 4.3.2.59 (construction impacts from increased vessel movement), and have not been reiterated here. In summary, it is likely that marine mammals will show some degree of habituation to existing levels of vessel movement within the wider area, particularly major transit routes where there is a lot of activity. Though some response is possible, habituation is likely to reduce impact level from vessels. Assessment of the potential effects of increased vessel traffic (collisions and behavioural responses) undertaken on marine mammals is combined, rather than being carried out on a species by species basis as, for the purpose of this assessment, as it is considered that individuals of all of the species under discussion are at an equal risk of collision or exhibiting a behavioural response.

4.3.1.89 Marine mammals will show some degree of habituation to additional vessel movements. The number and type of vessels to be utilised in the OSP operation and maintenance is yet to be decided but is unlikely to represent a significant increase in existing vessel activity within the Firth (see Chapter 5.2: Shipping and Navigation of this ES). Though there will be some response to additional vessel movement associated with operation and maitanence, this is likely to be of short duration and restricted due to vessels using a pre-defined vessel corridor, therefore effect magnitude is predicted to be **low**.

4.3.1.90 It is likely that the maintenance of the two OSPs would constitute only a small part of the increase in vessel traffic. Based on JNCC's advice (also endorsed by the SNCBs) relating to potential for corkscrew injury (details of which can be found in Table 4.3-12 above), the effects on marine mammals are predicted to be of low magnitude (for the OSPs) and of **minor significance**, which is in line with findings from the MORL ES (2012).

Electromagnetic Fields

4.3.1.91 The primary effect relating to the export cable during the operational phase of the developments will be from Electromagnetic Fields (EMF) produced by transmission cables.

4.3.1.92 Transmission of electricity through subsea cables (e.g. from offshore wind farms to shore) leads to the generation of both electric (E-fields) and magnetic (B-fields) fields (Gill et al. 2009). The type and strength of the fields produced will depend on the voltage and current which is passing along the cable. Both electric and magnetic fields increase in strength with increasing current or voltage (Portier & Wolfe 1998). The potential effects of these fields on the surrounding environment depends on the type of cable used and its insulation, orientation and configuration.

4.3.1.93 Magnetic fields can induce secondary electric fields (iE-fields) in nearby conductors; the strength of induced (secondary) fields will depend on the distance of the conductor from the cable, the strength of the magnetic field and the speed, direction of flow and chemical composition of the surrounding water. Such iE fields are also dependent on the current within the cable, the rate of change of the AC current, and the orientation and bundling of the cables.

4.3.1.94 Cetaceans are capable of sensing geomagnetism and may use geomagnetic cues as an aid to navigation; however, the importance of these cues and the potential impact on the detection of geomagnetic fields from local cable-induced fields remains unclear (Wiltschko & Wiltschko 2005, Luschi et al. 2007, Gould 2008, Lohmann et al. 2008).

4.3.1.95 A number of live stranding events have been linked with local geomagnetic anomalies or disruptions to normal patterns of daily geomagnetic fluctuations, with fields of less than 50nT having the potential to influence the stranding of some species (Kirschvink et al., 1986; Klinowska, 1990). EMF created by transmission cables at offshore wind farms can be 30-50μT (Hoffman et al. 2000). It is therefore possible that they could affect animals (such as cetaceans and bony fish) which use geomagnetic cues as an aid to navigation (Wiltschko & Wiltschko, 2005; Luschi et al., 2007; Gould, 2008; Lohmann et al., 2008).

4.3.1.96 There is, however, no evidence to date suggesting a change (positive or negative) in marine mammal activity / behaviour relating to magnetic fields from cables associated with offshore wind farms. Harbour porpoises continue to migrate in and out of the Baltic Sea over subsea HVDC cables (Basslink, 2001). It is thought that magnetic fields from cables are likely to be detected by cetaceans as a new, localised addition to the heterogeneous pattern of geomagnetic anomalies in the surrounding area. Gill and Bartlett (2010) concluded that the iE-field will also dissipate to one or two microvolts per meter within a distance of approximately 10m from the 33kV cable.

4.3.1.97 At present there is no indication that seals are sensitive to EMF (Faber, Maunsell and Metoc 2007) and they are not discussed further in this assessment.

4.3.1.98 Where possible, export cables will be buried to a target depth of 1 m. In areas where this is not possible, cables will be protected by a layer of rock or concrete Although unproven, it is considered unlikely that magnetic fields will affect cetaceans and the magnitude is therefore considered to be low, which is in line with findings from the MORL ES (2012).

4.3.1.99 The change from using DC to AC cabling will have no significance to the above assessment. In conclusion, the effects of electromagnetic fields on marine mammals are uncertain, but are considered to be unlikely and of low magnitude and are therefore considered not significant.

Toxic Contamination

4.3.1.100 Leaching of compounds (in particular heavy metals) from sacrificial anodes or antifouling paints on OSPs and associated vessels has the potential to contaminate marine mammals and their food supply.

4.3.1.101 Given that such systems are likely to be present on most (if not all) shipping vessels already present within the Moray Firth and taking into account the tidal regime around the consented sites (see Chapter 3.1 Hydrodynamics, Sedimentary and Coastal Processes of this ES), it is not considered there will be any detectable increase in metal concentrations within the Moray Firth should these systems be applied.

4.3.1.102 As a result of the above, effects on marine mammals are considered to be unlikely and **not significant**.

Decommissioning

4.3.1.103 The decommissioning programme has not yet been finalised, therefore a detailed assessment is not possible at this stage. The decommissioning of the OSPs and export cable may involve the use of cutting tools and / or other methods if appropriate.

4.3.1.104 Current cutting techniques include mechanical and abrasive cutting. No data is available at this time on noise levels produced by cutting mechanisms underwater but it would be expected to be lower or equivalent to the noise levels created during the installation of the OSP foundations and the export cables. There may also be disturbance from vessels associated with the decommissioning but, as with the construction phase, the associated effects are considered to be of low magnitude and therefore considered **not significant**.

Proposed Mitigation

4.3.1.105 The information below summarises mitigation measures proposed to be applied during the different stages of the modified OfTI. The suggested mitigation is consistent with that detailed in MORL ES (2012).

Construction

4.3.1.106 The primary effect on marine mammals during the construction phase of the modified OfTI is predicted to be from piling noise from the installation of the OSP foundations. MORL is working with The Crown Estate and other developers with regards to investigating and developing best practice for mitigation measures that may be implemented to reduce either the level of noise at the source or noise propagation. These investigations have shown that while such mitigation measures (such as bubble curtains and piling sleeves) have been relatively successful in low-tidal regimes such as German waters in depths of 8.5 m, they are either unviable in the deeper, tidal conditions of the Moray Firth (bubble curtains) or at the concept design or early prototype testing stage for deeper water (piling sleeves and other designs), and thus not commercially viable for large scale deployment at present.

4.3.1.107 Existing JNCC guidelines require the presence of a marine mammal observer prior to piling commencing and the instigation of a "soft start" procedure once piling starts. Typically this involves a 30 minute visual watch being conducted prior to all piling operations in parallel with a 30 minute acoustic survey. If a marine mammal is observed (visually or acoustically) within 500 m of the piling vessel during this period, piling is delayed until the animal has moved away from the area (outside of the 500 m buffer) or has not been sighted for 20 minutes.

4.3.1.108 Recent developments in passive acoustic monitoring technology promises to improve the potential to detect cetaceans in low light or poor weather conditions. Similarly, more effective acoustic deterrents are being developed to exclude seals from potential impact areas. It is anticipated that these developments may lead to more effective mitigation procedures within the lifetime of the modified OfTI. The use of alternative approaches will be investigated prior to construction commencing and their use decided upon after consultation with regulatory bodies.

4.3.1.109 Typical response distances from pile driving activity range from 10 m for lethal injury (240 dB) and 60 m for non-auditory physical injury (220 dB) for marine mammal species (see MORL ES (2012) Chapter 3.6 (Underwater Noise)). Given the small radii predicted to cause physical injury to marine mammals, mitigation will focus on ensuring that marine mammals are outside a 500 m buffer zone to reduce such impacts. Once piling begins, the power will be ramped up in stages thus giving the majority of marine mammals inside of this area the opportunity to move away from the area prior to the piling hammer reaching full power (and maximum noise generation).

4.3.1.110 The soft start procedure will involve the ramping up of power over a 20 minute period until the hammer reaches optimal force. This procedure has already been factored into the noise propagation models discussed in MORL ES (2012) (Chapter 3.6 (Underwater Noise)) and utilised within the assessment presented here. Therefore residual effects after the consideration of these mitigation measures have already been included in the impact assessment.

4.3.1.111 The risk to marine mammals of collision with construction vessels is predicted to be negligible and of low significance. Although mitigation is not considered a necessity, the designation of a navigational route for construction vessel traffic will aid marine mammals to predict vessel movement and reduce potential impacts.

4.3.1.112 For the purpose of this assessment it has been assumed that vessels with ducted propellers will be used. JNCC guidance (2012) recommends that no additional mitigation measures are required for activities greater than 30 nm from seal SACs. As the proposed works are at a greater distance than this from the Dornoch Firth and Morrich More SAC for harbour seals, and at least 20nm from grey seal haul-out sites that have been identified around the Fraserburgh area and south towards Cruden Bay, no additional mitigation measures are proposed.

4.3.1.113 As described in Table 4.3-4, the modelling on which the construction and decommissioning assessment is based has been undertaken including the mitigation measures described above.

Operation

4.3.1.114 The risk to marine mammals of collision with operational and maintenance vessels is predicted to be negligible and of low significance. Although mitigation is not considered a necessity, the designation of a navigational route for operation and maintenance vessel traffic will aid marine mammals to predict vessel movement and reduce potential effects.

Decommissioning

4.3.1.115 The decommissioning programme has not yet been finalised and will be dependent on the choice of foundation structure, therefore a detailed mitigation proposal is not possible at this stage. The most likely scenario would involve the use of cutting equipment and is predicted to be of low to medium magnitude of effect to marine mammals. Once the decommission programme has been decided upon, a review of mitigation requirements will be undertaken and instigated as required based on the best available procedures at the time.

Residual Effects

4.3.1.116 Much of the mitigation and management measures described above are standard procedure for such developments. For example, the use of a soft start procedure has already been incorporated into the noise modelling. The marine mammal observer / PAM survey (and subsequent soft start) is designed to ensure that no marine mammals are within a certain radius of the piling event thus reducing the potential for physical injury. This has already been incorporated into the impact assessments and so residual effects are the same.

4.3.1.117 The use of designated navigational routes, although primarily a management tool, will also help reduce risks to marine mammals from collision and is therefore an indirect form of mitigation. This has already been incorporated into the impact assessments present here and therefore included residual effects are the same. The assessment of effects of piling incorporates a series of conservative assumptions about the potential impacts of this noise on marine mammals. If all the assumptions detailed in Table 7.3-11 of Chapter 7.3 Marine Mammals (MORL ES (2012)), are confirmed, the assessments presented above are assessed as likely significant effects.

4.3.3 Cumulative Impact Assessment

4.3.1.118 This section presents the results of assessment of the potential significant cumulative effects upon marine mammals arising from the OfTI in conjunction with other existing or reasonably foreseeable marine and coastal developments and activities. MORL's approach to the assessment of cumulative impacts is described in MORL ES (2012) Chapter 1.3 (Environmental Impact Assessment). It should be noted Marine Licences together with Section 36 consents have now been granted for the three MORL windfarms and the BOWL wind farm. The CIA presented below updates the effects of the assessments presented in support of these licence applications but does not change the conclusion of the original assessments.

Summary of Effects

4.3.1.119 The cumulative effects on marine mammals that have been assessed are:

- Increased anthropogenic noise from piling activities;
- Changes in prey availability;
- Increased vessels use – collision risk; and
- Increased vessel use – ducted propellers.

4.3.1.120 The following activities / effects have not been considered within this cumulative assessment as their potential effects were considered not significant in assessment for the modified OfTI:

- Risk of stranding from EMF generated by transmission cables;
- Long term avoidance resulting from the presence of offshore structures; and
- Prey contamination due to toxic (heavy metal) contamination from use of sacrificial anodes and antifouling paints.

4.3.1.121 The receptors identified for consideration in this cumulative impact assessment are as detailed above under section 4.3.1 Baseline Information.

Summary of Residual Effects and Mitigation

4.3.1.122 Temporary, significant effects on marine mammal receptors from piling noise are predicted during the construction phases of the MORL and BOWL wind farm projects with associated OfTI, but no cumulative long term population level effects are predicted. No other significant cumulative effects are predicted.

4.3.1.123 No additional mitigation measures to those outlined in section 4.3.2 are proposed.

4.3.1.124 A summary of the potential cumulative effects is provided in Table 4.3-13.

Table 4.3-13 Cumulative Impact Summary

Effect/Receptor	Residual Significance Level for Modified TI	Whole Project Assessment: Modified TI + Stevenson, Telford and MacColl	Mitigation Method
Construction & Decomissioning			
Harbour Seal (increased anthropogenic noise from piling activities, changes in prey , increased vessel use – collision risk and ducted propellers)	No significant long term effect	No significant long term effects	None additional to those detailed in MORL ES (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Major significance over medium term for individuals during construction phase with minor significance in the long term at the population level for all construction scenarios modelled.		
Grey Seal (increased anthropogenic noise from piling activities, changes in prey , increased vessel use – collision risk and ducted propellers)	No significant long term effect	No significant long term effects	None additional to those detailed in MORL (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.

Effect/Receptor	Residual Significance Level for Modified TI	Whole Project Assessment: Modified TI + Stevenson, Telford and MacColl	Mitigation Method
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Major significance over medium term for individuals during construction phase with minor significance in the long term at the population level for all construction scenarios modelled.		
Harbour Porpoise (increased anthropogenic noise from piling activities, changes in prey , increased vessel use – collision risk and ducted propellers)	No significant long term effect	No significant long term effects	None additional to those detailed in MORL (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Major significance over medium term for individuals during construction phase with minor significance in the long term at the population level for all construction scenarios modelled.		
Bottlenose Dolphin (increased anthropogenic noise from piling activities, changes in prey , increased vessel use – collision risk and ducted propellers)	No significant long term effect	No significant long term effects	None additional to those detailed in MORL (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Medium significance over medium term for individuals during construction phase with minor significance in the long term at the population level for all construction scenarios modelled.		
Minke Whale (increased anthropogenic noise from piling activities, changes in prey , increased vessel use – collision risk and ducted propellers)	No significant long term effect	No significant long term effects	None additional to those detailed in MORL (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Major significance over medium term for individuals during construction phase with minor significance in the long term at the population level for all construction scenarios modelled.		
Operation			
Harbour Seal (reduction in prey availability, increased vessel usage – collision risk and ducted propellers)	No significant long term effect	Minor significance	None additional to those detailed in MORL (2012) Chaptes 7.3 (Marine Mammals) and section 4.3.2.
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Low magnitude, long term duration and minor significance		
Grey Seal (reduction in prey availability, ducted propellers)	No significant long term effect	Minor significance	None additional to those detailed in MORL (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.

Effect/Receptor	Residual Significance Level for Modified TI	Whole Project Assessment: Modified TI + Stevenson, Telford and MacColl	Mitigation Method
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Low magnitude, long term duration and minor significance		
Harbour Porpoise (reduction in prey availability, ducted propellers)	No significant long term effect	Minor significance	None additional to those detailed in MORL (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Low magnitude, long term duration and minor significance		
Bottlenose Dolphin (reduction in prey availability, ducted propellers)	No significant long term effect	Minor significance	None additional to those detailed in MORL (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Low magnitude, long term duration and minor significance		
Minke Whale (reduction in prey availability, ducted propellers)	No significant long term effect	Minor significance	None additional to those detailed in MORL (2012) Chapter 7.3 (Marine Mammals) and section 4.3.2.
Total Cumulative Impact Assessment ***(Whole project plus those developments listed in Section 4.3.3.11)***	Low magnitude, long term duration and minor significance		

Assessment of Cumulative Effects

4.3.1.125 The geographical scope of the cumulative assessment is principally focused on the Moray Firth area. It is, however, recognised that some mobile species may spend varying periods of time outside the Moray Firth and, as a result, there is potential for these to be affected by other activities / developments further afield.

Projects Assessed

Whole Project Assessment

4.3.1.126 A whole project assessment has been done for the likely significant cumulative effects of the modified TI in conjunction with the three consented wind farms (Telford, Stevenson and MacColl).

4.3.1.127 MORL has been consented with a reduced size of 186 turbines and the MORL OfTI has been modified from that initially assessed reducing the number of OSP's from eight to two.

Other Developments

4.3.1.128 The following developments were considered in the total cumulative impact assessment for the whole Project:

- MORL Western Development Area (WDA);
- BOWL wind farm and associated OfTI;
- Forth & Tay Offshore windfarms;
- Meygen Tidal Stream Project;
- Ports & harbours within the Moray Firth (Nigg, Invergordon, Ardersier);
- Oil and Gas activity;
- MOD activities;
- Aberdeen harbour; and
- European offshore wind deployment centre.

Western Development Area (WDA)

4.3.1.129 There are no significant geographical variations in the density of key marine mammal receptors (harbour seal, grey seal, harbour porpoise, bottlenose dolphin and minke whale) between the area of the three consented wind farms and the WDA (Baseline Information section 4.3.1).

4.3.1.130 The connection between the WDA and the three consented wind farms necessitates a slightly different approach to assessment, as the effects arising from the "worst case" for the modified Project cannot simply be added to the "worst case" scenario for the WDA. The potential capacity of the WDA (500 MW) when added to the consented capacity of the three MORL consented wind farms (1,116 MW) exceeds the overall target capacity of the MORL Zone (1,500 MW). It is not proposed that the target capacity for the MORL Zone will be exceeded. 500MW represents the maximum development on the WDA, but in the event that MORL successfully constructs in excess of 1,000 MW in the three consented wind farm sites then the development in the WDA will be restricted accordingly to ensure the MORL Zone capacity is not exceeded.

4.3.1.131 This restriction of the total capacity of the MORL Zone means that the effects from development in the three consented wind farms and WDA combined will be restricted also. In the MORL ES, effects were assessed on the basis of a potential capacity of 1,500 MW (3 x 500 MW) from the three MORL consented wind farms alone. So the predicted effects of a 1500MW offshore wind farm within the MORL Zone have been assessed and reported in the MORL ES. Where it is considered relevant and can be justified on the basis that conditions across the Zone are consistent, the conclusions from that assessment have been assumed in this ES to be representative of the effects of the three MORL consented wind farms and the WDA combined.

BOWL wind farm and Associated OfTI

4.3.1.132 A detailed cumulative assessment was undertaken with the BOWL site and OfTI. BOWL has been consented with a reduced size, of 125 turbines as per consents conditions for but with the potential for up to 140 turbines (see summary of worst case scerario Rochdale Envelope parameters assessed for BOWL in Table 4.3-16 below).

Firth of Forth and Tay Offshore Wind Farm Projects

4.3.1.133 The proposed Firth of Forth and Tay offshore wind projects (Neart na Gaoithe, SeaGreen (Alpha and Bravo) and Inch Cape offshore wind farms) have the potential for cumulative impact with the construction of the OfTI through cumulative impacts from piling (see Table 4.3-14 below).

Table 4.3-14 Details of Firth of Forth and Tay offshore wind farm projects included in the cumulative impact assessment

Renewable project	Details
Neart na Gaoithe offshore wind farm	Proposed scheme of up to 450 MW at Neart na Gaoithe, within the Firth of Forth, for which a Marine Licence Application was submitted within Quarter two 2012. Onshore Planning consent was received in June 2013 and the offshore windfarm is expected to reach financial close in 2014. Offshore consent is expected in 2014 with construction starting in 2015.
Firth of Forth offshore wind farm (Seagreen offshore wind farm)	Up to three phases of development within the Round 3 Zone outside the 12 nm boundary within the Firth of Forth and Tay. The offshore application for Phase 1 totaling 1,050 MW (Project Alpha and Bravo) was submitted in September 2012 but an addendum was submitted in October 2013. Consent is expected during 2014 and construction has been described in the ES to commence in the 4th quarter of 2015. Onshore application was submitted in June 2013 and was granted in November 2013.
Inch Cape offshore wind farm	Proposed wind farm with grid connection agreement for 1,050 MW at Inch Cape which is scheduled to begin construction in 2016. Consent application was submitted in July 2013, and consent is expected during 2014.

4.3.1.134 At the time of the MORL ES assessment (MORL, 2012), insufficent information on the Firth of Forth and Tay Projects was available to enable a meaningful assessment. However, all three projects now have active Marine Licence applications, and sufficent information is avaiable to update the cummulative assessment.

4.3.1.135 Marine Scotland have confirmed that they, and SNH and JNCC, agree with the conclusion of the cumulative population level impact assessment undertaken for bottlenose dolphin by Inch Cape Offshore Ltd, in support of the Inch Cape Project (Inch Cape ES, 2013). This assessment considered the cumulative impact on the east coast population of the construction timelines of BOWL, MORL, Inch Cape, Neart na Gaoithe and the Firth of Forth Alpha and Bravo Projects. The assessment concluded that the impact was minor in the long term (Appendix 14B, Inch Cape ES, 2013). No further assessment has therefore been undertaken for bottlenose dolphin in relation to Firth of Forth and Tay projects. A cumulative assessment on harbour porpoise, harbour and grey seals and minke whale is presented below.

Meygen Tidal Stream Project

4.3.1.136 The MeyGen tidal stream project covers an area of 3.5 km^2 in the channel between the island of Stroma and the north-eastern tip of the Scottish mainland. The Agreement for Lease is for 398 MW of installed capacity and will be consented in two separate phases. Phase 1 will involve the installation of up to 86 tidal turbines, with a maximum capacity of 86 MW.

4.3.1.137 The appropriate assessment (Scottish Government 2014c) carried out by Marine Scotland concluded that there will be no long term significant effects on the Moray Firth SAC and Dornoch Firth and Morrich Moore SAC. In addition, the impact assessment concluded that less than 10% of the harbour seal population will encounter the turbines annually, and no regional effects to grey seal populations are excpected (Meygen ES 2012).

Ports and Harbours within the Moray Firth

Ardersier Port

4.3.1.138 Port Ardersier has been given consent for onshore works by the Highland council and is still awaiting a decision from the Scottish government and regulators Marine Scotland and Transport Scotland for the offshore elements. Piling is considered to have potential cumulative impacts with the MORL OfTI works. However, piling is expected to take approximately two to three months. Therefore, due to the short duration of the piling from the ports construction works the impact is considered minor in the long term.

Nigg Port

4.3.1.139 The consented development will comprise of an extension to the south quayside harbour and berthing facilities at the Nigg Yard. Piling is considered to have the potential for cumulative impacts with the modified OfTI. Piling works are to be completed in one phase between October 2013 to April 2014 as stated in their ES (Nigg, 2013). Therefore, as construction is completed Nigg Energy Park has not been assessed.

Invergordon Service Base

4.3.1.140 The environmental statement and application was submitted to Marine Scotland for the new berth. Consultation period for the application ended on the 30th May 2014. Construction will be carried out in three stages and is projected to start in the spring / summer of 2014. The three stages of construction include: berth construction (including piling), containment bund and reclamation of laydown area.

4.3.1.141 The proposed development has the potential for cumulative impact with the construction of the modified OfTI through cumulative impacts from piling. Piling will be used to support the berth and moorings, which may utilise percussion piling initially to pile through the infill material after which it is suggested that vibro-piling will be used. Pile diameter has been proposed to be 914 mm in diameter with 90 vertical piles 65 m long and 16 raked piles of 68.5 m long. Piling has been estimated to take approximately 18 weeks.

4.3.1.142 The appropriate assessment (Scottish Government 2014b) conducted has concluded that there will be no significant long term effects on the the Moray Firth SAC and Donrnoch Firth and Morrich More SAC. In addition, due to the short term duration of construction and the expected construction finish date by 2015 piling is unlikely to occur during the construction works of the modified OfTI it is therefore considered that the impact will be minor in the long term.

Oil and Gas Activity

4.3.1.143 License blocks acquired by Suncor are within the modified boundaries of the modified OfTI. Suncor are known to be planning geophysical surveys in block 12/27 (see Figure 5.7-2) in 2014 and an installation of a well in 2015. Existing oil platforms in the Moray Firth include the Beatrice and Jacky oil platforms. Beatrice and Jacky oil platforms are located to the north-west of the development area. Access to these platforms does not pass through the eastern development area.

Other developments

- MoD activities - The Royal Air Force (RAF) use part of the outer Moray Firth as practice areas. Activities include flying, gunnery and subsurface exercises.
- Aberdeen harbour - Port upgrades (~£24 million) for the infrastructure and port facilities in 2012. Nigg Bay expansion project. Wildlife surveys to commence in second quarter of 2014.
- European offshore wind deployment centre - Proposed demonstrator site comprising 11 turbines. Consent was granted in March 2013. Offshore construction to be commenced.

Methodology

4.3.1.144 The detailed assessment process for cumulative impacts of projects within the Moray Firth has used noise propagation and impact analysis to quantify the potential risks of physical injury and displacement due to piling noise associated with the installation of the OfTI OSPs, MORL and BOWL offshore wind farms, and has used population modelling to assess the potential long term effects on harbour seal and bottlenose dolphin.

4.3.1.145 The assessment methodology has followed that outlined in the Moray Firth Offshore Wind Developers Group Discussion Document (ERM, 2011; see Technical Appendix 1.3 D of MORL ES, 2012).

4.3.1.146 A summary of the methodologies used within this assessment can be found in MORL ES (2012) Chapter 7.3 (Marine Mammals). A full review of likely significant effects on marine mammals and the methodologies used can be found in the following technical appendices (MORL ES 2012):

- Technical Appendix 7.3 A (Marine Mammals: Environmental Impact Assessment);
- Technical Appendix 7.3 B (Framework for assessing the impacts of pile-driving noise from offshore wind farm construction on Moray Firth harbour seal populations);
- Technical Appendix 7.3 C (SAFESIMM impact assessment for seals and cetaceans);
- Technical Appendix 7.3 D (A comparison of behavioural responses by harbour porpoise and bottlenose dolphins to noise: Implication for wind farm noise assessments);
- Technical Appendix 7.3 E (Identification of appropriate noise exposure criteria for assessing auditory injury for Pinnipeds using offshore wind farm sites);
- Technical Appendix 7.3 F (Noise propagation and SAFESIMM model outputs for marine mammal risk assessment);
- Technical Appendix 7.3 G (Habitat Regulations Appraisal: Marine Mammals - Two SAC's listing marine mammals as qualifying features can be found within the Moray Firth. For the purpose of Appropriate Assessment, an appraisal under the Habitats Regulation is presented within is appendix); and
- Technical Appendix 7.3 H (EPS Assessment: Supplementary Information - All cetaceans present within the Moray Firth are European Protected Species (EPS). MORL recognises that an EPS license is likely to be required for construction related disturbance to cetaceans. A preliminary assessment is presented, which will be revised once construction parameters have been finalised).

4.3.1.147 Additional supporting information on underwater noise modelling activities can be found in Chapter 3.6: Underwater Noise and Technical Appendix 3.6 A (Underwater Noise Technical Report) (MORL ES 2012).

4.3.1.148 Data was shared between MORL and BOWL to allow for a detailed cumulative assessment (including construction scenarios and predicted blow energy profiles to drive pin piles used in noise modelling).

Worst Case Scenario for Projects within the Moray Firth

4.3.1.149 A summary of the worst case parameters of wind farm design for the three MORL wind farms and the BOWL project, in terms of marine mammals and as modelled for the original impact assessment, is provided in Table 4.3-15 and 4.3-16 respectively. However as stated above in section 4.3.3.10 and 4.3.3.15, this provides a highly conservative worst case as overall number of turbines have reduced for both projects in addition to a reduction in MORL's OSPs associated with the modified OfTI. Results presented are therefore a conservative worst case.

Table 4.3-15 Summary of MORL worst case parameters

Worst Case Parameters	**Scenario Assessed**		
Construction Noise			
Installation 339 turbines (186 turbines consented)	Four pin piles (2.5 m diameter) per foundation		
Max, number of simultaneous piling events	Two		
Predicted blow energy profile as being required to drive a 2.5 m diameter pin into the soils of the MORL site	**Impact Energy (kJ)**	**No of blows**	**Time**
	170	260	15 mins
	450	2,400	45 mins
	890	1,000	15 mins
	1,080	7,000	2 hrs
	170	260	15 mins
Increased Suspended Sediment Concentration and Sediment re-Deposition			
Installation 339 turbines (186 turbines consented)	Drilling to facilitate pin pile installation and seabed preparation for installation of gravity bases. Inter array cable and export cable burial by energetic means.		
Loss of Habitat and Introduction of New Habitat			
Installation 339 turbines (186 turbines consented)	Use of tubular jackets and gravity bases		

Table 4.3-16 Summary of BOWL Worst Case Parameters

Worst case Parameters	Scenario Assessed		
Construction Noise			
Installation of 277 turbines (125 turbines consented as per conditions but with the potential for up to 140 turbines)	Four pin piles (2.4 m diameter) per foundation		
Max, number of simultaneous piling events	Two		
Predicted blow energy profile provided by BOWL as being required to drive a 2.4 m diameter pin into the soils of the BOWL site	**Impact Energy (kJ)**	**No of blows**	**Time**
	280	1,200	20 mins
	920	3,700	1 hr
	1,380	3,700	1 hr
	1,840	3,700	1 hr
	2,300	3,700	1 hr
Increased Suspended Sediment Concentration and Sediment re-Deposition			
Installation of 277 turbines (125 turbines consented as per conditions but with the potential for up to 140 turbines)	Drilling to facilitate pin pile installation and seabed preparation for installation of gravity bases. Inter array cable and export cable burial by energetic means.		
Loss of Habitat and Introduction of New Habitat			
Installation of 277 turbines (125 turbines consented as per conditions but with the potential for up to 140 turbines)	Use of tubular jackets and gravity bases		

Cumulative Assessment

Increased Anthropogenic Noise from Piling Activities

4.3.1.150 It is considered possible that increased levels of underwater noise from construction, operation and decommissioning activities may result in a combined impact on marine mammals with implications for levels of disturbance.

4.3.1.151 The use of the SPEAR model presented in MORL ES (2012) Chapters 7.3 (Marine Mammals) and in the 'Increased Anthropogenic Noise (Non-Piling Activities) section above has provided evidence that the greatest source of noise during the construction period will be from impact piling. The INSPIRE noise propagation modelling discussed in Chapter 7.3, and explained in detail in Technical Appendix 7.3 A (MORL, 2012), was extended to include the additional wind farm foundation piling activities of the now consented BOWL Project. For the purposes of this assessment, the installation of the three OSPs within the BOWL Rochdale Envelope are considered to occur within the construction period and footprint of the offshore generation station, and thus are included within the effects assessed with MORL ES (2012) Technical Appendix 7.3 A (Marine Mammals Environmental Impact Assessment).

4.3.1.152 As with the three consented wind farms of Telford, Stevenson and MacColl, jackets with pin piles are considered to be the worst case foundation technology within the BOWL Rochdale Envelope with regards impacts upon marine mammals (Table 4.3-16). The details of the noise propagation modelling undertaken are provided within Chapter 3.6 and Technical Appendix 3.6 A (Underwater Noise) (MORL, 2012). The outputs were used to predict the number of individuals of the key marine mammal species within the Moray Firth which fell within the criteria for PTS onset or could be displaced due to noise related disturbance (see Technical Appendices 7.3 A: Marine Mammals Environmental Impact Assessment and 7.3 B: Framework for assessing the impacts of pile-driving noise from offshore wind farm construction on Moray Firth Harbour Seal populations of the MORL ES, 2012 for full methodology).

4.3.1.153 Details of the inherent conservatism that is purposefully adopted in the assessment methodology can be found in Table 7.3-11 in Chapter 7.3 (MORL ES, 2012). A number of cumulative scenarios were assessed in the MORL ES (ES). The numerical outputs from the modelling process of Scenario E are presented in Table 4.3-17 below. This senario assumes a three year build out programme for BOWL and a five year build out programme for the three MORL wind farms with a year of overlap in which both sites are under construction. The years in the Table were those used in the MORL ES, 2012. The construction years are used in this cumulative assessment as indicative duration of construction activities only. The figures in brackets within the table represent the number of individuals expressed as a percentage of the Moray Firth populations or SCANS II Block J for minke whales[1]. The seal PTS values were modelled using 186 dB SELs and cetaceans using 198 dB SELs. The number of individual harbour seals and bottlenose dolphins estimated to experience displacement and PTS were then used in population modelling, the results of which are presented within Plates 4.3-2 and 4.3-3 below (see Technical Appendices 7.3 A and 7.3 B of the MORL ES (2012) for full details on both methodologies).

Table 4.3-17 Predicted Number of Individuals (and Percentage of Population Size) Affected by Piling Noise Each Year of Construction for Each Project

Scenario E - BOWL, overlapping for one year with MORL, followed by MORL[2]					
	Harbour Seal	**Grey Seal**	**Harbour Porpoise**	**Bottlenose Dolphin**	**Minke Whale**
PTS					
2014 to 2015 (BOWL)	168.6 (14.6 %)	236.5 (7.5 %)	8.2 (0.1 %)	0.07 (< 0.1 %)	35.4 (2.4 %)
2016 to 2016 (BOWL + MORL)	210.1 (18.1 %)	300 (9.5 %)	11.5 (0.2 %)	0.1 (0.1 %)	24.2 (1.7 %)
2017 to 2020 (MORL)	120.9 (10.4 %)	170 (5.4 %)	6.4 (0.1 %)	0.06 (<0.1 %)	12.3 (0.8 %)
Behavioural Displacement Each Year for the Total Spread of the Construction Vessels (Best Fit)					

[1] The details of these population estimates for each species can be found in Chapter 4.4 (Marine Mammals) of the MORL ES, 2012. The population of minke whales potentially subject to the effects of the Project construction phase was taken to be 1,462, based upon SCANS II model estimates for block J (which includes the Moray Firth)

[2] The years in this table were those used in the MORL ES, 2012, based on the construction programme information available at the time. Since then the indicative construction programmes for MORL and BOWL have been revised (please see current indicative construction programme for MORL in Chapter 2.2 of this ES). The construction years are used in this cumulative assessment as indicative duration of construction activities only.

Scenario E - BOWL, overlapping for one year with MORL, followed by MORL[2]					
2014 to 2015 (BOWL)	582 (49.2 %)	966 (26.9 %)	3,191 (52.2 %)	19 (9.6 %)	177 (12.1 %)
2016 to 2016 (BOWL + MORL)	609 (51.4 %)	995 (27.7 %)	3,312 (54.1 %)	21 (10.7 %)	179 (12.2 %)
2017 to 2020 (MORL)	522 (44.1 %)	739 (20.5 %)	2,933 (47.9 %)	17 (8.9 %)	168 (11.5 %)

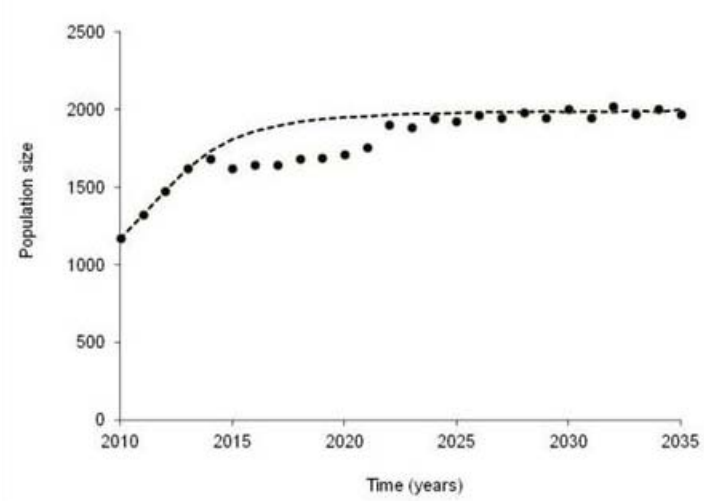

Plate 4.3-2 **Scenario E (BOWL, overlapping for one year with MORL, followed by MORL) - Population modelling for the harbour seal population in the Moray Firth. Data based on 186 dB SAFESIMM model outputs. The dashed line indicates the baseline trend, while the circles indicate the impact scenario on the population.**

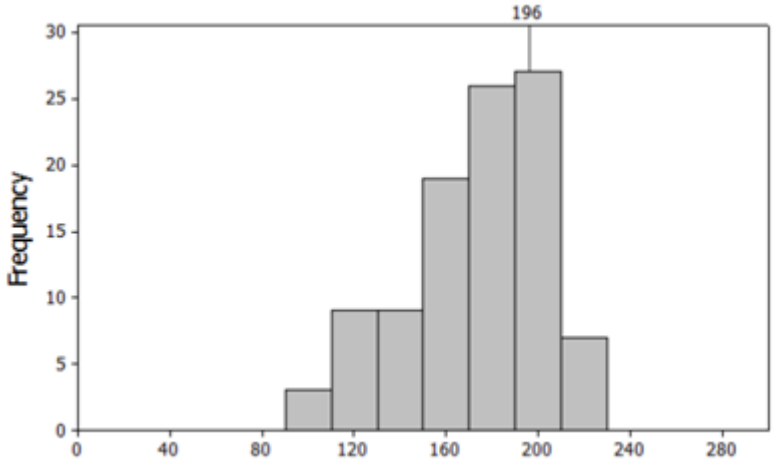

Plate 4.3-3 **Scenario E - Population Modelling for the Bottlenose Dolphin Population in the Moray Firth. Data Based on 198 dB SAFESIMM Model Outputs. Figures Represent the Frequency Distribution of Predicted Population Size after 25 Years**

4.3.1.154 The potential significance on receptor species is detailed below in Table 4.3-18.

Table 4.3-18 Summary of potential effects of piling noise during construction on relevant marine mammal receptors using precautionary modelling criteria

	Scenario E (BOWL, overlapping for one year with MORL, followed by MORL)
Harbour Seal	
Predicted Effect	Major significance over medium term for individuals during construction phase with minor significance long term effects on the population.
Grey seal	
Predicted Effect	Major significance over medium term for individuals during construction phase with minor significance long term effects on the population.
Harbour Porpoise	
Predicted Effect	Major significance over medium term for individuals during construction phase with minor significance long term effects on the population.
Bottlenose Dolphin	
Predicted Effect	Medium significance over medium term for individuals during construction phase, with minor significance for long term effects on the population level.
Minke Whale	
Predicted Effect	Major significance over medium term for individuals during construction phase with minor significance long term effects on the population.

4.3.1.155 It can be seen from Table 4.3-17 that the increase in simultaneous piling activity between the three consented MORL wind farms and the BOWL wind farm leads to an increase in modelled noise related displacement and the potential for individual animals to experience PTS.

4.3.1.156 The levels of displacement below were modelled on the intial pre-consented wind farm number of turbines, OSPs and cable route. However, the now consented wind farms have a reduced maximum number of turbines (now 186 turbines and two OSPs for MORL and 125 turbines but with the potential for up to 140 turbines for BOWL). This will reduce potential impacts from piling from those modelled and consented.

Harbour Seals

4.3.1.157 As discussed in Baseline Information section 4.3.1, results from harbour seals tagged at Moray Firth haul-out sites demonstrate that they remain in the area when foraging.

4.3.1.158 Population modelling undertaken for the original number of piles and OSPs demonstrated no significant long term population level impact. Therefore a reduced number of piles associated with both the OSPs and the wind farms will have lower level of potential impact, therefore no significant long term population level impact is predicted.

4.3.1.159 Displaced seals are likely to use alternative foraging areas within the Moray Firth where there are lower levels of disturbance. As seen during periods of natural changes in prey availability, these changes may also lead to temporary changes in the use of different Moray Firth haul-out sites (Thompson *et al.,* 1996). Harbour seals are not expected to be displaced to areas outside of the Moray Firth, and so would not suffer cumulative impact with projects occurring within the Firths of Forth and Tay or Pentland Firth and Orkney waters.

Grey Seals

4.3.1.160 Grey seals will travel over much larger areas than harbour seals, with tracking studies showing that many of the grey seals tracked within the Moray Firth originated from haul-out sites further afield. A number of the seals tracked within the Moray Firth were tagged on the Isle of May, confirming connectivity between the Moray Firth and the Firths of Forth and Tay.

4.3.1.161 Construction activities for the wind farms of the Firths of Tay and Forth are predicted to coincide with those of the Moray Firth over the period of 2014 to 2020. Precautionary modelling conducted for the MORL ES (2012) predicts that between 20.5 to 27.7 % of grey seals currently using the Moray Firth may be displaced from the area during construction, depending on the phase of the construction scenario E. Tracking studies demonstrate that should foraging areas close to piling events become less preferable to grey seals, they are capable of travelling to alternative areas. The large foraging range of this species will ensure that feeding areas outside of the noise influence from construction of the Firth of Forth and Tay, and Pentland Firth and Orkney waters should the construction phases of these projects coincide, is likely. Grey seals are therefore not expected to suffer cumulative impact with projects occurring within the areas of Firth and Forth and Tay, or Pentland Firth and Orkney waters.

Harbour Porpoise

4.3.1.162 Using the most conservative assumptions, between 47.9 to 54.1 % of harbour porpoise within the Moray Firth may be displaced during the piling activities within the Moray Firth. Harbour porpoise exhibit widespread distributions and are not tied to specific feeding or breeding grounds within the Moray Firth or elsewhere in the North Sea or North Atlantic. A population structure workshop held in 2007 under the aegis of the Agreement on the Conservation of Small Cetaceans of the Baltic, North-East Atlantic, Irish and North Seas (ASCOBANS) and the Helsinki Commission (HELCOM) concluded that there was some population structure within the North Sea, but the evidence was insufficient to define boundaries between any (sub-) populations at the time (ASCOBANS, 2009). Consequently, for the purposes of conservation, harbour porpoise in the North Sea are considered to represent a single population.

4.3.1.163 Relatively large numbers of harbour porpoise may be displaced from the Moray Firth and, from analysis of the ESs of the submitted Firth of Forth and Tay Projects are likely to include at least some piling, it can be assumed that significant numbers may be displaced from the Forth and Tay due to piling associated with developments. Although the local effects from piling will be significant on this species in the areas surrounding specific construction activities, the generalised distribution of this species suggests that the cumulative effects across such a wide area will be relatively low and that alternative foraging areas in the North Sea for harbour porpoises are likely to be available.

Bottlenose Dolphins

4.3.1.164 The most precautionary models discussed within the MORL ES (2012) predict that between 8.9 to 10.7 % of the population could be disturbed within the Moray Firth as a result of piling noise. Predicted noise levels within those parts of the Moray Firth frequented by bottlenose dolphins are not expected to be sufficient to exclude animals from these areas. Nevertheless, the coastal nature of this population suggests that should piling lead to some individuals moving outside the Moray Firth, they could be further exposed to piling activities along the eastern coast, in particular in the Forth and Tay region. Piling activities at Aberdeen are predicted to be short in duration and completed prior to construction activities beginning at either the three MORL consented wind farm sites, BOWL, or in the Forth and Tay region. Population Viability Analysis (PVA) carried out for the Inch Cape Project to assess cumulative impacts on bottlenose dolphin predict that there will be no significant long term impact on bottlenose dolphin utilising the east coast of Scotland. Marine Scotland (and SNH and JNCC) have confirmed that they accept the Inch Cape cumulative impact assessment.

Minke Whale

4.3.1.165 Using the precautionary fit, between 11.5 to 12.2% of minke whales of the reference population could be displaced during the piling activities. As with harbour porpoise, minke whales exhibit generalised distributions throughout the North Sea or North Atlantic. It is unclear whether minke whales in UK waters move slightly offshore during the winter months or migrate further afield. If population differentiation between North Atlantic minke whales from different regions exists, it seems present only at low levels (Árnason & Spilliaert, 1991; Daníelsdóttir *et al.,* 1992; Bakke *et al.,* 1996; Martinez & Pastene, 1999; Andersen *et al.,* 2003; Anderwald *et al.,* 2011). Sightings within the Moray Firth are most common between April and September, as has been reported for other areas (see MORL ES (2012) Technical Appendix 4.4 A (Baseline Marine Mammals)).

4.3.1.166 The impact assessments for the Forth and Tay offshore wind projects (Neart na Gaoithe, Firth of Forth and Inch Cape) are available. Although the local effects from piling may be significant in the medium term on this species in the areas surrounding specific construction activities, the generalised distribution of this species suggests that the cumulative effects across such a wide area of coastline will be minimal and that alternative areas in the northeast Atlantic for minke whales to forage are likely to be extensive. If all the assumptions detailed in Table 7.3-11 (Chapter 7.3: Marine Mammals) of the MORL ES (2012) are confirmed, the assessments presented above are assessed as likely significant effects.

Changes in Prey Availability

4.3.1.167 The potential for impact from changes in prey availabilty are presented above and have not been re-iterated here.

4.3.1.168 Noise modelling was conducted to predict impact ranges from piling noise produced by the MORL and BOWL projects simultaneously on key fish species (see MORL ES (2012) Chapters 14.2 (Fish and Shellfish Ecology) and 3.6 (Underwater Noise)).

4.3.1.169 Impact ranges were found to be similar to those derived from the worst case scenarios for the three MORL wind farm sites alone suggesting limited cumulative effects with the BOWL development and other projects. Cumulative effects of noise are therefore considered to be of **low** magnitude.

4.3.1.170 The indirect cumulative effects from changes in prey availability on potential marine mammal prey species are therefore considered to be of low magnitude, for a medium duration, negative and therefore of **minor significance**.

Increased Vessel Movement - Collision Risk and Barrier to Movement

4.3.1.171 There are no significant changes in the assessment of the three consented wind farms plus the modified OfTI on its own when considered cumulatively with the WDA with regards increased collision risk from vessels. Projects out with the Moray Firth are considered to be sufficiently distant not to constitute a potential cumulative impact. There are no significant changes in the assessment of the three consented wind farms plus the modified OfTI on its own when considered cumulatively with the WDA and BOWL.

4.3.1.172 Therefore no additional cumulative impact due to OfTI construction, decommissioning or operation is predicted and is therefore considered to be of **minor significance**.

Increased Vessel Use – Ducted Propellers

4.3.1.173 Section 4.3.2.49 to 4.3.2.54 outlines the concerns regarding ducted propellers and guidance from the JNCC for potential corkscrew injuries. The modified OfTI is greater than 30 nm away from the Dornoch Firth SAC.

4.3.1.174 Vessels use pre-defined corridors for movement to and from port, thereby moving in a predictable manner and maximising predictability and detection by marine mammals.

4.3.1.175 Following JNCC guidance (Table 4.3-12) cumulative impacts with projects listed in section 4.3.3.11 associated with OfTI works are deemed to be of low risk (over 30 nm from a harbour seal SAC and over 4 nm from a grey seal SAC). The impact is therefore considered to be of low magnitude.

4.3.1.176 Considering the uncertainty over the mechanism of the potential injury, and the low magnitude considered in the context of cumulative vessel activities, the impact of ducted propellers is considered to be uncertain, of low magnitude, a direct negative impact, but non-reversible should it occur, and therefore of **minor significance**.

Habitats Regulations Appraisal

4.3.1.177 No changes to the conclusions of the HRA as presented in Chapter 10, section 10.3.9 (OfTI HRA assessment) of the MORL ES (2012) are predicted. The piling locations for the OSPs are within the Rochdale Envelope assessed within the original ES (MORL ES, 2012), and the only change that could result from the modification to the OfTI route is that of the proximity of cable landing point to seal haul-outs and bottlenose dolphin feeding/transit habitat. The cable landing point remains out with the 30 nm and 4 nm for harbour seals and grey seals respectively, as outlined in Table 4.3-12, and the assessment against potential disturbance to bottlenose dolphin remains as described in the MORL ES (2012). Therefore the MORL Appropriate Assessment which has stated this development will not adversely affect the integrity of any SAC (Scottish Government, 2014) should be referred to.

4.3.4 References

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4 Biological Environment

4.2 Fish and Shellfish Ecology

4.2.1 Baseline Information

Introduction

4.2.1.1 This report summarises the ecology and distribution of fish and shellfish, including salmon and sea trout in the areas relevant to the modified Offshore Transmission Infrastructure (modified OfTI) for the three consented wind farms, Telford, Stevenson and MacColl, (further detail provided in Technical Appendix 4.2 A, Fish and Shellfish Ecology, and Technical Appendix 4.2 B, Salmon and Sea Trout).

4.2.1.2 An impact assessment evaluating the potential effects of the modified OfTI on fish and shellfish receptors during the construction, operation and decommissioning phases has taken account of guidance provided in the National Policy Statement (NPS) for Renewable Energy Infrastructure (EN-3): Offshore Wind Farm Impacts –Fish Cumulative impacts potentially arising from other offshore renewable developments and other marine activities are also considered.

Consultations

4.2.1.3 Consultation undertaken to date is listed in Table 4.2-1.

Table 4.2-1 Consultation Responses

Organisation	Consultation Response	MORL Approach
JNCC	Scoping opinion response: River Spey SAC is the most relevant river SAC in the vicinity of the modified OfTI. The following impacts need to be assessed: • Smothering effects/ suspended sediment (particularly less mobile fish and shellfish species); • Habitat loss; and • EMFs. Full scoping consultations provided in Chapter 1.3.	River Spey baseline in Appendix 4.2 B: salmon & sea trout technical report. Suspended sediment, habitat loss and EMFs assessed in Impact Assessment section.
Marine Scotland Science (MSS)	Scoping opinion response: Sandeels- there may be localised disturbance and suspended sedimentation, but should be limited due to sediments involved. Herring- avoid works during the herring spawning period if possible (August to September). Cod- cod survey data should be used to inform this process. Full scoping consultations provided in Chapter 1.3	Effects of suspended sediment on Herring and cod in Impact Assessment section.

Organisation	Consultation Response	MORL Approach
MSS Fish Lab	Scoping opinion response: Landfall is now likely to be on Inverboyndie Bay (immediately to the west of the Deveron). Large numbers of salmon and sea trout may be present at times and suitable precautions need to be considered. Consultation is required with the Deveron and Spey District Salmon Fishery Boards. Full scoping consultations provided in Chapter 1.3	Deveron and Spey Salmon & Fishery boards have commented on the fishery summaries in the salmon & sea trout technical report (Technical Appendix 4.2 B).
Spey District Salmon Fishery Board	Provided comment on the Salmon and Sea Trout technical report and supplied updated catch and release figures for the Spey.	Information incorporated within section 4.3 of salmon & sea trout technical report (Technical Appendix 4.2 B).
Deveron District Salmon fishery board	Provided further information regarding increased coastal fixed engine catches in the river Deveron district.	Information incorporated within Section 4.3 of salmon & sea trout technical report (Technical Appendix 4.2 B).
MSS	Add chart to show value of commercial fisheries. Include units for all parameters. Consider inter-array cables for changes to fishing activity.	Landings weights are included in Section 1.6 of Fish & Shellfish ecology technical report (Technical Appendix 4.2 A). Value of commercial fisheries is described in detail within Commercial Fisheries technical appendix (Technical Appendix 4.2 A).

Baseline Characteristics

Fish and Shellfish Ecology

4.2.1.4 The modified Offshore Transmission Infrastructure (modified OfTI) is located within the Moray Firth. The principle study area used for this assessment has been defined by the ICES rectangles within which the modified OfTI is located (45E7 and 44E7) and is shown in Figure 4.2-1. Rivers designated as Special Areas of Conservation (SACs) in the Moray Firth and the wider area are also shown.

4.2.1.5 In addition to site specific fish and shellfish characterisation surveys, characterisation of the existing environment (i.e. the fish and shellfish ecological baseline) has been undertaken using data sources listed below. These data sources are subject to certain sensitivities and limitations, which are described in more detail in Technical Appendix 4.2 A, Fish and Shellfish Ecology Technical Report.

4.2.1.6 A detailed overview of the fish and shellfish distribution in the vicinity of the modified OfTI is provided in Technical Appendix 4.2 A, Fish and Shellfish Ecology Technical Report and Technical Appendix 4.2 B: Salmon and Sea Trout Ecology and Fisheries.

4.2.1.7 The Moray Firth supports a number of commercially targeted fish and shellfish species. The principal shellfish and cephalopod species landed are *Nephrops* (*Nephrops norvegicus*), scallops (*Pecten maximus*) and squid (*Loligo spp.*). With respect to fish, haddock (*Melanogrammus aeglefinus*), herring (*Clupea harengus*), whiting (*Merlangius merlangus*), monkfish/ anglerfish (*Lophius spp.*), mackerel (*Scomber scombrus*) and cod (*Gadus morhua*) constitute the majority of landings. The relative importance of each of these species to the total landings weights varies depending on the ICES rectangle under consideration.

4.2.1.8 Scallops landings weights are particularly high in rectangle 45E7, representing almost 50% of the total. In ICES rectangle 44E7 *Nephrops* and squid account for higher

proportions of total average value. In both rectangles constituting the modified OfTI study area, haddock represents a considerably higher proportion of total landings than all other fish species. Landings weights for anglerfish, cod and herring are comparatively low. A full description of landings weights of species relevant to the modified OfTI is provided in Technical Appendix 4.2 A: Fish and Shellfish Technical Report.

Spawning and Nursery Grounds

4.2.1.9 The modified OfTI falls within, or is in close proximity to, the spawning and nursery grounds of a number of species (Coull *et al*., 1998; *Ellis et al*., 2010). Sandeel (Ammodytidae), *Nephrops*, cod, plaice (*Pleuronectes platessa*), lemon sole (*Micrstomus kit*), sprat (*Sprattus sprattus*) and whiting spawning grounds have all been defined within the vicinity of the modified OfTI. The modified OfTI does not however cross the spawning grounds of either the Orkney/Shetland or the Buchan herring stocks (the two stocks known to have spawning grounds in the vicinity of the Moray Firth).

4.2.1.10 A review of the species identified as having spawning and nursery grounds in the general area of the modified OfTI is given in the following sections. Charts and more detailed information are provided in Technical Appendix 4.2 A: Fish and Shellfish Technical Report (Section 1.7).

Sandeels

4.2.1.11 The Moray Firth is part of the Central Western North Sea sandeel sub-stock (ICES, 2009). Sandeels have a prolonged dormant overwintering period (September to March) during which they are buried (Winslade, 1974b; Wright & Bailey, 1993). Spawning occurs during December and January (Gauld & Hutcheon, 1990; Bergstad *et al*., 2001). Females lay demersal eggs which hatch during February and March (Macer, 1965; Langham, 1971; Wright & Bailey, 1996). Following spawning, overwintering resumes until April which marks the start of an extended period of pelagic feeding through spring and summer (Winslade, 1974b; Van der Kooij *et al*., 2008). The modified OfTI is located in high intensity spawning grounds and a low intensity nursery ground for sandeels (Ellis *et al*., 2010a) (Figure 3.4 of Technical Appendix 4.2 A: Fish and Shellfish Ecology).

4.2.1.12 Sandeels are highly substrate specific preferring a high proportion of medium and coarse sands (particle size 0.25 to <2 mm) with low silt content (Holland *et al*., 2005) as they create temporary burrows and ventilate their gills with interstitial water. The presence of fine particles of silt rich sediments potentially clogs the gills and inhibits respiration.

4.2.1.13 In light of the highly specific habitat requirements of sandeels they are likely to occupy discrete 'patches' within the Moray Firth and the area occupied by the modified OfTI.

Nephrops

4.2.1.14 Nephrops only leave their burrows when feeding and searching for a mate (Barreto & Bailey, 2013). In Scottish waters, spawning occurs from August to November (Howard 1989; Barreto & Bailey, 2013). Following fertilisation females incubate the eggs exogenously under the abdomen ('berried') for 8-9 months until they hatch as pelagic larvae from late April to August (Howard, 1989). Berried females remain in the burrow throughout the incubation period. Post hatch larval stages develop in the plankton before settling to the seabed six to eight weeks later as juveniles (Barreto & Bailey, 2013). The juveniles then enter burrows, remaining there for approximately one year (Howard, 1989).

4.2.1.15 Nephrops distribution is dependent upon the availability of substrates composed of fine cohesive mud within which they can construct burrows. The proposed location

of the modified OfTI falls within the Nephrops spawning and nursery grounds defined by Coull *et al*. (1998). Based on the presence of significant fisheries in those ICES rectangles occupied by the modified OfTI, (particularly 44E7) and the presence of suitable habitats (muddy sand and sandy mud) in central areas of its offshore route, it is likely that spawning and nursery grounds could occur in these locations (Figure 3.5 of Technical Appendix 4.2 A: Fish and Shellfish Ecology).

Herring

4.2.1.16 North Sea herring is divided into four sub-stocks on the basis of areas used for spawning. The sub-stocks most relevant to the modified OfTI are the Orkney-Shetland stock and the Buchan stock. The Orkney-Shetland stock spawns off the Scottish east coast and in Shetland/Orkney waters and the Buchan stock spawns outside the Moray Firth off Fraserburgh and south as far as the Firth of Forth. Spawning of both sub-stocks occurs between August and September (Coull *et al*., 1998; Barreto & Bailey, 2013) and shoals of herring arrive at traditional spawning grounds in a series of waves (Lambert, 1987).

4.2.1.17 Herring are demersal spawners prefering coarse grounds and high energy environments (Parrish *et al*., 1959; Maucorps, 1969; de Groot, 1980; Blaxter, 1985, Munro *et al*., 1998; Barreto & Bailey, 2013). Females deposit sticky eggs in single batches directly onto the seabed in areas of coarse sand, gravel, small stones or rocks (Hodgson, 1957; Munro *et al*., 1998; Barreto & Bailey, 2013). Areas of suitable spawning habitat constitute a small proportion of the area covered by the modified OfTI and are located within the northern and southern sections of the corridor.

4.2.1.18 Herring larvae hatch after approximately three weeks, depending on sea temperature (Maucorps, 1969; Hodgson, 1957; Munro *et al*., 1998; Barreto & Bailey, 2013). Hatched larvae measure between 7-10 mm and depend on their yolk-sac until first feeding (Hodgson, 1957; ICES, 2013).

4.2.1.19 The modified OfTI does not pass through spawning grounds of either the Orkney-Shetland or Buchan herring stocks (Coull *et al*., 1998) but is located within high intensity nursery grounds as defined by Ellis *et al*. (2010a). Maximum juvenile catch rates were highest west of the central section of the modified OfTI (Figure 3.6 of Technical Appendix 4.2 A: Fish and Shellfish Ecology).

Cod

4.2.1.20 The cod population of the Moray Firth is genetically distinct from other North Sea populations (Hutchinson *et al*., 2001) with spawning occurring between January and April, (Coull *et al*., 1998; ICES, 2005a). Eggs remain pelagic hatching over a period of two to three weeks, dependant on water temperature (Wright *et al*., 2003).

4.2.1.21 The proposed location of the modified OfTI falls within a low intensity cod spawning area (Figure 3.10 of fish and shellfish technical report). The Moray Firth has been defined as a high intensity nursery ground for cod with significant numbers of eggs found off the Moray Firth and to the east of the Shetland Islands (Fox *et al*., 2008) with cod eggs and larvae being passively transported from Shetland (Heath & Gallego, 1997).

4.2.1.22 Potentially significant impacts on spawning cod were identified as a result of piling noise associated with the installation of the Offshore Generating Stations in the EIA submitted as part of the Environmental Statement (ES) detailing the Telford, Stevenson and MacColl offshore wind farms in August 2012 (Chapter 7.2 – Fish and Shellfish Ecology, MORL (2012)). In consultation with MSS, MORL committed to undertake additional survey work and monitoring with the objective of increasing the confidence in the impact assessment and identifying whether further mitigation would be required.

Plaice

4.2.1.23 The modified OfTI crosses a small area to the northwest and an area to the south of the plaice spawning grounds defined by Coull *et al*. (1998). The area occupied by the modified OfTI has also been identified as a low intensity nursery ground (Figure 3.13 of Technical Appendix 4.2 A: Fish and Shellfish Ecology).

4.2.1.24 Plaice spawn between December and March with a peak usually occurring in February/March (Simpson, 1959; Harding *et al*., 1978; Rijnsdorp, 1989). Plaice are pelagic spawners and rarely spawn beyond the 50 m depth contour (Harding *et al*., 1978; Rijnsdorp, 1989; Armstrong *et al*., 2001; Murua & Saborido-Rey, 2003). Females spawn over a period of 4-6 weeks (Rijnsdorp, 1989).

4.2.1.25 The results of the North Sea egg survey (2004) showed that plaice eggs displayed a patchy distribution with higher abundances in the areas of Flamborough Head, the Firth of Forth, and the Moray Firth and to the east of the Shetland Isles (ICES, 2005b).

Lemon Sole

4.2.1.26 Lemon sole is widely distributed throughout the North Sea including in the vicinity of the modified OfTI and is thought to spawn where it is found (Rogers & Stocks, 2001). Spawning occurs from April until September (Coull *et al*., 1998) (Figure 3.14 of Technical Appendix 4.2 A: Fish and Shellfish Ecology).

Sprat

4.2.1.27 The modified OfTI falls within sprat spawning and nursery grounds defined by Coull *et al*. (1998) (Figure 3.15 of fish and shellfish technical report). The spawning grounds of sprat are widely distributed around the British Isles with spawning taking place from May to August (Coull *et al*., 1998), peaking in May to early July (Kraus & Köster, 2001). Females spawn repeatedly in batches throughout the spawning season (Milligan, 1986). Eggs and larvae of sprat are pelagic and subject to larval drift, often moving into coastal nursery areas within which the modified OfTI is situated (Nissling *et al*., 2003; Hinrichsen *et al*., 2005).

Haddock

4.2.1.28 The modified OfTI does not overlap with haddock spawning grounds as defined by Coull *et al*. (1998) although a more recent publication (Barreto & Bailey, 2013) shows that spawning occurs in an additional location to the east of the Moray Firth some distance away from the location of the modified OfTI. The modified OfTI does however fall within the haddock nursery grounds as defined by Coull *et al*. (1998) (Figure 3.16 of Techincal Appendix 4.2 A: Fish and Shellfish Ecology).

4.2.1.29 Results of international ichthyoplankton surveys found high concentrations of haddock stage I eggs in and off the Moray Firth (ICES, 2005b). The highest densities of mature and spawning haddock are found in depths of around 100 m and in areas of mud or sand (Gibb *et al*., 2004).

4.2.1.30 Haddock spawn between February and May (Coull *et al*., 1998) peaking in March and April (Coull *et al*., 1998; Fillina *et al*., 2009). Haddock release their eggs in batches over the spawning season (Gibb *et al*., 2004; Fillina *et al*., 2009). Haddock eggs are laid demersally and rise into the water column following fertilisation and develop into pelagic larvae (Page & Frank, 1989). Haddock produce a wide range of sounds (Wahlberg & Westerberg, 2005) bringing male and female fish together. It could also play a role in synchronising the reproductive behaviour of males and females (Hawkins & Amorim, 2000)

Whiting

4.2.1.31 The modified OfTI occupies a small area of low intensity whiting spawning ground and high intensity nursery ground by (Ellis *et al*. 2010a; Figure 3.17 of Technical Appendix 4.2 A: Fish and Shellfish Ecology). Whiting spawn between February and

June with females releasing their eggs in numerous batches (Teal *et al*., 2009). Eggs are pelagic and take about ten days to hatch (Russel, 1976).

Other Species

4.2.1.32 Low intensity nursery grounds have been defined in the vicinity of the modified OfTI for anglerfish, blue whiting (Micromesistius poutassou), hake (Merluccius merluccius), saithe (Pollachius virens), mackerel (Scomber scombrus), thornback ray (Raja clavata), spurdog (Squalus acanthias), spotted ray (Raja montagui) and tope (Galeorhinus galeus) as defined by Coull *et al*. (1998) and Ellis *et al*. (2010a) (Figure 3.18 and Figure 3.19 of Technical Appendix 4.2 A: Fish and Shellfish Ecology).

Key Species in the Food-web

4.2.1.33 Abundant species with high biomass such as sandeels and clupeids (e.g. herring and sprat) play an important functional role in North Sea food web dynamics occupying intermediate trophic levels, operating as significant predators of zooplankton and represent a key dietary component for a variety of aquatic and terrestrial predators including seals (Phoca spp.), harbour porpoise (Phocoena phocoena), minke whales (Balaenoptera acutorostrata) and seabirds (Wright & Bailey, 1993; Wanless *et al*., 1998; Furness, 1999; Wanless *et al*., 1999; Olsen & Holst, 2001; Wood, 2001; Santos and Pierce, 2003; Pierce *et al*., 2004; Santos *et al*., 2004; Wanless *et al*., 2005).

Species of Conservation Importance

4.2.1.34 A number of species of conservation importance have been identified as potentially present in the Moray Firth and the wider area including diadromous species migratory species, elasmobranchs and a number of commercially targeted fish species.

4.2.1.35 Diadromous migratory species potentially present in the vicinity of the modified OfTI include European eel (Anguilla Anguilla), allis and twaite shad (Alosa alosa, Alosa fallax), sea and river lamprey (Lampetra fluviatilis, Petromyzon marinus), smelt (Osmerus osperlangus), salmon (Salmo salar) and sea trout (Salmo trutta).

4.2.1.36 Elasmobranchs have a low stock resilience to fishing mortality due to slow growth rates (Smith *et al*., 1998).

4.2.1.37 A number of other fish species, which are commercially exploited, with conservation status may be present in the area of the modified OfTI. These include anglerfish, mackerel, cod, herring and sandeel.

Salmon and Sea Trout

4.2.1.38 Atlantic salmon and sea trout are anadromous migratory species of the family Salmonidae. Anadromous species spend a significant proportion of their life history in marine habitats and migrate to freshwater to spawn, which, in Scotland, occurs in the upper reaches of rivers during late autumn and winter.

4.2.1.39 Before entering the ocean, salmon spend one to five years in their natal river, going through different stages of development. At the end of this period, they undergo 'smolting', a process of physiological and morphological changes which prepare for ocean entry (McCormick *et al*., 1998), which happens through late March to June.

4.2.1.40 Time spent feeding at sea varies within and among salmon populations. A distinction is to be made between adults which spend only a year at sea prior to spawning ('grilse') and those spending multiple years at sea (known as 'multi- sea- winter' (MSW) salmon). In recent years a decrease in the proportion of MSW fish in the annual run has been observed (Aprahamian *et al*., 2008; Environment Agency & Cefas, 2011) associated with a change in run timing from spring-summer to summer –

autumn (Gough *et al.*, 1992; Milner *et al.*, 2000; Aprahamian *et al.*, 2008). A full description of the life cycle of Atlantic salmon is provided in Technical Appendix 4.2 B: Salmon and Sea Trout Ecology and Fisheries (Section 3.2).

4.2.1.41 The life cycle of sea trout is generally similar to salmon. Their marine migration is shorter however and the post spawning survival rates are higher (Gargan *et al.*, 2004). More detailed information on sea trout ecology is provided in Technical Appendix 4.2 B: Salmon and Sea Trout Ecology and Fisheries (Section 3.2)

Fisheries

4.2.1.42 Salmon and sea trout are an important part of Scotland's natural and cultural heritage and support commercial and recreational fisheries which are of significant importance to the Scottish economy.

4.2.1.43 Fisheries statistics show that salmon and grilse account for the majority of the catch in all salmon fishery districts within the vicinity of the modified OfTI, with the exception of the Lossie, where sea trout is the principal species caught. Catches from the Spey and Deveron districts contribute the two highest proportions to the total salmon and sea trout catch from all Moray Firth Districts (32.7% and 13.5%, respectively).

4.2.1.44 The principal fishing method in the vicinity of the modified OfTI is rod-and-line and is the only method used in a number of districts, including the Spey. Fisheries statistics show that the proportion of fish released exceeds that retained in most Moray Firth districts. Netting by both fixed engines (fixed nets set close to the coast) and net-and-coble (a method of encircling salmonids where the net is paid out from a small boat) occurs to a lesser extent and is now only practiced in six of the 15 districts for which data are provided.

4.2.1.45 Statistics showing annual variation in fishing effort illustrate that net and coble effort (max number of crew) has been variable between 2004 and 2013. Effort in the Ness has declined severely from 11 in 2004 to one in 2014, whereas effort in the Conon has remained relatively stable at between four and seven per year. Effort in the Kyle of Sutherland had declined to zero in 2012 but has increased again in 2013.

4.2.1.46 Fixed engine effort (maximum number of traps) in the Halladale and Kyle of Sutherland has remained stable from 2008 to 2013, whereas effort in the Deveron has changed dramatically, increasing from zero in 2004 - 2011 to an average of 33.5 in 2013. Effort in the Strathy has shown a general decline from 30 in 2004 to 20 in 2013.

4.2.1.47 More detailed information and charts on salmon and sea trout fisheries can be found in section 4.2 of Technical Appendix 4.2 B: Salmon and Sea Trout Ecology and Fisheries.

The Spey

4.2.1.48 Rod-and-line is now the only method currently used in the Spey district. There is a voluntary catch and release conservation policy in place which has delivered increasing release rates. In 2013, 88% of salmon and 76% of sea trout were released (Consultation, 2014a).

4.2.1.49 The salmon rod-and-line fishery runs from 11th February to the 30th September (Consultation Meeting, 2011). Overall, statistics on seasonal variations show that the highest total catches in the district (all species) are recorded from June to August followed by May and September.

4.2.1.50 Salmon are principally caught from May to September although March and April record relatively high salmon catches reflecting the diversity of salmon stock components in the river. Grilse catches are highest in July and August.

4.2.1.51 The highest sea trout catches are recorded in June and July with low numbers in the earlier months of the season.

The Deveron

4.2.1.52 The Deveron is primarily a salmon river although sea trout are important during the summer months (Consultation with Deveron DSFB, 2011). From 1991 to 2012 rod and line was the only method used in this district. Although the majority of the netting rights were bought out in 1991, two redundant netting stations have recently been purchased by USAN Fisheries Ltd and are now active (see Salmon and Sea Trout Technical Report, Technical Appendix 4.2 B).

4.2.1.53 Total combined catches (salmon, grilse, and sea trout) from the commercial stations for the past two years were 1,233 (in 2012) and 2,254 (in 2013). Catches of salmon in this fishery are considerably greater than sea trout.

4.2.1.54 The seasonality of the rod-and-line catch show that the period from August to October records the highest total catches (all species combined). Sea trout are caught in highest numbers in June and July. Grilse catches peak in August, although July, September and October also record relatively high numbers. Salmon are caught throughout the season with higher catches recorded in September and October.

4.2.1.55 The salmon and sea trout rod-and-line season is open from 11th February to 31st October (Consultation with Deveron DSFB, 2011). All salmon and grilse must be released up to the end of May whereas after the 1st June one male salmon or grilse under 10 lbs can be kept per day with a maximum of two fish per rod per week. In the case of sea trout all must be released throughout the season (pers. comm. Deveron Salmon Fisheries Board, 2014).

Site Specific Surveys

4.2.1.56 Potentially significant effects on spawning cod as a result of piling noise associated with the installation of the three consented wind farms were identified. This was submitted as part of the Environmental Statement (ES) detailing the Telford, Stevenson and MacColl Offshore Wind Farms in August 2012 (Chapter 7.2 – Fish and Shellfish Ecology, MORL (2012)).

4.2.1.57 The impact assessment in the MORL ES (MORL, 2012) took a precautionary approach, where conservative assumptions were applied due to the uncertainty regarding how cod may utilise the Moray Firth area. In consultation with MSS, MORL committed to undertake additional survey work and monitoring with the objective of increasing the confidence in the impact assessment and identifying whether further mitigation would be required. A cod spawning survey was therefore undertaken in 2013, sampling spawning cod numbers at 58 stations within and in the vicinity of the three consented wind farms (Appendix 1 of Technical Appendix 4.2 A: Salmon and Sea Trout Ecology and Fisheries).

4.2.1.58 Cod were recorded in low numbers at 35 out of 58 stations with a maximum of nine individuals caught at a single station (0T38, Trip B). A total of 23 spawning cod were caught throughout the survey, 12 in Trip A and 11 in Trip B. Further detail is provided in Appendix 1 (Cod Survey Report) of Technical Appendix 4.2 A: Fish and Shellfish Ecology.

Legislative and Planning Framework

4.2.1.59 As the modified OfTI is within Scottish waters, guidance is followed from Marine Scotland, responsible for consenting offshore generating stations in Scottish waters under section 36 of the Electricity Act 1989 and for issuing associated Marine Licences under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009. In addition, the following documents have provided guidance:

- Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume I: Environmental Report (Marine Scotland, 2010);
- Habitats Regulations Appraisal of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Appropriate Assessment Information Review (Marine Scotland, 2011);
- CEFAS Guidance Note for Environmental Impact Assessment in Respect of the FEPA and CPA Requirements (CEFAS 2004);
- OSPAR guidance on environmental considerations for offshore wind farm development (OSPAR, 2008);
- Institute for Ecology and Environmental Management (IEEM) Guidelines for Ecological Impact Assessment (IEEM, 2010); and
- Habitats Regulations: Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007.

4.2.2 Impact Assessment

Summary of Effects and Mitigation

4.2.2.1 The likely effects considered for assessment on fish and shellfish resources are as follows:

- Temporary disturbance of the seabed (increased suspended sediment concentrations (SSCs) and sediment re-deposition);
- Habitat loss;
- Underwater noise;
- Electromagnetic fields (EMFs); and
- Changes to fishing activity.

4.2.2.2 In the absence of detailed methodologies and schedules, the worst case scenarios for decommissioning activities and associated implications for fish and shellfish are considered analogous with those assessed for the construction phase.

Summary of Effects

4.2.2.3 Assessed impacts for the modified OfTI remain consistent with those previously assessed for the original OfTI described in detail within Chapter 7.2: Fish and Shellfish Ecology of the MORL ES (MORL, 2012).

4.2.2.4 No significant effects (e.g. above minor) have been identified on fish and shellfish ecology as a result of the construction/decommissioning phase of the modified OfTI. However, as discussed in the MORL ES (MORL, 2012) in Chapter 3.6, Underwater Noise, soft start piling will be used when constructing the two OSPs to enable mobile species to move away from the area of highest noise impact.

4.2.2.5 Similarly, no significant effects (e.g. above minor) have been identified on fish and shellfish receptors for the operational phase of the modified OfTI. As described in the assessment of EMFs, cable burial will reduce exposure of electromagnetically sensitive species to the strongest EMFs (OSPAR, 2008). Similarly, where burial is not feasible, cable protection will ensure that fish and shellfish receptors are not in direct contact with the cable, thus preventing exposure to the strongest EMFs. It is assumed that where cables are buried at depths greater than 1.5 m below the sea bed, effects of EMF on fish and shellfish species are likely to be negligible (DECC, 2008).

Proposed Mitigation Measures and Residual Effects

4.2.2.6 Mitigation measures further to those described above are not deemed necessary.

4.2.2.7 A summary of the pre and post mitigation impact assessment on fish and shellfish ecology is given in Table 4.2-2.

Table 4.2-2 Impact Assessment Summary

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
Construction & Decommissioning				
Underwater disturbance to the seabed (Increased SSCs and sediment re-deposition)	Adult and Juvenile Fish and Shellfish	Negative Minor Unlikely	None	Negative Minor Unlikely
	Diadromous Species	Negative Minor Unlikely (general) Probable (salmon and sea trout)	None	Negative Minor Unlikely (general) Probable (salmon and sea trout)
	Fish and shellfish which lay eggs on the seabed (herring, sandeels and squid)	Negative Minor Unlikely	None	Negative Minor Unlikely
Habitat Loss	Species of limited mobility	Negative Not significant Unlikely	None	Negative Not significant Unlikely
Noise	Plaice	Negative Not significant Probable	Soft start piling	Negative Not significant Probable
	Salmon and sea trout	Negative Minor Probable	Soft start piling	Negative Minor Probable
	Cod	Negative Minor Probable	Soft start piling	Negative Minor Probable

Effect	Receptor	Pre-mitigation Effect	Mitigation	Post-mitigation Effect
	Whiting	Negative Minor Probable	Soft start piling	Negative Minor Probable
	Herring	Negative Minor Probable	Soft start piling	Negative Minor Probable
	Larvae and Glass Eels	Negative Minor Probable	None	Negative Minor Probable
	Shellfish	Negative Minor Probable	Soft start piling	Negative Minor Probabale
Operation				
EMFs	Elasmobranchs	Negative Minor Probable	Cable burial/protection	Negative Minor Probable
	River and Sea Lamprey	Negative Minor Unlikely	Cable burial/protection	Negative Minor Unlikely
	European eel	Negative Minor Probable	Cable burial/protection	Negative Minor Probable
	Salmon and Sea trout	Negative Minor Probable	Cable burial/protection	Negative Minor Probable
	Other fish Species	Negative Minor Unlikely	Cable burial/protection	Negative Minor Unlikely
	Shellfish Species	Negative Minor Unlikely	Cable burial/protection	Negative Minor Unlikely
Changes to Fishing Activity	General (All)	Negative Not significant Unlikely	None	Negative Not significant Unlikely

Introduction to Impact Assessment

4.2.2.8 The following sections describe the assessment of likely significant effects of the construction, operation and decommissioning phases of the modified OfTI on fish and shellfish species. For the purposes of this assessment, the following modified OfTI elements have been considered:

- Two Alternating Current (AC) Offshore Substation Platforms (OSPs);
- 70 km of 220 kV HVAC cable for inter-platform cables and cabling up to the boundary of the three consented wind farms; and
- Up to four export 220kv cables of 52 km in length from the southern boundary of the three consented wind farms.

4.2.2.9 The precise location of the OSPs has not yet been defined, but they will be located within the boundaries of the three consented wind farm sites. The following Chapters and Appendices support this Chapter:

- Fish and Shellfish Ecology Technical Report (Technical Appendix 4.2 A);
- Salmon and Sea Trout Ecology and Fisheries Technical Report (Technical Appendix 4.2 B);
- Cod Survey Results (Appendix 1 of Fish and Shellfish Technical Report, Technical Appendix 4.2 A);
- Electromagnetic Fields Modelling (Appendix 4.3 D, MORL ES (MORL, 2012));
- Commercial Fisheries (Chapter 5.1);
- Hydrodynamics, Sedimentary and Coastal Processes (Chapter 3.1);
- Benthic Ecology (Chapter 4.1); and
- Underwater Noise (Chapter 3.6 MORL ES, 2012).

Details of Impact Assessment

4.2.2.10 Fish and shellfish species could be affected in different ways, depending on how they utilise the area of the modified OfTI, their ecology and the life stage under consideration (i.e. migratory species and degree of mobility).

4.2.2.11 As described in this chapter and in Technical Appendix 4.2 A: Fish and Shellfish Ecology Technical Report, a number of species are known to spawn and have nursery areas within the Moray Firth, including areas where the modified OfTI is located. Sandeels and herring lay their eggs on the seabed and may therefore be particularly sensitive to the effects of seabed disturbance. In addition, sandeels, herring and sprat are important prey species in the area for other fish species, marine mammals and seabirds.

4.2.2.12 Migratory diadromous species of conservation importance, particularly salmon and sea trout, European eel and river and sea lamprey, may transit the area of the modified OfTI during migration and in some cases (particularly sea trout) as part of their foraging activity (Technical Appendix 4.2 B: Salmon and Sea Trout Ecology Technical Report).

4.2.2.13 In addition, shellfish species of commercial importance (Nephrops, scallops, squid, edible crab, lobster and whelks) and elasmobranchs are also present at varying degrees in the area. The likely effects derived from the

construction/decommissioning and operational phases of the modified OfTI considered for assessment on fish and shellfish ecology are as follows:

- Temporary disturbance to the seabed (increased SSCs and Sediment re-desposition);
- Habitat loss:
- Underwater noise;
- Electromagnetic fields (EMFs); and
- Changes to fishing activity.

4.2.2.14 Effects have been separately assessed for the construction/decommissioning phases and the operational phase in terms of modified OfTI site specific effects. For the purposes of this assessment and in the absence of detailed methodologies and schedules, the worst case scenarios for decommissioning activities and associated implications for fish and shellfish are considered to be no worse than that assessed for the construction phase. Cumulative effects arising from other marine developments are discussed within section 4.2.3 of this chapter.

Rochdale Envelope Parameters Considered in the Assessment

4.2.2.15 The worst realistic case scenario for the effects of the modified OfTI on fish and shellfish ecology has identified the engineering design parameters which may result in the greatest effect upon fish and shellfish species.

4.2.2.16 In general terms, it is considered that the installation of the maximum number of cables and OSPs constitutes the worst case scenario, as this would result in the greatest footprint, duration and frequency of modified OfTI installation operations.

4.2.2.17 A summary of the worst case scenarios defined for the assessment of effects on fish and shellfish ecology is given in Table 4.2-3.

Table 4.2-3 Rochdale Envelope Parameters Relevant to the Fish and Shellfish Ecology Impact Assessment

Potential Effect	Rochdale Envelope Scenario Assessed
Construction & Decommissioning	
Temporary disturbance to seabed (increased suspended sediment concentrations and sediment re-deposition)	Up to 6-legged Jacket foundations (suction caissons): Max. number of OSPs: 2 AC Max. number of suction caissons per OSP: 4 Max. suction caisson diameter: 20 m Drilling to facilitate pin pile installation: Pile diameter: 3 m Cable installation by energetic means (i.e. jetting): Inter-platform cable installation: 220kV AC Max. number of trenches: 1 Target trench depth: 1 m Trench affected width per trench: 6 m Max. interplatform cabling length: 70 km of 220 kV HVAC cable for inter-platform cables and cabling up to the boundary of the three consented wind farms Offshore Export Cables installation: Max. number of export cables: 4 Max. number of cable trenches: 4 Cable route length from wind farm to shore: 52 km from edge of three consented wind farms
Habitat Loss (temporary physical disturbance)	Maximum area of physical disturbance during construction for the modified OfTI: Max. number of suction caissons per OSP: 4 Max. suction caisson diameter: 20m Max. scour protection diameter per OSP: 40m
Noise	Impact Piling for installation of OSPs: Max. number of OSPs: 2 AC Max. pile diameter: 3 m Max. Number of piles for foundations: 16 piles for 8-legged jacket Noise related to cable installation activities: Cable ploughing & jetting Cable laying Rock placing or concrete mattressing Vessel noise

Operation	
EMFs	Inter-platform cabling: Type: 220 kV AC Max. number of OSPs: 2 AC Max. number of trenches: 2 Max. number of cables in a trench: 2 Max. cabling length: 70 km of 220 kV HVAC cable for inter-platform cables and cabling up to the boundary of the three consented wind farms Target trench depth: 1 m Offshore Export Cables: Type: 220 kV AC Max. number of cable trenches: 4 Max. number of cables: 4 Total width of cable corridor: four times water depth (up to 1,200 m in Southern Trench area) Cable route length from wind farm to shore: 52 km Target trench depth: 1m
Changes to Fishing Activity	Max. number of OSPs: 2 AC Max. inter-platform cable length: 70 km of 220 kV HVAC cable for inter-platform cables and cabling up to the boundary of the three consented wind farms Max. offshore export cables length: 52 km

EIA Methodology

4.2.2.18 The impact assessment methodology used for the evaluation of effects on fish and shellfish species is described below. The significance criteria used are based on the magnitude of the effect and the sensitivity of the receptors. Both magnitude of effect and receptor sensitivity have been assigned using professional judgement. The parameters used to define these take account of the IEEM (2010) impact assessment guidelines.

Magnitude of Effect

4.2.2.19 Magnitude of Effect values have been assigned based on the following criteria:

- **Extent of effect**: referring to the full area over which the effect occurs (e.g. noise impact range);
- **Duration of effect:** referring to the duration over which the effect is expected to last;
- **Frequency:** how often the effect occurs; and
- **Reversibility:** Irreversible effects are those from which recovery is not possible within a reasonable timescale. Reversible (temporary) effects are those from which spontaneous recovery is possible or, for which effective mitigation is possible.

Sensitivity

4.2.2.20 The sensitivity of the receptor has been assigned taking account of its degree of adaptability, tolerance and recoverability to the effect. In addition the following parameters have been considered:

- **Timing of the effect:** referring to whether effects are caused during critical life-stages or seasons (e.g. spawning season and migration); and
- **Ecological value:** referring to conservation status of the receptor (i.e. protected to the European level and/or national level) and importance in the area (i.e. species of importance as prey to other marine organisms, species of commercial importance).

Significance

4.2.2.21 The significance of an effect is defined using the following categories:

- **Not significant:** An effect that is predicted to be indistinguishable from natural background variation using conventional monitoring techniques. The effect is not significant in the context of the nature conservation objectives or legislative requirements;
- **Minor significance:** The effect will be measurable in the short term and/or over very local scales using standard monitoring techniques. The effect does not affect nature conservation objectives and falls within legislative requirements. Effects are typically reversible;
- **Moderate significance:** The effect will be measurable in the long term and over a broad to very broad spatial scale and is likely to have a measurable effect. It may affect nature conservation objectives and may fall outside of acceptable limits or standards stipulated under relevant legislation. Effects may be reversible; and
- **Major significance:** A permanent effect which has a measurable effect on wider ecosystem functioning and nature conservation objectives and exceeds acceptable limits or standards.

4.2.2.22 The significance of an effect is determined taking account of the magnitude of the effect and the sensitivity of the receptor following the matrix below (Table 4.2-3). In addition to the significance ratings, whether the predicted effect is considered positive or negative has also been described. Those effects assessed to be above minor (i.e. moderate or major) are considered to be significant.

Table 4.2-3 Impact Assessment Matrix

Impact Assessment Significance Criteria		**Sensitivity of Receptor**		
		Low	Medium	High
Magnitude of Effect	Negligible	Not significant	Minor	Minor
	Small	Minor	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

4.2.2.23 The impact assessment uses the most up to date information on sensitivity for particular species/species groups, taking into account any limitations of the data. In addition, as a result of uncertainties in relation to the distribution of some species and how they utilise the area of the modified OfTI, (particularly in the case of migratory species) a number of conservative assumptions have been made.

4.2.2.24 For certain effects, the limited information available to date does not allow for the impact assessment to follow the standard methodology described above, making the assignment of magnitude and sensitivity difficult.

4.2.2.25 In light of the limitations of the impact assessment the probability for each effect to occur has been assessed as "certain/near certain", "probable", "unlikely" and "extremely unlikely". The definition of the probability categories used in the assessment is given below as provided in the IEEM (2010) guidelines:

- Certain/near certain: probability estimated at 95% or higher;
- Probable: probability estimated above 50% but below 95%;
- Unlikely: Probability estimated above 5% but less than 50%; and
- Extremely unlikely: Probability estimated at less than 5 %.

4.2.2.26 Probabilities have been assigned taking into account the available evidence for an effect to occur, the degree of available baseline information on the ecology of the receptors and the use that a species makes of the area in the vicinity of the modified OfTI.

Impact Assessment

Construction

4.2.2.27 A summary of effects on fish and shellfish receptors during the construction phase is provided in Table 4.2-2. The potential effects on fish and shellfish species are assessed for the construction phase of the modified OfTI below:

- Temporary disturbance to the seabed (increased SSCs and sediment re-deposition);
- Habitat loss; and
- Underwater noise.

Temporary Disturbance to the Seabed (Increased SSCs and Sediment Re-deposition)

4.2.2.28 Cable installation activities will result in sediment being released into the water column, leading to an increase in suspended SSCs. Sediment will be advected with ambient tidal currents and will be subject to general processes of dispersion and deposition. Once deposited, the sediment will effectively re-join the local sedimentary environment. These processes are described in detail in Chapter 3.1: Hydrodynamics, Sedimentary and Coastal Processes.

4.2.2.29 Physical disturbance resulting from offshore export cable installation could in theory affect fish and shellfish, particularly species of limited mobility. However, potential disturbance will be short-term (order of seconds to minutes, depending on the sediment grain size and degree of aggregation) and will be largely localised to the export cable installation (main effect within 10s of metres). The thickness of sediment accumulation will be limited by the volume of sediment being disturbed and should not exceed a few tens of centimetres other than immediately adjacent to the

cable. Once re-deposited to the seabed, the displaced material will join the natural sedimentary environment and cease to present any further potential effect (see section 3.1.2 of Chapter 3.1: Hydrodynamics, Sedimentary and Coastal Processes).

4.2.2.30 Taking the localised and short term nature of increased SSCs and sediment re-deposition, the magnitude of the effect is considered to be small. The potential effects of increased SSCs and sediment re-deposition on fish and shellfish receptors are assessed below by species/species group.

Diadromous Migratory Species

4.2.2.31 In the case of diadromous species, assuming fish are migrating through areas where cable and OSP installation activities are taking place, increased SSCs may result in localised avoidance and limited disturbance during migration. Given the proximity of the modified OfTI landfall to salmon and sea trout rivers, particularly those relevant to the Deveron and Spey Salmon Fishery Districts (SFDs) it is considered that there is potential for salmon and sea trout to be disturbed prior to river entry and immediately after leaving the rivers (see Technical Appendix 4.2 B: Salmon and Sea Trout Ecology and Fisheries Technical Report). The river Deveron is in very close proximity to the modified OfTI and the river Spey SAC is approximately 32km away from the cable landfall.

4.2.2.32 Works in close proximity to shore will only be undertaken over a limited period of time for cable installation in each trench. In this context the seasonality of river entry and, particularly in the case of salmon, the diversity of runs should be noted. Diadromous migratory species are considered of medium sensitivity. In combination with the small magnitude of the effect, the impact of increased SSCs is assessed to be negative, of minor significance and probable (for salmon and sea trout) and unlikely (for other diadromous species potentially entering/exiting rivers in the vicinity of the offshore export cable landfall site).

Fish and Shellfish Which Lay Their Eggs on the Seabed (Herring, Sandeels and Squid)

4.2.2.33 As herring and sandeels deposit their eggs on the seabed there is potential for these species to be affected by increased SSCs and smothering as a result of sediment re-deposition. The significance of any effect will however depend on the degree of overlap between their spawning areas and the areas affected.

4.2.2.34 The herring sub-stocks most relevant to the modified OfTI are the Orkney-Shetland stock and the Buchan stock. As shown in Figure 4.2-2, the modified OfTI does not pass through either of these spawning grounds. However, as suitable herring spawning substrate is present to the north east and southern areas of the offshore export cable route, the presence of herring eggs in these areas cannot be ruled out.

4.2.2.35 As sandeels spend a major proportion of their life cycle partially buried within the seabed, increased SSCs and sediment re-deposition have the potential to adversely affect this species group. Eggs are deposited on benthic substrates between December and January. Egg membranes are adhesive onto which grains of sand may become attached. Eggs covered by sediment experiencing reduced current flow and therefore lower oxygen tension, can have delayed hatching periods. This is considered a necessary adaptation to egg survival in a dynamic environment (Hassel et al., 2004). Based on Figure 4.2-3, the modified OfTI passes through a high intensity sandeel spawning ground (Ellis et al., 2010). These grounds are however extensive and the area covered by the modified OfTI is proportionally small.

4.2.2.36 Taking the wider area where both sandeels and spawning herring are distributed and the likely small degree of overlap with the areas affected by SSCs and sediment

re-deposition, herring and sandeel are considered receptors of **medium sensitivity**. The effect is therefore assessed to be **negative** of **minor significance** and **unlikely**.

4.2.2.37 As described in Technical Appendix 4.2 A: Fish and Shellfish Ecology, squid spawning may occur in areas relevant to the modified OfTI, particularly in the southern section. Therefore, there is potential for eggs to be subject to high SSCs and smothering through sediment re-deposition. However, given the localised effects of increased SSC and sediment re-deposition, the degree of overlap between areas affected and squid spawning grounds is likely be comparatively small. Squid are therefore considered receptors of **medium sensitivity** and the effect is assessed to be **negative**, of **minor significance** and **unlikely**.

Adult and Juvenile Fish

4.2.2.38 Mobile adult and juvenile fish will be able to avoid localised areas disturbed by increased SSCs. If displaced, juveniles and adults would be able to move to adjacent undisturbed areas within their normal distribution range. Adult and juvenile fish are therefore considered receptors of **low sensitivity** and the effect of increased SSCs and sediment re-deposition is assessed to be **negative**, of **minor significance** and **unlikely**.

Shellfish Species

4.2.2.39 The principal shellfish species (i.e. scallops, crabs, lobster, Nephrops and whelks) present in the vicinity of the modified OfTI are of limited mobility. It is therefore likely that these will remain in areas disturbed by increased SSC during cable installation. In addition, some shellfish species could be affected by smothering as a result of sediment re-deposition.

4.2.2.40 The distribution of these species is comparatively large in the context of the areas where seabed disturbance related effects may occur. Examples of the degree of sensitivity to smothering, increased SSCs and displacement for several shellfish species found in the area of the modified OfTI and in the wider Moray Firth for which the Marine Life Information Network (MarLIN) provides species specific information are given in Table 4.2-4 (MarLIN, 2014).

Table 4.2-4 Sensitivity of Shellfish Species to Smothering, Increased SSC and Displacement (Source: MarLIN, 2014)

Species	Smothering	Increased SSC	Displacement
Edible Crab	Very low	Low	Not sensitive
King Scallop	Low	Low	Not sensitive
Nephrops	Not sensitive	Not sensitive	Very low

4.2.2.41 Utilising the above information, the distribution ranges of shellfish species in the mmodified OfTI corridor and MarLIN's examples of sensitivity, shellfish species are considered of **low sensitivity** and the effect is assessed to be **negative**, of **minor significance** and **unlikely.**

Habitat Loss (Temporary Physical Disturbance)

4.2.2.42 Physical disturbance resulting from offshore export cable installation could in theory affect fish and shellfish, particularly species of limited mobility. A maximum area of 1.99km^2 seabed habitat could be temporarily disturbed or lost during the construction phase of the modified OfTI.

4.2.2.43 In addition to indirect effects through increased SSCs and sediment re-deposition, the disturbance of the seabed associated to construction works may result in a direct effect on species and life stages of limited mobility, such as shellfish species and demersal eggs (i.e. if unable to avoid construction machinery).

4.2.2.44 Considering the relatively small area directly affected and the temporary, intermittent and reversible nature of the effect, the magnitude of temporary seabed disturbance during construction activities for the modified TI is considered to be **negligible**. In addition, the majority of fish and shellfish species present in the area are mobile and their distribution ranges are extensive in comparison to areas potentially being disturbed by the installation of the modified OfTI.

4.2.2.45 It is not anticipated that there will be an effect on pelagic fish, pelagic eggs or pelagic larvae from habitat loss/temporary physical disturbance. Since there is no apparent impact pathway for temporary physical disturbance/loss of seabed habitat to impact on pelagic eggs and larvae they are therefore scoped out of the assessment.

4.2.2.46 As such, the only relevant receptors with the potential to be affected are herring by virtue of their substrate specificity for spawning. The modified OfTI does not overlap with herring spawning grounds as defined by Coull *et al*., (1998), therefore sensitivity of herring eggs is to be considered **low**. The effects of temporary physical disturbance and habitat loss on herring are assessed as **negative, not significant** and **unlikely**.

4.2.2.47 Likely significant effects on the benthic community derived from this are assessed in Chapter 4.1: Benthic Ecology.

Noise and Vibration

4.2.2.48 The following assessment considers the potential for underwater noise generated by construction activities to affect fish and shellfish receptors. Noise levels generated by decommissioning activities are not anticipated to exceed those of the construction phase. A number of activities associated with the construction phase of the modified OfTI generate underwater noise and vibration. These are as follows:

- Piling noise derived from the installation of pin pile OSPs;
- Cable ploughing and jetting;
- Cable laying;
- Rock placement or concrete mattressing; and
- Vessel noise.

4.2.2.49 Potential sensitivity to noise may vary between species or species groups. Therefore, to assess the likely effect of construction noise on fish, modelling was undertaken using the dB_{ht} (Species) metric which allows for species specific impact ranges to be defined. The noise modelling methodology is described in detail in Chapter 3.6: Underwater Noise in MORL ES (2012). The criteria for assessment of effects on fish is summarised in Table 4.2-5 below:

Table 4.2-5 Noise Assessment Effect Criteria

Level dB_{ht} (Species)	Effect
≥75	Mild avoidance reaction by the majority of individuals. At this level individuals will react to the noise, although the effect will probably be transient and limited by habituation.
≥90	Strong avoidance reaction by virtually all individuals
>110	Tolerance limit of sound; unbearably loud
>130	Possibility of traumatic hearing damage from single event

4.2.2.50 Noise modelling was undertaken for cod, dab, herring and salmon; species representing different degrees of hearing ability and sensitivity to noise. The outputs of the noise modelling at the 90 dB_{ht} (Species) for different construction activities are given in Chapter 3.6: Underwater Noise of the MORL ES (MORL, 2012). Detailed information on the noise modelling methodology and hearing ability of fish species is provided in Chapters 3.6: Underwater Noise in MORL ES (MORL, 2012) and Chapter 10.2: Fish and Shellfish Ecology in MORL ES (MORL, 2012).

4.2.2.51 Piling noise in relation to the installation of pin piles of the OSPs would produce the highest levels of underwater noise and therefore has the worst case potential to result in adverse effects on fish and shellfish receptors with other construction activities having negligible impact ranges on fish. Installation of pin piles has therefore been studied in more detail. The assessment of noise on fish has been primarily focused on the outputs of the modelled 90 dB_{ht} (Species) impact ranges, at which the greatest behavioural effects are to be expected.

4.2.2.52 Noises at 130 dB_{ht} (Species) have the potential to of cause traumatic hearing damage and noise at 110 dB_{ht} (Species) may cause unbearably loud sounds Chapter 3.6: Underwater Noise in MORL ES (MORL, 2012). This however would only occur in close proximity of where piling is taking place (10s to 100s of meters) (Table 4.2-6). A 'soft-start' (a period at the onset of piling when the hammer strike energy would be gradually increased) will be utilised at all piling locations. The aim of 'soft-start' piling is to allow mobile fish to leave the vicinity of the foundations before the highest noise levels are reached, in order to prevent exposure to the 110 and 130 dB_{ht} (Species) levels.

Table 4.2-6 130dB$_{ht}$ and 110dB$_{ht}$ (Species) Impact Ranges Associated to Piling of a 3 m pile by Species (Source: MORL ES, 2012)

Species	130dB$_{ht}$ (Species) Range (m)	110 dB$_{ht}$ (Species) Range (m)
Cod	220	4,000
Dab	30	460
Herring	370	5,400
Salmon	<10	160

4.2.2.53 For the purposes of this assessment one construction scenario (scenario1) was modelled (see Chapter 3.6: Underwater Noise in MORL ES (MORL, 2012). The construction programme of this scenario is summarised in Table 4.2-7.

Table 4.2-7 Noise Modelled Scenarios

Scenario	Build programme (years)	Max. no. years with piling activities	Max.no. of vessels (piling activities)
1	5	2	1

4.2.2.54 The following parameters have been considered to assess the worst case scenario for underwater noise effects, based on conservative assumptions:

- 8 pin piles per OSP;
- 2 OSPs; and
- 260 minutes per pile (assuming 3 m diameter piles).

4.2.2.55 Assuming piling over two years (one construction vessel), the average percentage of piling days (six) will constitute 1% of the total build programme.

Fish Species

4.2.2.56 Concerns were raised during consultation as part of the previous EIA process (for the three consented wind farms) with regard to the sensitivity of juvenile fish and in particular salmon and sea trout smolts. To address this issue a report on ontogenic development of auditory sensitivity in fish was commissioned. The report concluded that available experimental evidence suggests that the juveniles of marine fish are no more sensitive to sound than the adults of the species (Technical Appendix 3.6 A: Underwater Noise in MORL ES (MORL, 2012)). Furthermore, in some cases it appears that there maybe a degree of insensitivity to sound in juveniles when compared with adults, implying some protection from the adverse effects of noise. In light of this, juvenile fish have been assessed using the same criteria as that used for evaluation of the effect of impact piling on adults.

4.2.2.57 A comparative indication of the expected 90 dB$_{ht}$ (Species) noise effects for the four species modelled is given for a single piling operation (3 m pile) in Figure 4.2-4. Table 4.2-8 below shows the maximum, minimum and mean impact ranges modelled by species at the 90dB$_{ht}$ and 75 dB$_{ht}$ (Species) levels for a 3 m pile.

Table 4.2-8 Maximum, Minimum and Mean Impact Ranges Modelled by Species at the 90 dBht and 75 dBht Levels for a 3 m Pin Pile (Source: MORL ES, 2012)

Modelled Location	Species	90 dB_{ht} Impact Range (km)			75 dB_{ht} Impact Range (km)		
		Max.	Min.	Mean	Max.	Min.	Mean
1	**Cod**	34	25	30	82	41	64
	Dab	6.9	6.7	6.8	33	26	30
	Herring	39	29	34	94	41	69
	Salmon	2.5	2.5	2.5	14	13	14

4.2.2.58 As shown in both Figure 4.4-4 and Table 4.2-8 dab and salmon are expected to exhibit strong avoidance reactions (90dB_{ht} level) only in close proximity to the piling works, whilst cod and herring are expected to avoid wider areas. This pattern is similar at the 75 dB_{ht} level, where dab and salmon would be expected to exhibit behavioural responses over relatively short ranges when compared to cod and herring (Table 4.2-9).

4.2.2.59 The precise location of the OSPs within the boundary of the three consented wind farms has not yet been defined. Therefore a conservative approach has been taken where a 'worst case' piling location has been selected on the basis of closest proximity to the defined spawning grounds of plaice, cod and herring (Tables 4.2-5 to 4.2-7). Due to the substrate specificity of herring spawning, the distribution of gravel and sandy gravel (based on BGS data) is also shown. For salmon, the location of the two main rivers of the districts forming the local study area (Spey and Deveron) are shown in addition to the location of SAC rivers (Table 4.2-8).

4.2.2.60 The assessment of noise related effects is based primarily on the 90 dB_{ht} effect contours as strong avoidance is expected by virtually all individuals. In the case of salmon, 75 dB_{ht} levels, at which only mild avoidance reactions can be expected, have also been used to inform the assessment given its conservation status and the importance of associated fisheries at the local, regional and national levels in Scotland.

4.2.2.61 Due to the small number of OSPs (two), the frequency and duration of piling noise will be considerably less than that previously assessed for the installation of turbine foundations or for OSPs, which previously numbered up to eight (Chapter 3.6, Underwater Noise, in the MORL ES, 2012). Taking account of the species impact ranges and the short term nature and frequency of the effect, the magnitude of construction noise has been defined as follows:

- Based on the noise modelling outputs for **dab** (surrogate for plaice) the magnitude of the effect is assessed as **negligible**;
- Based on the noise modelling outputs for **cod** (surrogate for whiting) and herring, the magnitude of the effect is assessed as **small**; and
- Based on the noise modelling outputs for **salmon** (surrogate for sea trout), and taking into account the conservative 75 dBht levels, the magnitude of the effect is assessed as **negligible**.

4.2.2.62 The sensitivity of the receptors modelled based on their ecological importance, the use that they make of the modified OfTI corridor and the wider area and the significance of the predicted effects is given below:

- Plaice have defined spawning and nursery grounds in areas relevant to the modified OfTI. However the spawning and nursery grounds of plaice are spatially extensive and are considered of low intensity (Ellis *et al*., 2010). Plaice is therefore considered a receptor of **low** sensitivity. The effect of noise on plaice is assessed to be **negative, not significant** and **probable**.
- The cod population of the Moray Firth is genetically distinct from other North Sea populations and spawning activity has been low in recent years. In addition the Moray Firth is known to be a nursery ground for cod (Technical Appendix 4.2 A: Fish and Shellfish Ecology Technical Report). Noise contours at the 90 dB_{ht} level could overlap a significant area of their spawning (Figure 4.2-6). The uncertainties in relation to the current extent and importance of these grounds should however be recognised. For example, low numbers of spawning cod were encountered during the cod spawning survey (Appendix 1 of Technical Appendix 4.2 A, Fish and Shellfish Technical Report). Based on these results MSS did not require any further mitigation than that described in the MORL ES (2012) in relation to spawning cod during the construction of the three consented wind farms. The sensitivity of cod is therefore considered to be **medium**. The effect of piling noise on cod is therefore assessed as **negative**, of **minor significance** and **probable**.
- Whiting (for which cod has been used as a surrogate) have defined spawning and nursery grounds in the area relevant to the modified OfTI. However the extent of these grounds is large in relation to the small proportion potentially intersected by the modified OfTI. Whiting are therefore considered receptors of **low** sensitivity. The effect on whiting is therefore assessed as **negative**, of **minor significance** and **probable**.
- Herring are known to spawn in the Moray Firth, use the area as a nursery ground and are an important prey species for a number of other marine organisms. In addition, herring are substrate specific spawners. As shown in Figure 4.2-7 the modified OfTI does not pass through herring spawning grounds. In most years, the highest intensity of herring spawning tends to occur between Orkney and the Shetlands. Gravelly substrate, on which herring prefer to spawn, is available to the stock in various areas unaffected at 90 dB_{ht} levels (Figure 4.2-7)). As a result, herring are considered receptors of **medium** sensitivity and the effect is assessed to be **negative**, of **minor significance** and **probable.**
- In the absence of detailed information regarding the migratory routes of salmon and sea trout, it is assumed that they may transit the modified OfTI corridor as part of their normal migration and/or as part of their foraging activity. This is particularly pertinent to sea trout as marine migration and feeding occurs in more inshore/coastal habitats than salmon. It is considered that areas in the immediate vicinity of the rivers will not be affected by noise and hence fish will not be disturbed immediately prior to river entry or immediately after leaving the rivers at either the 90dB_{ht} or 75dB_{ht} levels, as demonstrated by the noise contours shown in Figure 4.2-8). No barrier effect is therefore expected to occur given the relatively small ranges expected for these species at both the 90dB_{ht} or 75dB_{ht} level (Figure 4.2-8). Taking the above into account and given the conservation status of salmon and sea trout and the importance of their fisheries to the local and national level in Scotland, they are considered to be of **medium** sensitivity. The effect on salmon and sea trout is assessed to be **negative**, of **minor significance** and **probable.**

Other Fish Species Present in the Vicinity of the Modified OfTI

4.2.2.63 The level of hearing specialisation in fish is assumed to be associated with possession of a swim bladder and whether the swim bladder is connected to the ear. Fish with specialist structures are considered to have the highest sensitivity, non-specialists with swim bladder of medium sensitivity and non-specialists without a swim bladder of lowest sensitivity (Nedwell *et al*., 2004). Based on this classification, potential magnitudes of effect have been assigned to a number of species that are present in the Moray Firth area (i.e. species with conservation status, of commercial value, key prey species) for which noise modelling has not been undertaken and direct surrogates have not been defined:

- For non-flatfish species that lack a swim bladder, namely sandeels, elasmobranchs, anglerfish, river lamprey and sea lamprey, the magnitude of effect may be similar to that assigned to dab (negligible);
- For species with a swim bladder that is not connected to the ear, namely mackerel, haddock and European eel, the magnitude of effect may be between that assigned to cod (small) and that assigned for dab (negligible); and
- For species which possess a connection between the swim bladder and the ear such as sprat, the potential magnitude of effect may be similar to that assigned to herring (small).

4.2.2.64 It is acknowledged that data relating to hearing ability exists only for a limited number of species and extrapolation of hearing capabilities between different species (especially those that are taxonomically distant), should be undertaken with caution (Hastings & Popper, 2005).

4.2.2.65 The likely potential magnitude of effect and the sensitivity of the species above is summarised in Table 4.2-9. Given the limitations and qualitative nature of the assessment, significance ratings and probabilities have not been defined. The limitations and the qualitative nature of the noise assessment for the species which have not been modelled and for which direct surrogates have not been defined should be recognised and only be taken as an indication of potential effects.

Table 4.2-9 Qualitative Assessment for Species Not Modelled and Without Defined Surrogates Based on Potential Magnitude of Effects and Receptor Sensitivities

Species	Potential Magnitude of Effect	Sensitivity of receptor	
Sandeels	Negligible	• Important prey species • Export cable site specific distribution unknown. The results of the sandeel survey undertaken suggest that there are not extensive areas supporting important sandeel populations within the Moray Firth Round 3 Area • Substrate specific	Medium
Elasmobranchs	Negligible	• Most species are of conservation Importance • Generally more prevalent in the north and west of Scotland than in the Moray Firth • Some with nursery grounds defined in the proposed sites (spurdog, spotted ray and thornback ray)	Low-Medium
River and sea lamprey	Negligible	• Conservation importance • Potentially transiting the site during migration (lack of detailed information on migration)	Medium
Anglerfish	Negligible	• Commercially important • High intensity nursery area in the wind farm sites	Medium
Haddock	Negligible-Small	• Commercially important • Nursery grounds in the area and spawning grounds in the proximity of the proposed wind farm sites	Low
European eel	Negligible - Small	• Conservation importance • Potentially transiting the site during migration (lack of detailed information on migration)	Medium
Mackerel	Negligible-Small	• Seasonal commercial fishery in inshore areas along the Moray coast and in the vicinity of the export cable landfall (Chapter 5.1: Commercial Fisheries) • No spawning or nursery grounds in the vicinity of the modified OfTI	Low
Sprat	Small	• Important as prey species • Spawning and nursery grounds in the area, however these are comparatively large	Low-Medium

Life Stages of Limited Mobility

4.2.2.66 Larvae and early life stages of fish have limited flight ability and are probably at least as sensitive as adults to acoustic noise (Wahlberg & Westerberg, 2005). Life stages of limited mobility such as larvae, and in the case of European eel, their juvenile form (glass eels), could be vulnerable to effects from acoustic sources as they have a limited ability to move out of areas where mortality, physical injury and auditory

injury could occur, assuming they drift through the vicinity of the modified OfTI corridor. Although there is limited information on the effect of piling noise to date on early life stages of fish, research recently carried out by the Institute for Marine Resources and Ecosystem Studies (IMARES) (Bolle *et al*., 2011) suggests that the assumption of 100% of larvae mortality within a radius of 1,000 m around a piling site (used in the Appropriate Assessment of Dutch offshore wind farms) is too conservative. Bolle *et al*., (2011) found no significant effects in the larval stages analysed at the highest exposure level (cumulative SEL = 206 dB re 1µPa2s) which represented 100 pulses at a distance of 100 m from piling. It is recognised that the results, based on sole larvae, cannot be directly extrapolated to fish larvae in general as inter-specific differences in vulnerability to sound exposure may exist. The findings, however, suggest that larval mortality would only occur within a few hundred metres from where piling is taking place. On this basis the magnitude of the effect is considered **negligible**. The sensitivity of larvae and glass eels is considered **medium** and the effect is assessed to be **negative, of minor significance and probable**.

Shellfish Species

4.2.2.67 The majority of shellfish species present in areas relevant to the modified OfTI, with the exception of squid, have limited mobility in comparison to most fish species. They therefore may not be able to avoid areas in close proximity to piling operations as quickly as mobile fish. The hearing mechanism of invertebrate species is currently not well understood although it is generally thought that invertebrate species are less sensitive to noise than fish due to the lack of a swim bladder.

4.2.2.68 Piling noise should not however interfere with normal behaviour as mobile shellfish species would be likely to return to the areas soon after cessation of the piling activity. Furthermore, other marine bivalves (e.g. mussels and periwinkles) exposed to a single airgun at a distance of 0.5 m also have shown no effects after exposure (Kosheleva, 1992). As such no effects on sedentary macro-invertebrates are to be expected.

4.2.2.69 Some species of squid and shrimp are thought to be sensitive to acoustic stimuli and it has been suggested that these species may be able to detect sound similarly to most fish, via their statocysts (Lovell *et al*., 2005; Mooney *et al*., 2010). The limited studies which have examined the effect of anthropogenic noise on invertebrates almost exclusively consider the effects of geophysical survey, particularly the effects of 'airguns', used in seismic surveys. Generally, these are of a lower frequency and higher source pressure than piling associated with installation of OSPs (Vella *et al*., 2001).

4.2.2.70 Levels recorded during piling at the Belwind offshore wind farm during construction showed that the maximum underwater noise level produced by piling was 196 dB re1µPa recorded at 520 m from the source, within the range of 100-1,000 Hz (Norro *et al*., 2009). The fact that these frequencies are within the same bandwidth as those which crustaceans appear to be sensitive to (e.g. 100–3,000Hz; Popper *et al*., 2001; Lovell *et al*., 2005) suggests that species such as lobster, crab and *Nephrops* are likely to be able to detect noise generated by construction activity. However, this does not necessarily imply a response in these species and provides no indication of whether there are any associated negative impacts.

4.2.2.71 Experiments exposing adult American lobster, which belongs to the same genus as the European lobster, to seismic air gun noise at frequencies similar to those associated with piling for turbine foundations (peak–to-peak pressure measures approximately 202 dB re 1µPa in the low level exposure and 227 dB re 1µPa in the high level exposure) found no evidence of immediate or delayed mortality (up to

nine months after noise exposure). Furthermore, based on measurements of serum enzymes (used as an indicator of internal tissue damage) even high level exposure had not resulted in internal organ damage. Results also suggested that noise exposure is unlikely to affect orientation and navigation in lobsters as no effect of exposure was recorded on either geo-orientation or equilibrium functions (Payne, 2007).

4.2.2.72 In laboratory experiments, *Nephrops* has been shown to display distinct postural responses to sound frequencies of 20-180 Hz. In the field *Nephrops* was found to respond to particle displacement and not pressure but no response was observed when the stimulus was further than 0.9 cm from the animal. This would suggest that sensitivity to noise in *Nephrops* is low (Goodall *et al*., 1990, Popper and Fay 1999, Popper *et al*., 2001).

4.2.2.73 Taking the above into account and the short term nature and frequency of piling associated with OSPs, the magnitude of the effect of noise on shellfish is considered **negligible** and the sensitivity of shellfish **low**. The effect on shellfish species is therefore assessed to be **negative**, of **minor significance** and **probable**.

Operation

Electromagnetic Fields

4.2.2.74 The export and inter-platform cables will generate EMFs during the operational phase of the modified OfTI. For both inter platform and export cables 220 kV AC will be used. AC cables will generate an electric field (E) and a magnetic field (B). The sheathing and armoured cores prevent the propagation of E fields into the environment, however, these materials are permeable to B fields, which therefore emanate into the surrounding environment.

4.2.2.75 The magnetic fields generated by AC cables are constantly changing. In turn, the motion of these B fields through the surrounding seawater induces varying electric (Ei) fields. Therefore both B and Ei fields will be generated by both export and inter platform cables during the operational phase of the modified OfTI.

4.2.2.76 The strength of the magnetic field generated by AC cables decreases exponentially, both horizontally and vertically with distance from source (Normandeau *et al*., 2011). Cables will be buried to a target depth of 1 m. Whilst cable burial does not completely mitigate B or Ei fields, it reduces exposure of electromagnetically sensitive species to the strongest EMFs that exist at the 'skin' of the cable owing to the physical barrier of the substratum (OSPAR, 2008).

4.2.2.77 In instances where adequate burial cannot be achieved, alternative protection such as mattresses or rock placement will be used. Benthic and demersal fish and shellfish species will therefore not be directly exposed to the strongest EMFs as a result of the physical barrier that burial and cable protection constitute.

4.2.2.78 The NPS EN-3 document states that where cables are buried at depths greater than 1.5 m below the sea bed, effects upon sensitive fish species are likely to be negligible. Since the strength of the magnetic field decreases with distance from the source, the likely effects of EMFs on fish and shellfish will be influenced by the position of particular species in the water column and water depth.

4.2.2.79 An estimate of the B fields expected to be produced by the cables proposed for the modified OfTI is given in Plate 4.2 - 1. The methodology used and the full results of the EMF modelling are provided in Technical Appendix 4.3 D of MORL ES (MORL, 2012). B

fields are expected to decrease very quickly horizontally with distance from the cable (within a few metres) and vertically (within 5 metres from the seabed). The E fields induced by these B fields, will as a result, also similarly decrease with distance from the source.

4.2.2.80 The expected B fields generated by offshore export cables and inter-platform AC cables are, taking cable burial to 1 m, well below the Earth's magnetic field (assumed to be 50 µT) (Plate 4.2-1)).

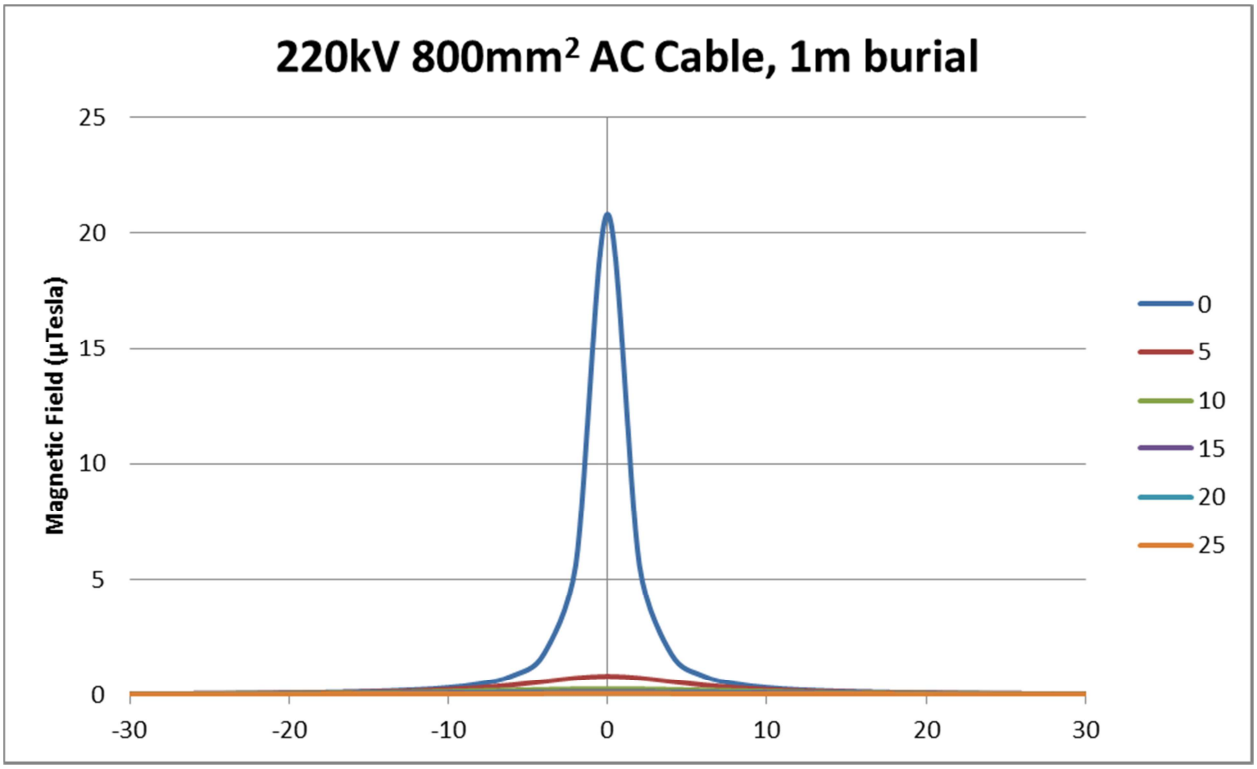

Plate 4.2 - 1 Magnetic Field Expected from 220kV 800mm2 AC Inter-platform Cables Assuming 1 m Burial

4.2.2.81 Taking the above into account it is considered that the area where EMF effects may occur will be limited to the modified OfTI and its immediate vicinity (e.g. within a few metres). The magnitude of the effect is therefore considered to be **small**.

4.2.2.82 A summary of the species for which there is evidence of a response to electric (E) and magnetic (B) fields is given below in Table 4.2-10 and Table 4.2-11 respectively, as provided in Gill *et al*., (2005). The potential effects of EMFs on these species are assessed separately in the following sections.

Table 4.2-10 Species Found in UK Waters for Which there is Evidence of a Response to E fields

Species/Species Group	**Latin Name**
Elasmobranchs	
Lesser Spotted Dogfish	*Scyliorhinus canicula*
Blue shark	*Prionace glauca*
Thornback ray	*Raja clavata*
Round Ray	*Rajella fyllae*
Agnatha	
River lamprey	*Lampetra fluviatilis*
Sea lamprey	*Petromyzon marinus*
Teleosts	
European eel	*Anguilla anguilla*
Cod	*Gadus morhua*
Plaice	*Pleuronectes platessa*
Atlantic salmon	*Salmo salar*

Table 4.2-11 Species Found in UK Waters for Which There is Evidence of Response to B Fields

Species/Species Group	**Latin Name**
Elasmobranchs	
All Elasmobranchs possess the ability to detect magnetic fields	
Agnatha	
River lamprey	*Lampetra fluviatilis*
Sea lamprey	*Petromyzon marinus*
Teleosts	
European eel	*Anguilla anguilla*
Plaice	*Pleuronectes platessa*
Atlantic salmon	*Salmo salar*
Sea Trout	*Salmo trutta*
Yellowfin tuna	*Thunnus albacores*
Crustaceans	
Lobster, crabs, shrimps and prawns	Specific cases non-UK *Decapoda;* Crangon crangon (ICES, 2003) *Isopoda: Idotea baltica* (Ugolini & Pezzani,1995) *Amphipoda: Talorchestia martensii* (Ugolini, 1993) and *Talitrus saltator* (Ugolini and Macchi, 1988)
Molluscs	
snails, bivalves and squid	Specific case non-UK Nudibranch: *Tritonia diomedea* (Willows, 1999)

4.2.2.83 An assessment of the likely effect of EMFs on sensitive receptors expected to be present in the area of modified OfTI is given below. It is recognised that there is limited current information available on behavioural effects of EMFs. This is particularly evident in the case of diadromous migratory species for which very limited research is available. Research examining the response of EMFs on diadromous is being undertaken by MSS, but has not been published at the time of writing.

Elasmobranchs

4.2.2.84 Elasmobranch species are considered most susceptible to EMFs. Elasmobranchs naturally detect bioelectric emissions from prey, conspecifics and potential predators/competitors (Gill *et al.,* 2005). In addition, elasmobranchs are known to

either detect magnetic fields using electrosensory systems or through an as yet undescribed magnetite receptor system (Normendaeu *et al.*, 2011).

4.2.2.85 Both attraction and repulsion reactions associated with E fields in elasmobranch species have been observed. Gill & Taylor (2001) found limited laboratory based evidence that the lesser spotted dogfish avoids DC E fields at emission intensities similar to those predicted from the modified OfTI AC cables.

4.2.2.86 Threshold levels of EMF for elasmobranchs have not been defined, however the influence of EMF on fish appears to be limited to 2 m either side of the cable, indicating the scope of EMF propagation (Gill *et al.*, 2005).

4.2.2.87 Information gathered as part of the monitoring programme at Burbo Bank wind farm suggests that certain elasmobranch species (sharks, skates and rays) do feed inside the wind farm and demonstrated that they are not excluded during periods of power generation (Cefas, 2009). Monitoring at Kentish Flats found an increase in thornback rays, smooth hounds and other elasmobranchs during post-construction surveys in comparison to pre-construction surveys.

4.2.2.88 A recent review by the UK Marine Management Organisation (MMO, 2014) concluded the following in relation to elasmobranchs and EMF generated by offshore wind cabling: "From the results of post-consent monitoring conducted to date, there is no evidence to suggest that EMFs pose a significant threat to elasmobranchs at the site or population level, and little uncertainty remains. Targeted research using high tech equipment and experimental precision has been unable to ascertain information beyond that of fish being able to detect EMFs and at what levels they become attracted or abhorrent to them. EMFs emitted from standard industry cables for offshore wind farms are unlikely to be repellent to elasmobranchs beyond a few metres from the cable if buried to sufficient depth. It is likely that the more subtle effects of EMF, including attraction of elasmobranchs, inquisitiveness and feeding response to low level EMFs, may occur. The Burbo Bank offshore wind farm post-consent monitoring undertook EMF specific surveys including stomach analysis of common elasmobranch species. Fish caught at the cable site (and hence subject to EMFs) were well fed. No deleterious effects were recorded to fish populations, at least when this effect occurs in association with the probable increased feeding opportunities reported as a result of increased habitat heterogeneity".

4.2.2.89 As such, EMFs produced by the cables may result in some behavioural effects on elasmobranchs, however, these are not likely to result in significant deviations from normal behaviour (e.g. feeding or migration).

4.2.2.90 The majority of elasmobranch species potentially transiting the area of the modified OfTI are in most cases more frequently found off the north and west coast of Scotland. The modified OfTI, however, falls within defined low intensity nursery grounds (Ellis *et al.*, 2011) for several of these, namely spurdog, thornback ray and spotted ray.

4.2.2.91 Given the conservation status of most elasmobranch species, the potential for the modified OfTI to be used as a nursery ground by some of them, and the evidence of their ability to detect EMFs, they are considered to be a receptor group of **medium sensitivity**. The effect of EMFs on elasmobranchs is therefore assessed to be **negative** of **minor significance** and **probable.**

River and Sea Lamprey

4.2.2.92 Lampreys, like elasmobranchs, possess electroreceptors that are sensitive to weak, low-frequency electric fields (Bodznick & Northcutt, 1981; Bodznick and Preston, 1983). Whilst responses to E fields have been reported in lamprey, information on the use that they make of the electric sense is limited. It is likely, however, that they use it in a similar manner as elasmobranchs to detect prey, predators or conspecifics and potentially for orientation or navigation (Normadeau *et al*., 2011). Experiments using sea lamprey (Chung-Davidson *et al*., 2008) found that weak electric fields may play a role in their reproduction and that electrical stimuli may mediate different behaviours in feeding-stage and spawning-stage individuals.

4.2.2.93 Both river and sea lamprey are species of conservation importance. In addition, sea lamprey is a primary reason for selection of the River Spey as a SAC. Whilst the behaviour and distribution of both river and sea lamprey in the marine environment is poorly understood, given the central location of the modified OfTI in the Moray Firth, it is likely that sea lamprey may transit the area where the modified OfTI is located. Similarly, river lamprey have been reported in rivers in the Moray Firth and are hence also likely to be present in the vicinity of the modified OfTI.

4.2.2.94 EMFs generated by the cables could therefore result in behavioural effects on these species in areas adjacent to the OfTI and potentially cause limited disturbance during migration. Lampreys are considered of **medium sensitivity** and the effect of EMFs assessed to be of **negative minor significance** and **likely.**

European Eel

4.2.2.95 European eel are known to possess magnetic material of biogenic origin of a size suitable for magnetoreception (Hanson *et al*., 1984; Hanson and Walker, 1987; Moore and Riley, 2009) and are thought to use the geomagnetic field for orientation (Karlsson, 1985). In addition, their lateral line has been found to be slightly sensitive to electric current (Berge, 1979; Vriens & Bretschneider, 1979).

4.2.2.96 A number of studies have been carried out in relation to the migration of eels and the potential effect of EMFs derived from offshore wind farm cables. It has been shown that a B-Field from the cable connecting the wind farm at Nysted (Denmark), to the mainland at around 5 µT resulted in some deviation in the swimming direction of European eel (Eltra, 2000). However this result was found to be statistically insignificant Westerberg (1994). Research by Westerberg (1999) on High Voltage Direct Current (HVDC) cables and eel migration found some effects associated with magnetic disturbance were likely to occur on eel although the consequences appeared to be small. In addition, no indication was found that the cable constituted a permanent obstacle to migration, neither for adult eels nor for elvers.

4.2.2.97 Further research where 60 migrating silver eels were tagged with ultrasonic tags and released north of the 130 kV AC export cable of the Nysted wind farm found swimming speeds were significantly lower around the cable than in areas to the north and south (Westerberg and Lagenfelt, 2008). Based on the results of Westerberg and Lagenfelt (2008) before publication, Öhman *et al*., (2007) suggested that even if an effect on migration was demonstrated, the effect was small and on average the delay caused by the passage was approximately 30 minutes.

4.2.2.98 Based on the above, European eel are considered of medium sensitivity and the effect of EMFs generated by the offshore transmission cables assessed to be **negative,** of **minor significance** and **probable.**

4.2.2.99 MSS is undertaking research into the behavioural effect of EMFs on diadromous species. It is anticipated that the results of MSS's study will contribute to increasing the knowledge in this field. This research is ongoing and results are expected to be released in 2015.

Salmon and Sea Trout

4.2.2.100 Research carried out on salmon and sea trout indicates that these species are able to respond to magnetic fields (Formicki *et al*., 2004; Tanski *et al*., 2005; Sadowski *et al*., 2007; Formicki and Winnicki, 2009). Furthermore, Atlantic salmon possess magnetic material in their lateral line, of a size suitable for magnetoreception (Moore *et al*., 1990). Most of the limited research undertaken on salmon and sea trout has however, been focused on physiology based laboratory studies.

4.2.2.101 Research under these conditions has found that EMFs can elicit localised physiological responses on salmon and sea trout (McCleave and Richardson, 1976; Vriens & Bretshneider, 1979; Hanson *et al*., 1984; Formicki *et al*., 1997, 2004). Swedpower (2003) however found no measurable impact when subjecting salmon and trout to magnetic fields twice the magnitude of the geomagnetic field. In line with this, Atlantic salmon migration in and out of the Baltic Sea appears to be unaffected despite crossing over a number of operational sub-sea HVDC cables (Walker, 2001). Öhman *et al*. (2007) state that detection of stimuli may not necessarily lead to behavioural responses in fish and that senses that detect magnetic fields are not the only means of spatial orientation. Vision, hearing and olfaction as well as hydrographic and geoelectric information could all be used for spatial orientation. This is true of salmonids which are believed to use olfactory cues in the later stages of migration whilst searching for the natal river.

4.2.2.102 Since the strength of EMFs decreases exponentially with distance from the source, the magnitude and intensity of the potential behavioural effects on salmonids would be closely linked to the proximity of the fish to the source of EMF.

4.2.2.103 Gill and Barlett (2010) suggest that any effect on the migration of salmon and sea trout will be likely be dependent on the depth of water and the proximity of the rivers to a development site. Given the central location of the modified OfTI in the context of the Moray Firth area, the uncertainties in relation to migratory patterns and the proximity of the proposed offshore cable landfalls to salmon and sea trout rivers (particularly those relevant to the Deveron and Spey SFDs) it is likely that salmon and sea trout will transit the area of the modified OfTI.

4.2.2.104 There is potential for EMFs generated by offshore export cables to result in a behavioural response on migrating salmon and sea trout (both adult and juveniles). However, as they normally swim in the upper metres of the water column during migration, salmon will not be exposed to the strongest EMFs. It is acknowledged that there may be increased exposure to EMF in sea trout, as the species is known to also forage in benthic habitats. However, the potential EMF footprint originating from the cable is likely to be small (e.g. tens of meters) in comparison to the total foraging habitat available.

4.2.2.105 Furthermore, salmon and sea trout use other cues for navigation in addition to the geomagnetic fields and these would more likely be prevalent in shallow areas in the proximity of the rivers. As shown in Figure 4.2-9, the predicted B fields are expected to decrease significantly within 5 m from the seabed. Assuming 1 m burial the expected B fields produced by the proposed cables will in all cases be well below the Earth's magnetic field.

4.2.2.106 Based on the above, salmon and sea trout are considered receptors of **medium sensitivity** and the effect is assessed to be **negative,** of **minor significance** and **probable.**

4.2.2.107 It is anticipated that the findings of MSS's current research into the behavioural responses of migratory fish to EMFs will contribute to increase the current knowledge in this field.

Other Fish Species

4.2.2.108 As indicated in Table 4.2-10 and Table 4.2-11, further to the species described above, there is some evidence of a response to EMFs for other teleost species such as cod and plaice. The results of monitoring programmes carried out in operational wind farms do not, however, suggest that EMFs have resulted in a detrimental effect on these species. Lindeboom *et al*., (2011) suggest that the presence of the foundations and scour protection and potential changes to the fisheries in the vicinity of offshore wind farm development, are expected to have the most effect upon fish species and that noise from the turbines and EMFs from cabling do not seem to have a major effect on fish and other mobile organisms attracted to the hard bottom substrates for foraging, shelter and protection (Leonhard & Pedersen, 2006). In line with this, research carried out at the Nysted offshore wind farm, focused on detecting and assessing possible effects of EMFs on fish during power transmission and found no differences in the fish community composition after the wind farm was operational (Hvidt *et al*., 2005). Whilst effects on the distribution and migration of four species were observed (European eel, flounder, cod and Baltic herring) it was recognised that the results were likely to be valid on a very local scale and only on the individual level, and that an effect on a population or community level was likely to be limited. In general terms it is considered that fish species/species groups other than those previously assessed are receptors of **low sensitivity** and the effect of EMFs is assessed to be **negative,** of **minor significance** and **unlikely.**

Shellfish Species

4.2.2.109 Limited research has been carried out to date on the ability of marine invertebrates to detect electromagnetic fields. Whilst there is to date no direct evidence of effects to invertebrates from undersea cable EMFs (Normandeau *et al*., 2011), the ability to detect magnetic fields has been studied for some species and there is evidence in some of a response to magnetic fields, including molluscs and crustaceans. However, it is generally accepted that effects derived from EMFs on invertebrates are limited to behavioural reactions rather than direct effects (Normandeau *et al*., 2011).

4.2.2.110 The functional role of the magnetic sense in invertebrates has been hypothesised to be for orientation, navigation and homing using geomagnetic cues (Cain *et al*., 2005; Lohmann *et* al., 2007). Crustacea, including lobster and crabs, have been shown to demonstrate a response to B fields, with the spiny lobster (Panulirus argus) shown to use a magnetic map for navigation (Boles and Lohmann; 2003). Concern has therefore been raised on the potential for EMFs to affect some invertebrate species during migration in the Moray Firth particularly edible crab (Cancer pagurus) and lobster (Homarus gammarus), both species commercially important in the area. As suggested by fisheries data, these species are found along the Caithness coast, in coastal areas off Fraserburgh and, to a lesser extent, in the proximity of the southern section of the offshore cable route.

4.2.2.111 Whilst there is no detailed information on the extent and preferred migration routes used by these species in the Moray Firth, given the central location of the modified OfTI there is potential for these species to encounter the offshore export cables

during migration. Limited research undertaken with the European lobster, found no neurological response to magnetic field strengths considerably higher than those expected directly over an average buried power cable (Ueno *et al*., 1986; Normandeau *et al*., 2011).

4.2.2.112 It should be noted that indirect evidence from monitoring programmes undertaken in operational wind farms do not suggest that the distribution of potentially magnetically sensitive species of crustaceans or molluscs have been affected by the presence of submarine power cables and associated magnetic fields. In this context, however, the lack of shellfish specific EMFs monitoring programmes should be recognised. Based on the above shellfish species are considered receptors of **low sensitivity** and the effect is assessed to be **negative,** of **minor significance** and **unlikely**.

Changes to Fishing Activity

4.2.2.113 Changes to fishing activity during the operational phase of the modified OfTI could potentially have an effect on fish and shellfish receptors. Primarily this would relate to those species which are commercially targeted and/or caught as by-catch, although a wider range of organisms may also be affected due to changes in seabed communities associated with seabed disturbance.

4.2.2.114 As the export cables and inter-array cables within the modified OfTI are expected to be buried, it is expected that fishing activity will continue as previously during the operational phase and therefore it is considered that there will be no changes to fishing activity within the vicinity of the modified OfTI and hence it is considered that there will not be an impact (positive or negative) to fish and shellfish populations (Chapter 5.1: Commercial Fisheries).

4.2.2.115 In the commercial fisheries assessment, effects on commercial fisheries above minor were not identified during the operational phase of the modified OfTI (Chapter 5.1: Commercial Fisheries). The potential for changes in fishing activity to impact on fish and shellfish ecology have therefore been assessed as negative, unlikely and of minor significance.

Decommissioning

4.2.2.116 In the absence of detailed decommissioning schedules and methodologies it is assumed that the sensitivity of receptors during the decommissioning phase will be the same as given for the construction phase. Similarly, the magnitude of effect is considered to be no greater and in all probability less than that considered for the construction phase. Therefore it is anticipated that any decommissioning effects would be no greater and probably less than that assessed for the construction phase. As piling is not expected to be necessary during decommissioning, effects associated with noise during this phase will likely be considerably smaller than those assessed for the construction phase above.

Proposed Monitoring and Mitigation

Construction and Decommissioning

4.2.2.117 No significant effects (e.g. above minor) have been identified on fish and shellfish ecology as a result of the construction/decommissioning phase of the modified OfTI. In order that mobile species are not exposed to the highest noise levels during piling, 'soft start' methods will be employed for installation of the OSP foundations.

Operation

4.2.2.118 Similarly, no significant effects (e.g. above minor) have been identified on fish and shellfish receptors for the operational phase of the modified OfTI. As mentioned in the assessment of EMFs, cable burial will reduce exposure of electromagnetically sensitive species to the strongest EMFs that exist at the "skin" of the cable owing to the physical barrier of the substratum (OSPAR, 2008). Similarly, where burial is not feasible, cable protection will ensure that fish and shellfish receptors are not in direct contact with the cable and will not be exposed to the strongest EMFs.

4.2.3 Cumulative Impact Assessment

Summary

4.2.3.1 This section presents the results of assessment of the potential cumulative effects upon fish and shellfish arising from the modified OfTI in conjunction with other existing or reasonably foreseeable marine coastal developments and activities. MORL's approach to the assessment of cumulative effects is described in Chapter 1.3: Environmental Impact Assessment.

4.2.3.2 A summary of the cumulative impact assessment is given below in Table 4.2-12. Likely significant cumulative effects (above minor) have been identified in relation to construction noise on a number of species, namely, cod, herring, salmon and sea trout. In addition, the potential for a significant cumulative effect associated to loss of habitat to occur on sandeels has been identified.

Table 4.2-12 Cumulative Impact Summary

Effect/Receptor	MORL Modified OfTI	Whole Project Assessment: Telford, Stevenson and MacColl and Modified OfTI	Mitigation Method
Temporary disturbance to the seabed (increased SSCs and sediment re-deposition)	General: Minor Salmon and sea trout: Minor	General: Minor Salmon and sea trout: Minor	None proposed
Overall CIA for Increased SSCs and Sediment Re-Deposition	General: Minor Salmon and sea trout: Minor		
Construction Noise	General : Minor Salmon and sea trout: Minor	General; Minor Cod and Herring: Minor following mitigation	Soft start piling
Overall CIA for Construction Noise	General : Minor Salmon and sea trout: Minor		
Habitat Loss	General: Minor	General: Minor	None proposed
Overall CIA for habitat loss	General: Minor		
EMFs	General: Minor	General: Minor	Cable burial/protection

Effect/Receptor	MORL Modified OfTI	Whole Project Assessment: Telford, Stevenson and MacColl and Modified OfTI	Mitigation Method
Overall CIA for EMFs	General: Minor		
Changes to fishing activity	General: No impact	General: No impact	None proposed
Overall CIA for changes to fishing activity	General: No impact		

Assessment of Cumulative Effects

4.2.3.3 This section details the assessment of cumulative effects upon fish and shellfish ecology arising from the modified OfTI and the three consented wind farm sites (Telford, Stevenson and MacColl) and the Beatrice offshore wind farm (BOWL), WDA, European Offshore Wind Development Centre (EOWDC), Neart na Gaoithe, Inch Cape, and Firth of Forth wind farms (Figure 4.2-9) in conjunction with other existing and foreseeable planned marine project/ development activities.

4.2.3.4 The geographical scope of the cumulative assessment is principally focused in the Moray Firth area. It is, however, recognised that some species may spend varying periods of time outside the Moray Firth and, as a result, there is potential for these to be affected by other activities / developments further afield.

4.2.3.5 The developments and activities considered in detail within this assessment are listed below:

- Beatrice Offshore Wind Farm (BOWL) and associated infrastructure;
- MORL Western Development Area (WDA) generating stations;
- EOWDC.

4.2.3.6 Developments that are at an earlier stage and for which there are limited development details at this stage, are also considered. The worst case scenarios for these projects are limited in detail and are as follows:

- Firth of Forth phase 1; – 2 x 75 turbine wind farms;
- Inch Cape Offshore Wind Farm; - 213 turbines, three met masts, five offshore substations and 6 offshore export cables; and
- Neart na Gaoithe Offshore Wind Farm; – 125 turbines and two offshore substations

4.2.3.7 The developments listed above are likely to have particular relevance to potential cumulative impacts on salmon and sea trout due to their wide ranging and relatively poorly defined migration pathways. Therefore the potential impacts of these developments are considered separately.

4.2.3.8 In addition, the following developments have been identified which may have cumulative effects over the life of the modified Project but where there is insufficient information available for a detailed assessment of cumulative effects to be carried out :

- Hywind;
- Kincardine Offshore Wind Farm;
- The SHE-T cable;
- Relevant oil and gas activities (Beatrice and Jacky platforms and associated infrastructure and Suncor);
- Tidal and wave energy developments in the Pentland Firth and Orkney Waters Strategic Area;
- Port and harbour developments in the Moray Firth;
- Dredging and sea disposal in the Moray Firth; and
- Relevant military activities.

4.2.3.9 The cumulative effects arising from dredging, sea disposal and port and harbour development in the Moray Firth have not been taken forward for assessment, since these are sporadic and typically short-term activities and concentrated along the coastline of the Moray Firth.

Methodology

4.2.3.10 The assessment methodology has followed that outlined in the Moray Firth Offshore Wind Developers Group Discussion Document (ERM, 2011; see Appendix 1.3 D of the MORL ES (MORL, 2012)).

Worst Case Scenario for Projects Where Detailed Assessment is Possible

4.2.3.11 A summary of the realistic worst case parameters of wind farm design for the BOWL project, the WDA and the EOWDC, in terms of fish and shellfish ecology, is provided in Table 4.2-13 to Table 4.2-16. Worst case parameters for the modified OfTI are provided in Table 4.2-3.

Table 4.2-13 Summary of the MORL Three Consented Wind Farms Worst Case Parameters

Worst case parameters	Scenario assessed
Construction noise	
Installation of 186 6 MW turbines and 2 met masts	Four 2.5m pin piles per foundation
Max. number of simultaneous piling events per wind farm	2
Increased suspended sediment concentration and sediment re-deposition	
Installation of 192 gravity bases (186 WTGs and 6 OSPs) Installation of 572 km of inter –array cabling (target burial depth of 1m)	Drilling to facilitate pin pile installation and seabed preparation for installation of gravity bases. Inter array cable burial by energetic means 1
Loss of Habitat and Introduction of New Habitat	
Installation of 192 gravity bases (186 WTGs and 6 OSPs) Installation of 572 km of inter –array cabling (target burial depth of 1m)	Gravity Bases each with total foot print area of 65m diameter
EMFs	
Estimated total length of Inter –array cabling	572 km

Table 4.2-14 Summary of BOWL Worst Case Parameters

Worst case parameters	Scenario assessed
Construction noise	
Installation of 140 turbines	Four pin piles (2.4m diameter) per foundation
Max. number of simultaneous piling events	2
Increased suspended sediment concentration and sediment re-deposition	
Installation of 143 gravity base foundations (turbines and OSPs) Length of inter-array cables = 325 km and trench width = 3 m. Length of export cable = 65 km	Drilling to facilitate pin pile installation and seabed preparation for installation of gravity bases. Inter array cable and export cable burial by energetic means
Loss of Habitat and Introduction of New Habitat	
Installation of 140 turbines if lowest rated (3.6 MW) turbines selected, plus 2 AC OSPs and 1 AC / DC substation. Gravity base and scour protection with combined permanent zone of influence of 11,690 m2 per foundation.	Total area of loss of original habitat and area of new hard substrata = 3.52 km2 equating to 2.7 % of the BOWL development area
EMFs	
Inter array cabling total length	325 km
Export cabling length	65 km

4.2.3.12 WDA Worst Case Parameters are provided in Table 4.2-16. The WDA comprises a part of the MORL Zone within which no wind farms have yet been applied for. MORL has been consented for 1,116MW within the Zone to date (within the three consented wind farms). The WDA could be developed for up to 500 MW, should the full consented capacity (1,116MW) for the three consented sites not be built out. Under any scenario, the maximum capacity of the entire Zone of 1.5GW, and will not be exceeded. The worst case parameters presented below are for 500 MW capacity within the WDA.

Table 4.2-15 Summary of WDA Worst Case Parameters

Worst case parameters	**Scenario assessed**
Construction noise	
Installation of 100 turbines	Jackets on pin piles (2.4m diameter) per foundation
Max. number of simultaneous piling events	2
Increased suspended sediment concentration and sediment re-deposition	
Installation of 101 gravity base foundations (turbines and OSPs) Length of inter-array cables = 130 km and trench width = 3 m. Length of export cable = Approx. 60 km	Drilling to facilitate pin pile installation and seabed preparation for installation of gravity bases. Inter array cable and export cable burial by energetic means
Loss of Habitat and Introduction of New Habitat	
Installation of 100 turbines and 1 AC OSPs and with GBS foundations & scour material. Cable protection associated with up to 4 J tubes per turbine assuming protection required up to 50 m distance from turbine and at 10 m width = 2,000 m2 per turbine;	Total area of loss of original habitat and area of new hard substrata = 1.20 km2 equating to 0.5 % of the WDA development area. Note: development within the WDA will offset development within Telford, Stevenson and MacColl.
EMFs	
Inter array cabling total length	130 km
Export cabling length	Approx. 60 km

Table 4.2-16 Summary of EOWDC Worst Case Parameters

Worst case parameters	**Scenario assessed**
Construction noise	
Installation of 11 turbines	Monopiles (8.5m diameter) per foundation
Max. number of simultaneous piling events	1
Increased suspended sediment concentration and sediment re-deposition	
Installation of 11turbines Installation of inter-array cables Installation of export cable	Gravity base foundations (40 m diameter) Max length 13 km Max length 26 km

Worst case parameters	Scenario assessed
Loss of Habitat and Introduction of New Habitat	
Installation of 11 turbines	Gravity base foundations (40 m diameter)
EMFs	
Inter array cabling total length	13 km
Export cabling length	26 km

Other Developments

4.2.3.13 Developments that are at an earlier stage and for which there are limited details at this stage, are also considered. Detailed cumulative impact assessment of these developments is not possible as insufficient information is available. Instead, a commentary on the potential for cumulative effects on the basis of the information available is presented but no quantitative conclusions on the likely significance of any impacts can be drawn. Projects for which a detailed cumulative impact assessment is not possible due to a lack of sufficient information include:

- Hywind;
- Kincardine Offshore Wind Farm;
- The SHE-T cable;
- Relevant oil and gas activities (Beatrice and Jacky platforms and associated infrastructure and Suncor);
- Tidal and wave energy developments in the Pentland Firth and Orkney Waters Strategic Area;
- Port and harbour developments in the Moray Firth;
- Dredging and sea disposal in the Moray Firth; and
- Relevant military activities.

Cumulative Assessment

4.2.3.14 The types of effects considered in this assessment are:

- Temporary disturbance to the seabed (Increased SSCs and sediment re-deposition);
- Underwater Noise;
- Habitat Loss; and
- EMFs.

4.2.3.15 As the cables of the modified TI will be buried where possible, it is expected that normal fishing activity will resume within the vicinity of the modified OfTI, therefore, the contribution of the modified OfTI to the cumulative impact of changes to fishing activity will be of negligible significance. As a result, changes to fishing activity is scoped out of the assessment

Temporary Disturbance to the Seabed (Increased SSCs and Sediment Re-deposition)

4.2.3.16 The release of sediment into the water column as a result of construction works being carried out simultaneously in adjacent areas may result in an effect on fish and shellfish species. The likely cumulative impact of multiple and simultaneous sources of sediment release is detailed in Chapter 3.1 (Hydrodynamics, Sedimentary and Coastal Processes). This takes account of the following:

- The receptors identified for the three consented wind farms, modified OfTI and BOWL foundation installation (drilling for pin piles or bed preparation of GBS);
- The three consented wind farms, modified OfTI and BOWL inter array cable burial; and
- The three consented wind farms, modified OfTI and BOWL transmission cable burial.

4.2.3.17 The maximum cumulative result of interaction between sediment plumes is an additive increase in SSCs. As indicated in Chapter 3.1 (Hydrodynamics, Sedimentary and Coastal Processes) no significant cumulative effects are expected as a result of this. Similarly, **no significant cumulative effects** in terms of sediment re-deposition have been identified in Chapter 3.1 (Hydrodynamics, Sedimentary and Coastal Processes).

4.2.3.18 Taking the above into account the construction phase of the BOWL site is expected to result in effects of **minor significance** on fish and shellfish receptors. The cumulative effect of increased SSCs and sediment re-deposition is therefore considered to be of **minor significance** on fish and shellfish in general.

Salmon and Sea Trout

4.2.3.19 In the case of salmon and sea trout, in addition to the above, SSCs and sediment re-deposition associated with installation activities in the EOWDC project, may further contribute to the potential cumulative effects identified above for fish and shellfish in general, assuming salmon and sea trout also transit the Aberdeen Bay area during migration. Given the small number of foundations needing installation in the EOWDC (11) and the relatively small amount of cable installation disturbance through increased SSCs, it is expected to result in an effect of **minor significance** on salmon and sea trout.

4.2.3.20 Should the migratory pathways of salmon and sea trout take them into close proximity to the EOWDC, Neart na Gaoithe, Inch Cape and SeaGreen wind farms they may also be subject to increased SSCs related to construction activities from these developments. However, any increases in SSCs will be limited both temporally and spatially.

4.2.1.60 Taking the above into account, the cumulative effect associated with increased SSCs and sediment re-deposition on salmon and sea trout is assessed to be of minor significance.

Underwater Noise

4.2.3.21 For assessment of the cumulative impact of construction noise, it is possible that piling operations may take place simultaneously at the BOWL project, the three consented wind farm sites and the OSPs of the modified OfTI.

4.2.3.22 Worst case cumulative noise scenarios were modelled taking the potential maximum of eight simultaneous piling operations (six at Telford, Stevenson and MacColl / WDA and two at BOWL). The outputs of these are provided in Chapter 3.6

(Underwater Noise) of the MORL ES (MORL, 2012) and Technical Appendix 4.2 A for herring, cod, salmon and dab.

4.2.3.23 The expected impact ranges taking the cumulative scenario are similar to those expected from piling at six locations within Telford, Stevenson and MacColl. The noise effects associated to piling at BOWL, given the smaller number of piling operations needed (installation of a maximum of 140 turbines), the maximum of two piling operations proposed and the modelled impact ranges, are expected to be of minor significance on fish and shellfish species in general. An exception to this is the effect on cod and herring. Given the uncertainties in relation to the use that these species make of the Moray Firth area, particularly in relation to the extent and relative importance of the area in terms of spawning grounds, there may be potential for effects of minor to moderate associated with noise during construction of the BOWL site to occur.

4.2.3.24 Taking the above into account construction noise is considered to result in a cumulative effect of **minor** significance on fish and shellfish in general with the exception of cod and herring, for which a cumulative effect of **moderate** significance may occur.

Salmon and Sea Trout

4.2.3.25 In addition to the assessment for general species given above, due to the migratory behaviour of salmon and sea trout, additional projects have been included as part of the cumulative assessment. Given the relatively small ranges associated with two piling operations at BOWL, noise derived from construction work at BOWL is considered to result in an effect of **minor significance** on salmon and sea trout.

4.2.3.26 Assuming that the migratory pathways of salmon and sea trout take them into close proximity to the EOWDC, Neart ne Gaoithe, Inch Cape and Firth of Forth wind farms they may also be subject to noise generated during construction of these developments.

4.2.3.27 Taking the potential for salmon and sea trout to be exposed to construction noise not only in the Moray Firth area but also further afield, the cumulative effect of construction noise on these species is assessed to be of **minor to moderate** significance.

4.2.3.28 It should be noted that the potential for a cumulative effect to occur will be dependent on the construction schedules on the timing and migration route taken by salmon and sea trout populations from different rivers, and on the degree of overlap between these, and areas impacted by construction noise.

4.2.3.29 The impact assessment on these species has taken a precautionary approach, where conservative assumptions have had to be applied as a result of the uncertainty surrounding currently available information on the use that these species may make of the areas during the construction phase.

4.2.3.30 In order to mitigate this uncertainty, MORL is committed, in consultation with Marine Scotland and the relevant fisheries stakeholders, to strategic monitoring and research to help improve the knowledge base on salmon population ecology and migratory movements within the Moray Firth to help inform whether mitigation is required and, if so, to define feasible measures in order to reduce the significance of the likely effects.

Loss of Habitat

4.2.3.31 The installation of the BOWL project will result in an incremental loss of habitat as successive placement of foundations onto the seabed occurs. This will add to that resulting from the three consented windfarms and the modified OfTI. The loss of seabed area is however likely to be small in relation to the total extent of available habitat. The loss of habitat resulting from both the BOWL site, the three consented wind farms and the modified OfTI is therefore expected to result in an effect of negligible to minor significance on fish and shellfish species. The cumulative effect arising from this is therefore assessed to be of **minor** significance.

4.2.3.32 In the particular case of sandeels, the potential for a cumulative impact to occur will be dependent on the location of high density sandeel patches, the overall distribution of sandeel habitat in the Moray Firth and the degree of overlap between these and wind farm related infrastructure. The results of the sandeel survey undertaken, suggest that there are not extensive areas supporting important sandeel populations in the three consented wind farms sites. A specific sandeel survey has not been undertaken for the modified OfTI, however, utilising the benthic particle size distribution (PSD) data, station KPA2 contains substrates suitable for sandeels, and therefore it is possible that sandeels could be present.

4.2.3.33 Taking the relatively small area expected to be lost through the installation of the BOWL project, the three consented windfarms and the modified OfTI, the effect of loss of habitat on sandeels is expected to be of **minor** significance. The distribution and relative importance of the BOWL site and the wider Moray Firth in terms of sandeel distribution, are however currently unknown. In light of this and taking a precautionary approach, the cumulative effect of loss of habitat on sandeels is considered to be of **minor to moderate** significance.

Salmon and Sea Trout

4.2.3.34 The introduction of the EOWDC, Neart na Gaoithe, Inch Cape and Firth of Forth windfarms will further contribute the loss of seabed habitat for salmon and sea trout. The loss of seabed area is however likely to be small in relation to the total extent of available habitat therefore, the cumulative effect of loss of habitat on salmon and sea trout is considered to be, as assessed for fish and shellfish in general above, of **minor** significance.

EMFs

4.2.3.35 The adjacent location of BOWL will result in an increase in the spatial extent of EMF related effects associated with the operational phase of the modified OfTI.

4.2.3.36 Post-construction monitoring undertaken in operational wind farms to date, does not suggest that EMF related effects have had a significant detrimental effect on fish and shellfish species. EMF related effects resulting from the three consented wind farms, the BOWL project and the WDA are therefore considered to be of minor significance. Therefore the cumulative effect associated with the modified OfTI on fish and shellfish species in general is considered to be of **minor** significance.

Salmon and Sea Trout

4.2.3.37 There is potential for salmon and sea trout to be exposed to EMF related effects associated with the EOWDC, Neart na Gaoithe, Inch Cape and Firth of Forth windfarms. However, as they normally swim in the upper metres of the water column during migration, salmon and sea trout will not, for the most part, be exposed to the strongest EMFs. It is acknowledged that there is an increased potential for exposure to EMF in sea trout, as the species is known to also forage in benthic habitats.

However, the potential EMF footprint originating from the cable is likely to be small (e.g. tens of meters) in comparison to the total foraging habitat available. In light of these considerations and in addition to the results of the EMF modelling provided in Technical Appendix 4.3 D in the MORL ES (MORL, 2012) for AC cables, the effect of EMFs during the operational phase of the developments under consideration are considered to be of minor significance. The cumulative effect of EMF on salmon and sea trout, is therefore considered to be as assessed above for fish and shellfish in general, of **minor** significance.

Other Developments

Construction

4.2.3.38 There is potential for increased SSCs and sediment re-deposition and noise associated to construction works in other marine developments / activities to occur on fish and shellfish, including installation of the SHE-T cable, Oil and Gas and military activities in the Moray Firth. The potential for a cumulative impact to occur will depend on the location and nature of these activities.

4.2.3.39 In the particular case of herring, as spawning of the Orkney / Shetland stock primarily takes place in the area between the Orkney and the Shetlands, there might be also potential for suspended sediment concentrations, sediment re-deposition and construction noise associated with the Pentland Firth and Orkney waters marine energy developments to further contribute to cumulative impacts.

4.2.3.40 In addition to the above, there is potential for Salmon and Sea Trout to be subject to increased SSCs, sediment re-deposition and construction noise associated to construction works in the proposed offshore wind farm developments in the Firth of Forth.

4.2.3.41 It is appropriate to adopt a precautionary approach in light of uncertainties surrounding the developments considered here. However, it is important to consider that the potential for a cumulative effects to occur will be entirely dependent on the degree of overlap (if any) in construction schedules.

Operation

4.2.3.42 Other offshore developments, including the SHE-T cable, potential future oil and gas related infrastructure and the proposed Pentland Firth and Orkney waters marine renewable developments, may further contribute to any cumulative effects associated to loss of habitat and EMFs and changes to fishing activity during the operational phase. Given that for all three of these, potential effects were generally not assessed to be above minor. It is considered unlikely that the modified OfTI will further contribute to any significant cumulative effect.

Habitats Regulations Appraisal

Modified OfTI

4.2.3.43 As part of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (the 'Habitats Regulations') it is required that the likely effect of the modified OfTI on Atlantic salmon and sea lamprey SAC populations be assessed. These species are qualifying features and primary reasons for selection of a number of SACs in the Moray Firth. In addition to these species, freshwater pearl mussel is also a primary reason for selection of a number of SACs. Given the central location of the modified OfTI relative to the habitat of the species (restricted to freshwater) it is not considered that freshwater pearl mussel SAC populations will be directly affected

through construction/decommissioning or operation of the modified OfTI. It was agreed with SNH that freshwater pearl mussel would be scoped out of the terrestrial ecology assessment, and this is further discussed in the Terrestrial Ecology chapter (Chapter 4.6). It is however recognised that SAC populations of this species may be indirectly affected if significant effects on their host species (salmon and sea trout in particular) occur.

4.2.3.44 Through the implementation of the Habitats Directive and as a result of the European importance of Scotland's salmon populations, eleven Scottish rivers have been designated as Special Areas of Conservation (SACs), with salmon being a primary reason for the selection of the sites. Of these, the River Spey is the closest SAC located to the modified OfTI, is and the salmon population is considered of high quality.

4.2.3.45 As specified in the JNCC and SNH scoping response (28/10/2010 and 29/05/2014), the SACs needing assessment in relation to fish and shellfish resources are as follows:

- River Spey SAC;
- Berriedale & Langwell Waters SAC;
- River Evelix SAC;
- River Moriston SAC ;
- River Oykel SAC; and
- River Thurso SAC.

4.2.3.46 The qualifying status of the SAC species and the conservation objectives of each relevant SAC are given in Table 4.2-18

Table 4.2-17 Qualifying status of SAC species and SAC conservation objectives (SNH, 2012)

SAC	Qualifying Species	Conservation Objective
River Spey	**Freshwater pearl mussel;** Primary reason for SAC selection **Atlantic salmon:** Primary reason for SAC selection **Sea lamprey**: Primary reason for SAC selection **Otter:** Primary reason for SAC selection	• To avoid deterioration of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying features. • To ensure for the qualifying features that the following are maintained in the long term: 1. Population of the species (including range of genetic types for Atlantic salmon only) as a viable component of the site; 2. Distribution of species within site; 3. Distribution of extent of habitats supporting the species; 4. Structure, function and supporting processes of habitats supporting the species; 5. No significant disturbance of the species; 6. Distribution and viability of the species' host species (for freshwater pearl mussel and sea lamprey); and 7. Structure, function and supporting processes of habitats supporting the species' host (for freshwater pearl and sea lamprey)

SAC	Qualifying Species	Conservation Objective
Berriedale & Langwell Waters	**Atlantic salmon:** Primary reason for SAC selection	• To avoid deterioration of the habitats of Atlantic salmon or significant disturbance to Atlantic salmon, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and • To ensure for the qualifying species that the following are maintained in the long term: 1. Population of the species, including range of genetic types for salmon, as a viable component of the site; 2. Distribution of the species within the site; 3. Distribution and extent of habitats supporting the species; 4. Structure, function and supporting processes of habitats supporting the species; and 5. No significant disturbance of the species.
River Evelix	**Freshwater pearl mussel:** Primary reason for SAC selection	• To avoid deterioration of the habitats of freshwater pearl mussels or significant disturbance to freshwater pearl mussels, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and • To ensure for the qualifying species that the following are maintained in the long term: 1. Population of the species as a viable component of the site; 2. Distribution of the species within the site; 3. Distribution and extent of habitats supporting the species; 4. Structure, function and supporting processes of habitats supporting the species; 5. No significant disturbance of the species; 6. Distribution and viability of the species' host species; and 7. Structure, function and supporting processes of habitats supporting the species' host species.
River Moriston	**Freshwater pearl mussel:** Primary reason for SAC selection **Atlantic salmon:** Qualifying feature for SAC selection	• To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and • To ensure for the qualifying species that the following are maintained in the long term: 1. Population of the species, including range of genetic types for salmon, as a viable component of the site; 2. Distribution of the species within the site; 3. Distribution and extent of habitats supporting

SAC	Qualifying Species	Conservation Objective
		the species; 4. Structure, function and supporting processes of habitats supporting the species; 5. No significant disturbance of the species; 6. Distribution and viability of freshwater pearl mussel host species; and 7. Structure, function and supporting processes of habitats supporting fresh water pearl mussel host species.
River Oykel	**Freshwater pearl mussel:** Primary reason for SAC selection **Atlantic salmon**: Qualifying feature for SAC selection	As above
River Thurso	**Atlantic salmon:** Primary reason for SAC selection	Idem as for the Berriedale & Langwell Waters SAC

4.2.3.47 For the SACs detailed in section 1.3, the effects on the relevant fish and shellfish qualifying species have been assessed based on the Conservation Objectives outlined previously in 6.1-1 as follows:

1. Deterioration of the habitats of the qualifying species.
2. Significant disturbance to the qualifying species.
3. Changes in the distribution of the species within the site.
4. Changes in the distribution and extent of habitats supporting the species.

4.2.3.48 In addition, in the particular case of Atlantic salmon, sea lamprey and freshwater pearl mussel SAC populations, the following criteria have been also been taken into account for assessment:

5. Changes to the population of the species, (including range of genetic types of salmon) as a viable component of the site.
6. Structure, function and supporting processes of habitats supporting the species;
7. Changes to the distribution of freshwater pearl mussel and sea lamprey host species and to the structure, function and supporting processes of habitats supporting fresh water pearl mussel and sea lamprey host species.

4.2.3.49 It should be noted that, as indicated by JNCC/SNH in their scoping response, in the case of salmon, it is not possible to conclusively identify from/to which SAC watercourses any particular individuals (post smolts or adults) are coming or going. The assumption that all individuals are SAC salmon should therefore be made. As a result the effects identified for salmon are considered to be applicable to any of the relevant SACs. In the case of freshwater pearl mussel, as any effect on the SAC populations could only be a result of their host species being adversely affected (salmon and sea trout) the same limitation applies. In order to assess likely effects on freshwater pearl mussel SAC populations it has therefore been assumed that the effects identified for Atlantic salmon apply to the freshwater pearl mussel's host species in the relevant SACs.

4.2.3.50 A summary assessment of the potential effect of the modified TI on the relevant Atlantic salmon, freshwater pearl mussel and sea lamprey SAC populations is given in Table 4.2-18 below.

Table 4.2-18 Assessment of Effects on Qualifying Species in the Relevant SACs per Criterion

Species	criterion	Assessment
Atlantic salmon	1	The habitat of the SACs will not be subject to any direct deterioration as a result of the construction/ decommissioning or operation of the modified OfTI as these are located in freshwater habitats. Deterioration of the marine habitats of Atlantic salmon could however theoretically occur. However,: Chapter 4.1 (Benthic Ecology) predicts not significant to minor effects on benthic habitats associated with the modified OfTI. Chapter 4.2 (Fish and Shellfish Ecology) predicts no potential for effects above minor associated to changes to fishing activity to occur. Deterioration of the marine habitats of Atlantic salmon are therefore not expected to occur.
	2	This chapter predicts that disturbance through increased SSC, sediment re-deposition, noise during construction and EMFs will result in minor effects which would likely only occur at the level of individuals as opposed to population. Significant disturbance to the qualifying species population are therefore not expected to occur.
	3	Changes to the distribution of the species are not expected in the site as no significant disturbance to the species or its habitat has been identified
	4	As assessed for criterion 1
	5	As assessed in criteria 1, 2, 3 and 4
	6	Based on assessment for criteria 1, structure, function and supporting processes of habitats supporting the species are expected to be maintained.
Freshwater Pearl Mussel	1	The freshwater pearl mussel SACs are located in-river, some distance from the modified OfTI. The habitat of the SACs will not be subject to direct deterioration as a result of the construction / decommissioning or operation of modified OfTI.
	2	Given the distribution of freshwater pearl mussel (restricted to the freshwater habitats) direct disturbance to the species has no potential to occur. In addition, as the established distribution and viability of the host species population (salmon) is not expected to be impacted, impacts on freshwater pearl mussel populations (driven indirectly) are not expected to occur
	3	Given the distribution of the species (restricted to the freshwater habitat) direct changes to the distribution of the species in any of the SACs associated with the to modified OfTI has no potential to occur.
	4	As assessed for criterion 1
	5	As freshwater mussel populations are located in freshwater habitats they will not be subjected to any direct impacts relating to the modified OfTI which could potentially alter population structure. Furthermore, the established distribution and viability of the host species population (salmon) is not expected to be impacted. Therefore, indirectly driven impacts on freshwater pearl mussel populations are not expected to occur.
	6	Based on assessment for criteria 1, structure, function and supporting processes of habitats supporting the species are expected to be maintained.
	7	As assessed for criteria 1, 2, 3, 4 and 5 for Atlantic salmon.

Sea Lamprey	1	The Spey SAC is located some distance from the modified TI. The habitat of the SAC will not be subject to any direct deterioration as a result of the construction/ decommissioning or operational phase of the modified OfTI. Deterioration of the marine habitats of sea lamprey could however theoretically occur: Chapter 4.1 (Benthic Ecology) predicts not significant to minor effects on benthic habitats. Chapter 4.2 (Fish and Shellfish Ecology) predicts no potential for effects above minor associated to changes to fishing activity to occur. Therefore no significant deterioration of the marine habitats of the qualifying species are expected to occur.
	2	There is no potential for disturbance to the qualifying species in Freshwater habitats. Chapter 4.2 (Fish and Shellfish Ecology) predicts that disturbance through increased SSC, sediment redeposition, noise during construction, and EMFs will result in minor effects. Significant disturbance to the qualifying species in the marine environment is therefore not expected occur.
	3	Changes to the distribution of the species are not expected in the site as no significant disturbance to the species or its habitats has been identified (See assessment against criteria 1 and 2 for sea lamprey).
	4	As assessed for criterion 1.
	5	As assessed for criteria 1, 2, 3 and 4.
	6	As assessed for criteria 1 Based on assessment for criteria 1, structure, function and supporting processes of habitats supporting the species are expected to be maintained.
	7	As assessed for 1,2,3,4 and 5 for Atlantic salmon.

4.2.3.51 On the basis of the assessment summarised above, it is considered that the conservation objectives for the SACs under consideration will not be affected as a result of the construction, operation and decommissioning of the modified OfTI. Similalrly, it is anticipated that the favourable status of salmon, freshwater pearl mussel and sea lamprey will be upheld. Overall the conclusion of the assessment that the integrity of the SACs under consideration will not be impacted.

In-Combination HRA

4.2.3.52 The relevant SACs requiring in-combination assessment in relation to fish and shellfish resources are as specified in the preceding section. Similarly, the qualifying status of the SAC species and the conservation objectives of each relevant SAC are as provided in Table 4.2-17. A summary assessment of the potential in-combination effect of the modified TI in combination with the developments outlined in section 4.2.3 on the relevant Atlantic salmon, freshwater pearl mussel and sea lamprey SAC populations is given below in Table 4.2-19

Table 4.2-19 In-Combination Assessment of Effects on Qualifying Species in the Relevant SACs per Criterion

Species	Criterion	Assessment
Atlantic salmon	1	The salmon SACs are located in freshwater habitats that are at a considerable distance from the Project, the BOWL site and associated TI, the EOWDC and other developments in the Firth of Forth and elsewhere. The habitat of the SACs will not be subject to any direct deterioration as a result of the in-combination effect of the construction/ decommissioning or operation of the modified OfTI. Deterioration of the marine habitats of Atlantic salmon could however theoretically occur: Chapter 4.1 (Benthic Ecology) predicts negligible to minor effects on benthic habitats. Chapter 4.2 (Fish and Shellfish Ecology) predicts minor effects associated to loss of habitat and introduction of new habitat and no potential for effects above minor associated to changes to fishing activity to occur. The habitat of the SACs will not be subject to any direct deterioration as a result of the in-combination effect of the construction/ decommissioning or operation of the modified OfTI. Therefore, in combination deterioration of the marine habitats of Atlantic salmon are not expected to occur.
	2	The in-combination assessment predicts disturbance through increased SSC, sediment re-deposition and EMFs will results in a minor in-combination effect. Noise during construction, has however been considered to have potential to result in minor to moderate effects on Atlantic salmon. Significant disturbance to the qualifying species may therefore occur in-combination.
	3	Significant disturbance to the species has been identified in relation to in-combination construction noise. Significant disturbance to the habitat of the species is however not expected to occur (See assessment against criteria 1 and 2 above). Taking the above into account, there might be potential for changes to the distribution of the species in the site to occur. This will however depend on the degree of overlap between construction noise and migrating salmon.
	4	As assessed for criterion 1.
	5	As assessed in criteria 1, 2, 3 and 4
	6	Based on assessment for criteria 1, structure, function and supporting processes of habitats supporting the species are expected to be maintained.
Freshwater Pearl Mussel	1	The freshwater pearl mussel SACs are located at a considerable distance from the Project, the BOWL site the EOWDC, and those developments located in the Firth of Forth and elsewhere. The habitat of the SACs will not be subject to any direct deterioration as a result of the construction / decommissioning or operation of these developments.
	2	Given the distribution of freshwater pearl mussel (restricted to the freshwater habitat) direct disturbance to the species has no potential to occur in combination.
	3	Given the distribution of the species (restricted to the freshwater habitat) direct changes to the distribution of the species in any of the SACs associated to modified OfTI has no potential to occur.
	4	As assessed for criterion 1.
	6	Based on assessment for criteria 1, structure, function and supporting processes of habitats supporting the species are expected to be maintained.

Species	Criterion	Assessment
	7	As assessed for criteria 1, 2, 3, 4 and 5 for Atlantic salmon.
Sea Lamprey	1	The Spey SAC is located some distance from the three consented MORL wind farms modified TI, the BOWL site and associated TI, the EOWDC and other developments in the Firth of Forth and elsewhere. The habitat of the SAC will not be subject to any direct deterioration as a result of the construction/ decommissioning or operational phase of the modified OfTI or other projects under consideration. Deterioration of the marine habitats of sea lamprey could however theoretically occur: Chapter 4.1 (Benthic Ecology) predicts not significant to minor effects on benthic habitats. This chapter predicts no potential for effects above minor associated with changes to fishing activity to occur. Therefore no in-combinadeterioration of the marine habitats of the qualifying species are expected to occur.
	2	The in-combination assessment predicts disturbance through increased SSC, sediment re-deposition, EMFs and noise will result in a minor effect on sea lamprey.Therefore significant in-combination disturbance to the qualifying species is not anticipated to occur.
	3	Changes to the distribution of the species are not expected to occur in-combinaion as no significant disturbance to the species or its habitats has been identified (See assessment against criteria 1 and 2 for sea lamprey).
	4	As assessed for criterion 1.
	5	As assessed for criteria 1, 2, 3 and 4.
	6	As assessed for criteria 1, 2, 3 and 4.
	7	As assessed for 1,2,3,4 and 5 for Atlantic salmon.

4.2.3.53 The above HRA relating to the relevant SACs for the modified OfTI have determined that there is potential for combination effects on the SAC populations of Atlantic salmon to occur. As a result, there may also be potential for indirect in-combination effects on freshwater pearl mussel and sea lamprey SAC populations.

4.2.3.54 It is important to consider that the assessment of the effects on Atlantic salmon necessitated a precautionary approach due to the limited information currently available in relation to the use that Atlantic salmon make of the Moray Firth area and other coastal waters around Scotland. In addition, it is not possible to conclusively identify which SAC watercourses individuals from any population originate from (post smolts or adults), the conservative assumption being that the natal habitats of all individuals are SAC rivers.

4.2.3.55 The Appropriate Assessment undertaken by Marine Scotland Licensing Operations Team (MS-LOT) for the three consented MORL wind farms and associated transmission infrastructure as detailed in the MORL ES (MORL, 2012) concluded that the project would not adversely affect the site integrity of any of the Atlantic Salmon, Freshwater Pearl Mussel, or Sea Lamprey SACs assessed above, either alone, or in-combination with the BOWL development and other projects that have also been consented.

4.2.3.56 With respect to Atlantic Salmon SACs, MS-LOT considered that this was possible by agreement of working practice and mitigation that relate to the effects via conditions on any consents, as follows:

- Soft start for piling work could be expected to help mobile fish move out of the area and thereby assist in mitigating against noise disturbance to individuals during construction.

- Piling schedules and construction programmes should be further discussed, post-consent, between MS-LOT, MSS, the Association of Salmon Fishery Boards ("ASFB"), the SNCBs and developers, once turbine layouts, numbers and foundation choices and have been confirmed. It is noted that the zone of predicted noise impacts for Atlantic salmon is based on a 'worst case' scenario which may not occur.

- Strategic monitoring and research will help to improve the knowledge base on salmon population ecology and migratory movements in Scottish waters and may help inform mitigation proposals.

4.2.3.57 MS-LOT further concluded that:

> "The installation of the export cables close to shore could take a matter of days so that mitigation, or avoidance, of impacts to smolts could be possible by timing the work to avoid peak smolt runs (if the timing of these can be established). This mitigation should be progressed in post-consent discussions between MS-LOT, MSS, the ASFB, the SNCBs and developers. In relation to potential cumulative impacts arising from EMF around intra-array and export cables, proposed mitigation to shield / bury cables will help to reduce EMF. For Atlantic salmon, it is recommended that deeper burial depth or directional drilling removes the risk of any operational effect (the SNCBs advised up to 3m, where possible) i.e. for export cables in shallower water approaching landfall (water depths of up to ~20m). Where cable burial or directional drilling is not possible, rock armouring or a similar protective layer should be considered. It is considered that potential impacts from cable installation can be reduced or avoided and that while there may be some noise disturbance to individual salmon, the effects do not risk the integrity of SAC populations; but do merit further research and quantification. The SNCBs have advised that operational noise will not result in likely significant effects to salmon."

4.2.3.58 In consultation with Marine Scotland, DSFBs and other relevant stakeholders MORL has committed to undertake appropriate survey work and monitoring with the objective of increasing confidence in the impact assessment and identifying appropriate mitigation where required. Significance of likely effects will therefore be reduced to levels that are satisfactory to both regulators and stakeholders. It is the intention of MORL to continue this cooperative consultation with regard to the modified OfTI.

4.2.3.59 With this commitment in mind, and in light of the conclusions of the Appropriate Assessment previously undertaken by MS-LOT in respect of the three consented MORL wind farms and associated export cable, it is expected that no adverse in-combination effects on any Conservation Objectives will occur, and no changes are expected to the population viability of Atlantic salmon, freshwater pearl mussel or sea lamprey in any of the SACs assessed above.

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