24 OFFSHORE TRANSMISSION WORKS MARINE MAMMALS

24.1 INTRODUCTION

1. This section of the ES evaluates the likely significant effects of the construction, operation and decommissioning of the OfTW on marine mammals. The assessment is based on a characterisation of the baseline environment for cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals), describing their abundance and distribution across the Project area, including the whole of the Moray Firth (defined as the 'Study Area'). Reference is also made to cetacean and pinniped populations over a wider geographic area due to the highly migratory nature of marine mammals.

2. The following technical reports support the assessment within this Section:

- Annex 7A: Underwater Noise Modelling Technical Report;
- Annex 7B: OfTW Underwater Noise Technical Report;
- Annex 12A: Updated Technical Report Summarising Information on Marine Mammals Which Occur in the Moray Firth, including the following appendices:
  - Appendix 1: Thompson and Brookes (2011) Technical report on pre-consent marine mammal data gathering at the BOWL and MORL wind farm sites;
  - Appendix 2: Thompson (2011) Bottlenose dolphin densities across the Moray Firth;
  - Appendix 3: SMRU (2011) Grey seal usage maps for MORL/BOWL developments.
- Annex 12B: Framework for Assessing the Impacts of Pile-Driving Noise From Offshore Windfarm Construction on Moray Firth Harbour Seal Populations.

3. This section includes the following elements:

- Assessment Methodology and Significance Criteria;
- Baseline Conditions;
- Development Design Mitigation;
- Assessment of Potential Effects;
- Mitigation and Monitoring;
- Residual Effects;
- Summary of Effects;
- Statement of Significance; and
- References

4. An assessment of cumulative effects of the OfTW with other developments is contained in Section 12: Wind Farm Marine Mammals.

24.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

24.1.1.1 Scope of Assessment

5. The scope includes a description of all marine mammal species, from resident populations through to infrequent visitors, which are known to occur within the defined Study Area. The European otter *Lutra lutra,* which inhabits the nearshore

marine environment will be considered in the ES that accompanies the application for the OnTW.

6. The assessment focuses on a number of key marine mammal species that were identified during the desktop review and site-specific studies as regularly occurring within the Study Area and therefore most likely to be affected by the OfTW. These species include bottlenose dolphin *Tursiops truncatus*, harbour porpoise *Phocoena phocoena*, minke whale *Balaenoptera acutorostrata*, common dolphin *Delphinus delphis*, white-beaked dolphin *Lagenorhynchus albirostris*, Risso's dolphin *Grampus griseus*, harbour (or common) seal *Phoca vitulina*, and grey seal *Halichoerus grypus*.

7. Particular attention is paid to existing and proposed ecological conservation measures within the defined Study Area. Two SACs designated under the Habitats Directive (92/43/EEC) lie within the inner Moray Firth (Figure 8.1). The effects on the Moray Firth SAC (designated for bottlenose dolphins) and the Dornoch Firth and Morrich More SAC (designated for harbour seal) have been assessed in order to determine whether there is likely to be a significant effect on the ecological integrity of these two sites. A Report to inform an Appropriate Assessment is provided in a separate document that will follow this ES.

24.2.1 POLICY AND PLANS

8. This ES has been prepared in the context of the key legislation and guidance documents related to marine mammals and offshore wind farm development. The assessment methodology has taken into account the following key guidance documents:

- IEEM (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland. Marine and Coastal;
- Defra et al. (2004). Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in respect of FEPA and CPA requirements. Version 2 June 2004. Prepared by CEFAS for MCEU;
- Defra (2005). Nature Conservation guidance on offshore wind farm development. Version 1.9;
- Joint Nature Conservation Committee et al. (2009). Statutory nature conservation agency protocol for minimising the risk of disturbance and injury to marine mammals from piling noise. JNCC June 2009;
- Joint Nature Conservation Committee (2008). The deliberate disturbance of marine European Protected Species. Guidance for English and Welsh territorial waters and the UK offshore marine area; and
- Joint Nature Conservation Committee et al. (2010). The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area.

9. Other receptor-specific documents include:

- JNCC (2010). Corkscrew Seal Injuries – Draft Minutes of Meeting held on 5th July 2011; and
- Thompson, P.M. and Hastie, G. (*in prep*) Proposed revision of noise exposure criteria for auditory injury in pinnipeds (see Annex 12B for details).

24.2.2 CONSULTATION

10. This ES takes account of the consultation opinions from stakeholders (see Section 5: Consultation) in response to the Scoping Report prepared for the OfTW (BOWL, 2011). The key consultees who provided responses relevant to marine mammals included MS, SNH, JNCC, WDCS, and the RSPB.

Table 24.1 Summary of Responses from Consultees

Consultee	Summary of Consultation	Project Response
Marine Scotland	There should be calculations to indicate the degree of alteration of natural fields (EMF) that would be caused by the cables, the predicted changes should then be compared to what is known about the sensitivity of marine mammals to EMF.	Section 24.1.1.25
	In order to mitigate against corkscrew injuries to seals an MMO protocol will be required along with EMP 3 months prior to construction.	Potential for corkscrew injuries and mitigation is discussed in Section 24.1.1.22.
SNH	Need to consider the strong connectivity between the Moray Firth SAC and Study Area.	Baseline describes movement of resident bottlenose dolphin between SAC and Study Area (Para 57)
	Noise impacts on cetaceans also need to be considered at both shore landing points.	The cable landfall point has yet to be confirmed but will be to the west of Portgordon between NGR: NJ 38614 64277 to NJ 37525 64629, effects along this section of coastline are considered in this assessment.
	Indirect effects of noise on prey species will need consideration.	This has been included (see Section 24.1.1.24).
	Total will be laying a pipeline near a seal SAC on Shetland this summer – mitigation measures for Directional Positioning (DP) vessels may be relevant.	Mitigation for DP vessels considered in Section 24.5.
	Need to consider an area off Fraserburgh coast which has been suggested as a Marine Protected Area (MPA) of importance for minke whale.	Minke Whale distribution has been considered in this ES however given the lack of availability of information from SNH on this non-statutory proposal (originating from WDCS) and the distance of the OfTW from Fraserburgh this issue is not considered further in this section, however, see Para 49.

Consultee	Summary of Consultation	Project Response
SNH	Need to consider the list of Marine Priority Features (PMF).	The status of each species was assessed in relation to PMFs and gives additional weight to the conservation importance (Para 48)
	Cumulative impacts need to consider Beatrice and R3 offshore wind farms together with SHETL route and Caithness Hub.	See cumulative assessment Section 12.
	Structure of Environmental Statement (ES) (including cumulative impact assessments) to address the requirements of Habitats Regulations Appraisal (HRA) as well as EIA.	Numbers of bottlenose dolphin and harbour seal have been related to SAC populations and connectivity between Study Area and SACs has also been considered. A separate document providing further information for HRA accompanies this ES.
	In respect of seal licensing, we think it would be helpful if the telemetry study were to be extended to include any available records for grey seals.	Grey seal tracking study has been undertaken (Para 17).
	SNH advise that it will be important to estimate the density of key marine mammal species not only at each wind farm site (i.e. within the site boundaries of Beatrice and the Round 3 zone) but across the entire area of predicted effect from each wind farm individually and cumulatively (to be determined on a species by species basis).	Marine mammal densities have been estimated for the whole of the inner and outer Moray Firth, and considered movement of marine mammals between the Moray Firth and other sites outside the Study Area.
	Moray Firth Offshore Wind Developers Group (MFOWDG) suggest that 'long term avoidance' of the wind farm sites by marine mammals is scoped out as a potential effect. We think it is too early to do so and that this issue should be considered in CIA.	The assessment deals with the issue of avoidance during construction including the likely duration of avoidance.
	Recommend undertaking field studies looking at impacts of construction noise on marine mammals due to the limited evidence available.	Construction and operation – related monitoring work is discussed in Section 24.5 and 12.6.
	Further discussion is needed to define and agree the reference populations/ population scale at which it is relevant to consider noise impacts.	An EIA methodology was presented to the statutory authorities and the assessment scale subsequently agreed. See each species section for details on reference population.

Consultee	Summary of Consultation	Project Response
	Need to consider future Marine Protected Areas and species that are Priority Marine Features.	See Para 49
JNCC	Must provide specifications on when and what activities require the use of vessels with ducted propellers.	Details of activities using vessels with ducted propellers is provided in Section 7.
RSPB	The EIA process should take into account any potential marine SPAs or offshore SACs and any future Marine Protected Areas.	See Paras 41, 44 and 48.
WDCS	Military activities (including aviation) should be included as a potential impact on marine mammals.	See cumulative assessment in Section 12.
	Long term avoidance should be included as a potential cumulative impact.	The assessment considers potential avoidance due to EMF (Section 24.1.1.25) and cumulative avoidance within the BOWL site is considered elsewhere (Section 12).

24.2.3 GEOGRAPHICAL SCOPE

11. The Study Area has been defined within an appropriate geographical frame of reference that encompasses the key areas for resident marine mammal populations and regular visitors to the Moray Firth and also considers the extent of noise effects (based on the Rochdale Envelope) as predicted by the noise modelling undertaken for the OfTW (Annex 7A).

24.2.4 DATA COLLECTION METHODS

24.1.1.2 Desktop Study

12. A comprehensive literature review for historical data and published studies was carried out for the Moray Firth region as a collaborative study for BOWL and MORL. As such, the resulting scientific reports relate to both these projects, but for ease of reporting, only the Project site is referred to throughout this Section; no reference is made to the Moray Firth Round 3 Zone. Data on distribution and sightings was collated with the site-specific survey information to provide a long-term baseline dataset (see Annex 12A and summary below). Further information on the ecology and health of species within the Moray Firth was gathered from peer-reviewed scientific literature (Culloch and Robinson, 2008; Robinson and Tetley, 2007; Robinson et al., 2009; Thompson et al., 2004), SAC conservation objectives documentation (SNH, 2006) and commissioned reports (Thompson et al., 2004). Potential threats to marine mammals were investigated through reviews of other North Sea offshore wind farm Environmental Statements, and published reports on specific threats e.g. noise impact studies (Senior et al., 2007; Southall et al, 2007).

24.1.1.3 Site-Specific Surveys

13. Aberdeen University (AU) in collaboration with the Scottish Marine Research Unit (SMRU) undertook a number of site-specific studies throughout 2009 and 2010 to characterise the marine mammal populations within in the Moray Firth (see Annex 12A). The key objectives of the surveys were:

1) To characterise the wind farm project areas with respect to the marine mammal species present; detail seasonality and year-to-year variability in occurrence.
2) To assess the density of animals at the proposed project areas.
3) To assess the likelihood of movement of individuals between local SACs and the proposed wind farm project areas.

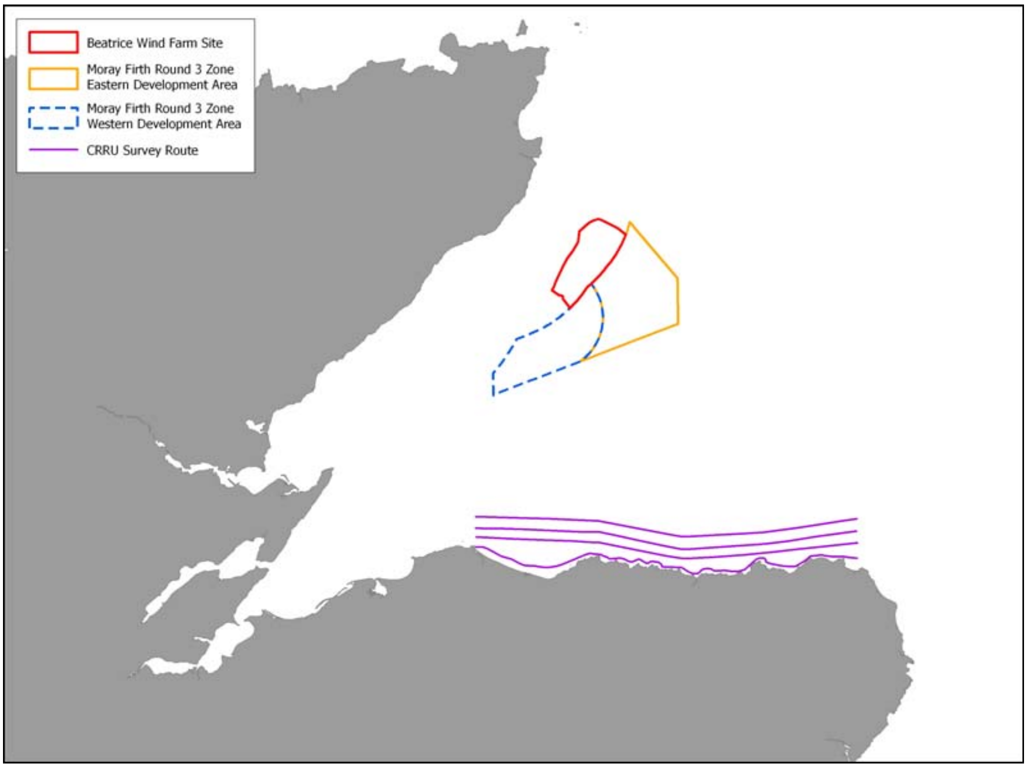
14. The BOWL surveys together with a number of previous surveys within the Moray Firth were used to inform the baseline with respect to objectives 1 and 2 above, and included:

- Boat-based and aerial visual surveys:
  - AU boat surveys in the Moray Firth SAC (2004, 2005);
  - AU boat surveys in the Outer Moray Firth (2009);
  - AU aerial surveys in the Outer Moray Firth (2010);
  - Natural Power surveys of the MORL site (2010); and
  - Institute of Estuarine and Coastal Sciences (IECS) University of Hull boat surveys of the BOWL site (2010)[1].
- Passive acoustic monitoring:
  - Echolocation detectors i.e. Timing Porpoise Detectors (T-PODs) for the Beatrice demonstrator project (2005-2007);
  - SNH and SEERAD funded study of the southern Moray Firth mostly using T-PODs except for the last year where C-PODs (the digital device superseding the T-POD) were used (2006-2008);
  - DECC funded study across the Moray Firth in 2009 and 2010 using C-PODs (and in the latter year pairing these with T-PODs to provide a comparison of detection rates); and
  - BOWL site specific studies from July 2010 to November 2011.

15. Data from the Cetacean Research and Rescue Unit (CRRU) surveys carried out along the southern shore of the Moray Firth (May to October 2001-2008) were also used to supplement the baseline for the cable route (Plate 24.1).

[1] Note that subsequent analyses of these data revealed that there may have been some observer error and therefore this dataset was subsequently removed from the analyses in agreement with SNH and JNCC.

Plate 24.1 CRRU Survey Tracks Extending from Lossiemouth (in the west) to Fraserburgh (in the east)



16. Additional baseline data were collated to assess the likelihood of movement of individuals between local SACs and the proposed wind farm sites (Objective 3 above). The species of concern within the local SACs include the bottlenose dolphin population within the Moray Firth SAC and harbour seal population within the Dornoch Firth and Morrich More SAC. Bottlenose dolphins were recorded within the Study Area using passive acoustic techniques together with specialised whistle classification software developed by SMRU which identified the marine mammal species, rather than simply the presence of a marine mammal. Baseline data on harbour seals were collated using two decades worth of tracking data (recorded using VHF, satellite and GSM telemetry) together with habitat association modelling to predict the occurrence of seals within the Project Boundary.

17. A grey seal usage study was also carried out by SMRU using grey seal telemetry data from 1995-2008 combined with aerial survey data from 1996-2009 (Annex 12A). Maps of estimated total usage (including haul-out sites) and at-sea usage in a 100 km radius of the Project Boundary were produced. Maps illustrating the confidence intervals of the grey seal telemetry data were also produced in order to show the variability in the data.

24.2.5 ASSESSMENT OF EFFECTS

24.1.1.4 Realistic Worse Case and Rochdale Envelope

18. The key parameters for the assessment on marine mammals are based on a realistic worst case scenario as defined by the Rochdale Envelope scenarios set out in

Section 2: OfTW Physical Processes and Geomorphology, Annex 7A: Wind Farm Underwater Noise Technical Report), Annex 7B: OfTW Underwater Noise Technical Report, Section 23: OfTW Fish and Shellfish Ecology, Section 28: OfTW Shipping and Navigation and EMF From Submarine Cables (Normandeau et al., 2011). Full details on the range of options being considered for the OfTW are provided in Section 7.

Table 24.2 Rochdale Envelope Scenario for Marine Mammals

	Potential Effect	Rochdale Envelope Scenario
Construction and Decommissioning Phases	Physical injury, displacement and disturbance resulting noise emissions during cable installation.	Short-term noise arising from cable laying activities assuming disturbance over a 24 hour period for a total of 240 days; use of up to 3 vessels with dynamic positioning thrusters (the noise estimates were based on larger and noisier vessel than those that would be used for cable laying); use of rock dumping as cable protection measure over 45% of the route (this is louder than concrete mattressing) although in general noise is dominated by sound of DP thrusters.
	Physical injury/mortality from vessels with ducted propellers and ship strike	Use of up to three vessels with ducted propellers over a 24 hour period for a total of 120 days. Range of construction vessels with some exceeding 100 m, and others with speeds of >25 kts
	Suspended solids impairing foraging efficiency	Installation of approximately 65 km of export cable using jet trencher (assuming post-lay trenching operations have to be adopted) and scour effects of cables and cable protection measures. Elevation in suspended solids concentration (SSC) (medium sands) over a distance of 25 m (and no more than 125 m as an extreme case) downstream of the cable route and for a duration of 20 seconds to approximately 500 seconds. Sediment deposition is predicted to be localised and very small relative to natural variability (12 cm over 5 m or 2.4 cm over 25 m); release of any associated pollutants into the water column.
	Indirect effects due to loss of foraging area/ reduction of prey species	Loss of foraging area of approximately 1.5 km per day over a period of 240 days. As a precautionary approach it is assumed that prey species will be displaced from the cable route development area during the entire 240 day construction period.
Operation Phase	Behavioural effects arising from EMF	Magnetic field strength of 5 μT and electric field strength of 1000 μV/m over a distance of 4 m for a typical 132 kV export cable.
Cumulative Effects	Cumulative effects	The Wind Farm and OfTW have been assessed as one project against cumulative effects from other projects/activities in the Study Area in Section 12: Wind Farm Marine Mammals.

19. Behavioural and TTS effects have been assessed by assuming a worst case scenario in that individuals affected in the impact areas will be excluded from foraging areas, thereby resulting in reproductive failure. These precautionary assumptions were discussed with, and approved by, key stakeholders including SNH and JNCC. However, it should be noted that Section 12: Wind Farm Marine Mammals required further population modelling to provide a more accurate assessment of the potential effects of piling noise on the harbour seal SAC population and this information was consequently fed into the cumulative effect assessment for the Project (Annex 12A).

24.1.1.5 Potential Effects on Marine Mammals

20. The potential effects on marine mammals from construction, operation and decommissioning have been outlined above (Table 24.2) and were identified on the basis of available data and literature, and consultation with regulatory bodies and stakeholders. Assessment of the potential effects on each receptor was undertaken following the most recent guidelines on ecological impact assessment in the marine environment from the Institute of Ecology and Environmental Management (IEEM, 2010), which suggests the following:

- Identification of the proposed activity, duration of activity, biophysical change and relevance to receptor in terms of ecosystem structure and function;
- Characterisation of unmitigated impact on the feature;
- Rationale for prediction of effect on integrity (of a site or ecosystem) or conservation status (of a habitat or population);
- Significance (at population and individual level) without mitigation and confidence in predictions (see Section 24.2.7);
- Mitigation, enhancement and compensation; and
- Residual significance and confidence in predictions.

21. The confidence in predictions is the likelihood that a change or activity will occur as predicted and gives a probability of occurrence based on statistical significance in common scientific practice. The four-point scale employed is:

- Certain/near probable: probability estimated at 95% chance or higher;
- Probable: probability estimated above 50% but below 95%;
- Unlikely: probability estimated above 5% but less than 50%;
- Extremely unlikely: probability estimated at less than 5%.

24.1.1.6 Marine Mammals and Noise

22. Sound plays an important role in the life-histories of marine mammals. Marine mammals use sound to communicate, find prey, avoid predators, and navigate about their environment. Anthropogenic noise which exceeds natural background levels has the potential to cause disturbance, and in extreme cases, injury or fatality to marine mammals. Different marine species have a wide variation in sensitivity to underwater noise, both in terms of the ranges of the frequencies of sound which they can hear and the lowest levels of sound at which they can perceive that sound (their threshold of hearing). For example, harbour porpoise are highly sensitive as

they hear over a broad bandwidth of frequencies and also their range of perception will start at a much lower sound pressure level (dB re. 1 Pa) than for other species (see Annex 7A). In other words, for a given noise, harbour porpoise will perceive the noise as being louder than for a less hearing sensitive species. The effects of noise depend on the hearing sensitivity of a species together with the components of the noise itself (e.g. intensity, duration, frequency bandwidth) and the distance to the noise source. The range of potential effects will also be shaped by the physical and environmental parameters, including water depth, salinity and substrate (Parvin et al., 2006). The effects of underwater sound can be broadly summarised into three categories: physical injury and mortality, auditory damage (either permanent or temporary) and behavioural responses.

Physical Injury/Fatality

23. Intense underwater noise can have a severe effect on marine mammals from blast type injuries. Lethal effects may result in immediate mortality or physiological damage such that an animal is debilitated and mortality will ensue after a period of time. Lethal effects may occur where peak to peak pressure levels exceed 240 dB re 1 μPa, whilst physical injury may occur where peak to peak pressure exceeds 220 dB re 1 μPa (Parvin et al., 2006).

Auditory Damage

24. Damage to auditory structures may either result from a single pulsed sound of high magnitude, or from longer exposure to lower magnitude sound, depending on the frequency and duration (Parvin et al., 2006). One potential effect is a shift in the threshold at which sounds can be detected, the level of which increases after a trauma and sounds can become more difficult to detect. The threshold shifts can either be temporary (TTS) or permanent (PTS) and it is likely that animals experiencing PTS will be unable to forage successfully, detect predators or navigate. As a result PTS may eventually lead to mortality. Noise levels at which TTS and PTS may occur are described below based on two different modelling approaches.

Behavioural Responses

25. At lower noise levels than those causing auditory injury, there may be behavioural effects on a species, of which the most significant would be avoidance of the ensonified area. Avoidance may have negative effects on an animal if it causes a migratory species to be delayed or diverted, inhibits feeding in an important foraging area, or generally leads to stresses on an individual that may reduce fitness and have biological consequences such as reduced breeding success. In other cases, avoidance of an area may have no effect on the individual, particularly where prey species are abundant or species are wide-ranging in nature showing no particular affinity for an area. The magnitude of effect also depends on the duration of avoidance and this is considered for each species for which there is a potential noise impact.

24.1.1.7 Noise Modelling and Assessment

26. The sensitivity of marine mammals to noise has been assessed using two different modelling approaches. A detailed review of the methodologies is given in the Underwater Noise Modelling Technical Report (Annex 7A), however, a brief summary of each approach is given below.

The dB_{ht} (species) Approach

27. The first modelling approach assumes that each species perceives the noise differently, therefore the noise level is weighted according to the frequency range that each species can detect. The metric produced, expressed as dB_{ht} (species), will vary between species such that a hearing sensitive species may have a higher dB_{ht} for a given noise producing activity (e.g. trenching) than for a less hearing sensitive species (Nedwell et al., 2007a). The dB_{ht} (species) metrics are then assessed against a number of criteria which indicate the potential effect of perceiving sound at a given level (Table 24.3). The level at which behavioural effects are most likely to become manifest for the majority of individuals has been determined as 90 dB_{ht}, although for the purposes of this assessment 75 dB_{ht} has been used as a precautionary measure based on advice from the statutory consultees. TTS is assumed to occur above 110 dB_{ht} and PTS above 130 dB_{ht} (Newell et al., 2007a).

Table 24.3 Assessment criteria proposed for dB_{ht} (species) used in this study to predict the potential behavioural effect of underwater noise on marine species.

Level in dB_{ht} (species)	Effect
75	Significant avoidance reaction by up to 50% of individuals although habituation will limit the response.
90 and above	Strong avoidance reaction by virtually all individuals with potential for TTS over prolonged exposure.
Above 110	Tolerance limit of sound: unbearably loud and causing TTS from a single event.
Above 130	Possibility of traumatic hearing damage (causing PTS) from a single event.

28. It should be noted that in this section the dose-response curve (as discussed in Section 12) was not employed since the differences in impact area between each noise threshold was minimal for the noise arising from construction of the OfTW. Consequently this graded approach was not necessary in this case.

M-weighted SELs

29. The second approach considers the sound exposure level (SEL) over a given period, thereby accounting for both the Sound Pressure Level (SPL) at sound source and the duration the sound is present in the acoustic environment (Southall et al., 2007). This method proposes a range of hearing for marine mammals in water within four main functional groups (Table 24.4). For each group auditory injury criteria for SEL and SPL have been proposed at which animals are likely to be sensitive to hearing damage. For the low, medium and high frequency cetaceans the criteria is given as an SEL of 183 dB re 1 $\mu Pa^2/s$ for the onset of behavioural effects and 15 dB more (i.e. 198 re 1 $\mu Pa^2/s$) for the onset of PTS. For the pinnipeds in water the SEL

criteria is 171 dB re 1 µPa²/s for behavioural effects and 186 dB re 1 µPa²/s for PTS, however the PTS threshold has subsequently been revised due to insufficient evidence to support Southall's (2007) proposal for different criterion for pinnipeds and cetaceans (Thompson and Hastie, in prep (Annex 12B)). It has therefore been proposed that an M-weighted PTS-onset threshold of 198 dB re. 1 µPa²/s be used, which reflects the only studies available to Southall et al. (2007) in which exposure to pulsed noise induced TTS in marine mammals, see Tables 24.5 and 24.6.

Table 24.4 Functional marine mammal hearing groups and auditory range over which each group hears underwater. (From Southall et al., 2007).

Functional hearing group	Estimated auditory bandwidth	Species in the Moray Firth	Frequency-weighting code
Low frequency cetaceans	7 Hz - 22 kHz	Minke whale Fin whale Humpback whale	M_{lf}
Mid frequency cetaceans	150 Hz - 160 kHz	Bottlenose dolphin Common dolphin White beaked dolphin Risso's dolphin Killer whale Long-finned pilot whale	M_{mf}
High frequency cetaceans	200 Hz - 180 kHz	Harbour porpoise	M_{hf}
Pinnipeds in water	75 Hz – 75 kHz	Harbour seal Grey seal	M_{pw}

Density/Noise Maps

30. The Subacoustech noise study (OfTW Underwater Noise Technical Report, Annex 7B) modelled the noises from each of five activities associated with the transmission works: cable laying, trenching, backhoe dredging, cable protection and vessel noise for a selection of relevant species (i.e. sensitive receptors) known to occur in the Study Area and for which noise data were available. For each activity the 90 dB_{ht}, 75 dB_{ht} and M-weighted SELs noise bands were overlaid on species density maps for bottlenose dolphin, harbour porpoise, grey seal and harbour seal. The numbers of individuals that fell within each noise band were subsequently counted. Where the noise band dissected a 4 x 4 km grid cell, the numbers from that cell were counted if the line dissected the cell such that the centre point of that cell was included. Conversely counts were excluded if the line dissected the cell such that the centre point of the cell was not within the noise band.

24.2.6 SIGNIFICANCE CRITERIA

31. The significance of potential effects has been based upon the value, sensitivity and importance within the Study Area of each marine mammal receptor combined with the magnitude of the likely effect. All marine mammals are generally considered to be high value receptors due to their conservation and protection status but their sensitivity to a given effect may vary (e.g. different species have different hearing sensitivities) and their importance within the Study Area also differs (e.g. SAC

population of one species compared with a few irregular sightings of another species). Therefore, for a given magnitude (small, medium or large) the effect will differ between species and so too will the significance of that effect (see Section 4, EIA Process and Methodology). Whilst effects are broadly categorised as 'negligible', 'minor', 'moderate' and 'major' there is also the potential for an effect to fall in between these categories.

32. Potential effects were not just assessed on an individual basis, instead the magnitude of the effect upon individuals was compared to the wider population such that the potential tolerance of the population and its recoverability were taken into consideration in the assessment. In the context of SAC populations (i.e. those of bottlenose dolphins and harbour seals within the Moray Firth), potential losses of individuals through either lethal effects, injury or PTS were assessed in terms of the percentage increase over and above natural mortality levels. The thresholds for calculating potential losses arising from each of these potential effects are presented in Table 24.5 bottlenose dolphin and harbour porpoise) and Table 24.6 (harbour and grey seal) below. For each potential effect, the noise modelling study gave an area over which each effect occurs for each species. In addition, the effect was also expressed as the area of sea excluded over a particular timescale allowing comparisons between different activities at any one time e.g. short piling operation compared to all-day dredging activity. This was expressed as km^2 times hours of sea excluded (see Annex 7A for further description of this calculation).

33. In terms of the EIA Regulations, only major or moderate effects are considered to be significant and therefore requiring mitigation. Minor and negligible effects are not considered to be significant in terms of the EIA Regulations.

Table 24.5 Summary of thresholds calculated in the noise modelling study – Harbour porpoise and bottlenose dolphin

Species	Potential effect	Method of assessment	Threshold to be calculated	Assumptions used	Population Significance
Harbour Porpoise/ Bottlenose Dolphin	Permanent physical injury/death	Subacoustech (Nedwell et al., 2007b)	240 and 220 dB re. 1 µPa (Unweighted) for fatal and physical injury, respectively	Following Parvin et al. (2007) and based on data in the studies of Yelverton et al. (1975), Turnpenny et al. (1994), Hastings and Popper (2005).	100% mortality of individuals affected over and above natural levels.
		Southall et al. (2007)	No given criteria	Not applicable.	
Harbour Porpoise/ Bottlenose Dolphin	Permanent threshold shift (PTS)	Subacoustech	130 dBht	Possibility of traumatic hearing damage from a single event.	PTS would affect the long-term survivability and reproductive success of harbour porpoises due to hunting/foraging heavily reliant on acoustic cues. Therefore 100% mortality of individuals within PTS area will be assumed.
		Southall et al. (2007)	198 dB re. 1 µPa2/s(M) for Mid and High Frequency Cetaceans	Cumulative (long term) injury; uses mid and high frequency cetacean level from Southall et al. (2007).	
Harbour Porpoise/ Bottlenose Dolphin	Temporary threshold shift (TTS)	Subacoustech	90 dBht for 8 hours (worst case) 99 dBht for 1 hour (realistic case)	Madsen et al, (2006) highlighted that experiments with marine animals demonstrate a near linear relationship between Noise Dose and duration of where each doubling of the noise energy (3dB increase) results in a halving of the acceptable noise exposure period.	Temporary effect to animals within ensonofied area. Individuals move away from this area and once outside recover. Where completely excluded from foraging habitat, individuals will exhibit 100% reproductive failure for the period of the exclusion. Intermittent exclusion such as due to periodic or seasonal dredging and piling activity will result in a lower reduction in reproductive success.
		Southall et al. (2007)	No given criteria	TTS data used in development of PTS criteria.	

Species	Potential effect	Method of assessment	Threshold to be calculated	Assumptions used	Population Significance
Harbour Porpoise/ Bottlenose Dolphin	Behavioural effect	Subacoustech	90 and 75 dBht	90 dBht - Strong avoidance reaction by virtually all individuals. 75 dBht (precautionary) – Significant avoidance, about 50% of individuals will react to the noise, although the effect will probably be limited by habituation.	Individuals completely excluded from foraging habitat will exhibit 100% reproductive failure for the period of the exclusion. Intermittent exclusion will result in a lower reduction in reproductive success.
		Southall et al. (2007)	183 dB re. 1 µPa2/s (M) for Mid and High Frequency Cetaceans	Tentative criteria for single blows - recognised as tentative by authors.	

Table 24.6 Summary of thresholds calculated in the noise modelling study – harbour and grey seals

Species	Potential effect	Method of assessment	Threshold to be calculated	Assumptions used	Population Significance
Harbour Seal/ Grey Seal	Permanent physical injury/death	Subacoustech	240 and 220 dB re. 1 µPa (Unweighted) for fatal and physical injury, respectively	Following Parvin et al. (2007) and based on data in the studies of Yelverton et al. (1975), Turnpenny et al. (1994), Hastings and Popper (2005).	100% mortality of individuals affected over and above natural levels.
		Southall et al. (2007)	No given criteria	Not applicable.	
Harbour Seal/ Grey Seal	Permanent threshold shift (PTS)	Subacoustech	130 dBht	Possibility of traumatic hearing damage from a single event.	PTS effect less likely to have an effect on foraging ability compared with cetaceans. However as PTS area lies within behavioural area of effect, the individual would therefore experience either complete or intermittent exclusion from foraging areas. This will give rise to either a 100% reproductive failure for the period of the exclusion for complete exclusion or reduced failure for intermittent exclusion.
		Southall et al. (2007)	198 dB re. 1 µPa2/s(M)	Uses mid and high frequency cetaceans from Southall revised from pinnipeds in water threshold (see explanation in para 29), as agreed with statutory authorities.	
Harbour Seal/ Grey Seal	Temporary threshold shift (TTS)	Subacoustech	90 dBht for 8 hours (worst case) 99 dBht for 1 hour (realistic case)	Madsen et al, (2006) highlighted that experiments with marine animals demonstrate a near linear relationship between Noise Dose and duration of where each doubling of the noise energy (3dB increase) results in a halving of the acceptable noise exposure period.	Temporary effect to animals within ensonofied area. Individuals move away from this area and once outside recover. Where completely excluded from foraging habitat, individuals will exhibit 100% reproductive failure for the period of exclusion. Intermittent exclusion will result in a lower reduction in reproductive success.
		Southall et al. (2007)	No given criteria	TTS data used in development of PTS criteria.	
Harbour Seal/ Grey Seal	Behavioural effect	Subacoustech	90 and 75 dBht	75 dBht precautionary.	Individuals completed excluded from foraging habitat will exhibit 100% reproductive failure for the period of the exclusion. Intermittent exclusion will result in a lower reduction in reproductive success.
		Southall et al. (2007)	171 dB re. 1 µPa2/s (M) Pinnipeds (in water)	Tentative criteria for single blows - recognised as tentative by authors.	

24.3 BASELINE CONDITIONS

24.3.1 DESIGNATIONS AND LEGISLATION

24.1.1.8 Cetaceans

34. Cetaceans are protected under Annex IV of the EC Habitats Directive (92/42/EEC) because they are endangered, vulnerable or rare (Table 24.7). Harbour porpoise and bottlenose dolphins are Annex II (Habitats Directive) species for which SACs are designated by member states to ensure their protection and for the conservation of habitats that are essential to their life and reproduction. The Habitats Directive is transposed into UK law through the Conservation (Natural Habitats & c) Regulations 1994 (as amended in 2004 and 2007) (referred to as the 'Habitats Regulations'). All species of cetaceans are listed in Schedule 2 of these Regulations as European Protected Species (EPS), which are protected by law from deliberate capture, injury or killing, deliberate disturbance, or damage to a resting place. Licensing for inshore activities (within 12 nm) is the responsibility of Marine Scotland, whilst licensing for offshore activities is undertaken by Defra.

35. Whales and dolphins are also fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), which makes it an offence to kill, injure, or disturb them in their places of shelter or rest (i.e. the seas in which they live). In addition, Schedule 6 (Part 3) of the Nature Conservation (Scotland) Act 2004 make amendments to the Wildlife and Countryside Act 1981, making it an offence to intentionally or recklessly disturb a dolphin, whale (cetacean) or basking shark.

24.1.1.9 Seals

36. Seals are listed on Annex V of the Habitats Directive and as such are legally protected by regulations on the number that can be taken from the wild. Under the Marine (Scotland) Act 2010, this protection has been strengthened such that it is an offence to kill, injure or take a seal at any time, unless under licence or for animal welfare reasons. This Act supersedes all existing seal legislation e.g. the Conservation of Seals Act 1970 and the Conservation of Seals (Scotland) Order 2004. In addition, it is now an offence under the Marine (Scotland) Act 2010 to disturb seals at designated haul-out sites in Scotland. Although not afforded the protection given to EPS, both harbour and grey seals are listed on Annex II of the EU Habitats Directive and therefore, where included as a feature, receive a level of protection under certain SAC designations.

24.1.1.10 International Agreements

37. The Bonn Convention on the Conservation of Migratory Species of Wild Animals (1979) provides protection for migratory animals (listed on Appendix II) over all or part of their natural range through international cooperation, including strict protection for endangered species (Appendix I). In order to achieve this, a number of legally binding agreements have been made by contracting parties, one of which is the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS). Under this agreement, provision is made for the protection and

management of cetaceans through research, monitoring, pollution control, raising public awareness and reducing problems such as by-catch and disturbance.

38. The Bern Convention on the Conservation of European Wildlife and Natural Habitats (1979) ensures protection of wild animals species and their habitats (listed in Appendices I and II) and to regulate exploitation of some species (Appendix III). The Convention for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR, 1998) aims to maintain and improve the biodiversity of the Northeast Atlantic through a number of key measures which includes identification of species and habitats that are in threat of decline and require protection.

39. The Convention on International Trade in Endangered Species (CITES) regulates the commercial trade in species listed on Appendix I or II of the convention. Those cetaceans and pinnipeds known from the Moray Firth and listed on Appendix II are detailed in 24.7. These species are not necessarily threatened with extinction but may become so and therefore are strictly regulated.

40. Species were also checked against the IUCN Red List of Threatened Species to determine their current threat status and all species were listed as Least Concern (LC) (IUCN, 2011).

Table 24.7 Summary of legislation and conventions relevant to the protection of the cetacean and pinniped species considered in this section

Species	Wildlife and Countryside Act 1981	EC Habitats Directive (Annex)	Bonn Convention (Appendix)	Bern Convention (Appendix)	CITES (Appendix)	Conservation of Seals Act 1970	OSPAR (annex)	ASCOBANS	Section 74 CRoW Act 2000	UK Biodiversity Action Plan*
Bottlenose dolphin	5 & 6	II & IV	II	II	II	-	-	yes	yes	SD
Harbour porpoise	5 & 6	II & IV	II	II	II	-	V	yes	yes	HP
Atlantic white-sided dolphin	5	IV	II	II	II	-	-	yes	yes	SD
White-beaked dolphin	5	IV	II	II	II	-	-	yes	yes	SD
Risso's dolphin	5	IV	II	II	II	-	-	yes		
Common dolphin	5 & 6	IV	II	II	II	-	-	yes	yes	SD
Minke whale	5	IV	-	III	I	-	-		Yes	BW
Harbour seal	-	II & V	II	III	-	yes	-	-	-	-
Grey Seal	-	II & V	II	III	-	yes	-	-	-	-

SD – small dolphins grouped plan
HP – harbour porpoise species plan
BW – baleen whales grouped plan

24.1.1.11 Natura 2000 sites

Moray Firth SAC

41. Species listed on Annex II of the EU Habitats Directive are those for which strict protection is required through the designation of Natura 2000 sites, such as SACs and SPAs.

42. Bottlenose dolphins are an Annex II species that are a primary reason for designation of the Moray Firth SAC (Figure 8.1). This is the only known resident population of bottlenose dolphins in the North Sea, with approximately 195 individuals present in the Moray Firth all year round, although there is considerable annual variability in the population (Cheney et al., in press a). The SAC extends from the inner firths to Helmsdale on the north coast and Lossiemouth on the south coast (Figure 8.1). Whilst estimates of the SAC population have varied over the years, a substantial proportion (~50%) of the total Moray Firth population regularly use the SAC suggesting that this is an important area for the resident population and therefore the total Moray Firth population of 195 individuals is also taken as the size of the SAC population (Cheney *et al.* in press b).

43. As a result of this designation, SNH has a responsibility to report on the condition of the SAC for the conservation status of the bottlenose dolphin population every six years. The current condition status assessment of the population is "Unfavourable (recovering)" and is based on a number of conservation targets for the interest feature (i.e. bottlenose dolphins) for this SAC, for example, maintaining or increasing population of dolphins using the SAC (Thompson et al., 2006; Thompson et al., 2009). Previous work showed that there was a reduction in the use of the SAC by dolphins during the late 1990s, followed by a slight increase during the previous 2002-2004 reporting period (Thompson et al., 2006).

Dornoch Firth and Morrich More SAC

44. The Dornoch Firth and Morrich More SAC is an estuarine environment with a diverse range of estuarine and coastal habitats from mud and sand flats through to coastal sand dunes and heath (Figure 8.1). There are 12 Annex I habitats that are primary reasons for designation and two Annex II species, namely otter *Lutra lutra* and common (or harbour) seal *Phoca vitulina*. The Dornoch Firth supports the most northerly haul-out and breeding population of common seals, representing almost 2% of the UK population (JNCC, 2011).

45. The condition of the Dornoch Firth and Morrich More SAC has been assessed three times during the last reporting cycle. There were 405 seals in 2000, 220 seals in 2002 (although this is considered an undercount because the survey was undertaken more than two hours after low tide), and 290 seals in 2003 (SNH, 2005a). These data, along with previous counts made in 1992 (662), 1994 (542) and 1997 (593), indicate that the number of harbour seals within the SAC during the moulting season has decreased over the reporting cycle. Conversely, over this same time period there has been a gradual increase in the number of harbour seals recorded in Loch Fleet (albeit not as steep as the opposing decrease) suggesting a slight shift in the population to favouring the Loch Fleet area (Cordes et al., 2011). Indeed, seals from

these two areas forage in the same location (Cordes et al., 2011). The population of harbour seals within this SAC is considered to be "Unfavourable (recovering)" (SNH, 2005a) based on a number of conservation targets (e.g. a stable or increasing population of common seals within the SAC during the moulting season and no loss in extent or distribution of habitat suitable for use by breeding and moulting common seals in the SAC), and a management plan is now in place which is addressing one of the reasons believed to be behind the decline (shooting of seals mainly to protect salmon and sea trout fisheries).

Grey Seal SACs

46. There are six grey seal SACs in Scotland: the Trenhish Isles (Strathclyde), the Monach Isles (Outer Hebrides), North Rona (Outer Hebrides), Faray and Holm of Faray (Orkney), the Isle of May (Firth of Forth) and the Berwickshire and North Northumberland Coast (which crosses the border between Scotland and England on the east coast). None of these fall within the Study Area in the Moray Firth, however, due to the long-range movements of grey seals, the links between these SACs and the Study Area have been considered in this assessment (Para 90).

Loch Fleet National Nature Reserve (NNR)

47. Loch Fleet National Nature Reserve (NNR) is designated for a variety of coastal habitats, (sand dunes, sand flats, saltmarsh, and eelgrass), which are also important features within the Dornoch Firth and Morrich More SAC (SNH, 2005b). Similarly, the species (birdlife and marine mammals) found within Loch Fleet are also featured within this SAC, and this includes harbour seal. Numbers of harbour seal in Loch Fleet can vary between 40 and 90, with populations higher during the winter months. Although grey seal are rarely seen during the summer months here, small numbers occur during the winter.

24.1.1.12 Priority Marine Features

48. A list of draft Priority Marine Features (PMFs) has been identified by SNH for Scottish territorial waters, and for which future conservation action will be required. Of the marine mammals included on the list, the minke whale has been identified as an important species within the outer Moray Firth.

49. A Marine Protected Area (MPA) has been proposed by the Whale and Dolphin Conservation Society (WDCS) for Minke Whale off the Fraserburgh coast. Details of the proposal (which is non-statutory) are set out in a document published in 2010 (WDCS, 2010).

24.3.2 CETACEAN POPULATIONS IN THE STUDY AREA

50. The Moray Firth is an important area for cetaceans (whales, dolphins and porpoises) as either resident populations or seasonal visitors. Marine mammal species known to regularly occur within the Study Area include: bottlenose dolphin, harbour porpoise, minke whale, common dolphin, white-beaked dolphin, and Risso's dolphin. Other infrequent visitors include long-finned pilot whale *Gloicephala melas*, killer whale *Orcinus orca*, humpback whale *Megaptera novaeangliae*, and fin whale *Balaenoptera physalus* but due to their very low frequency of

occurrence within the Study Area (see Annex 12A, Section 4.7), these latter species have been scoped out of the assessment.

51. In the southern part of the Moray Firth, through which the proposed cable route runs, the most abundant species were bottlenose dolphin, harbour porpoise and minke whale. In contrast the number of sightings of common dolphin, white-beaked dolphin and Risso's dolphin were very low. Most individuals of white-beaked and Risso's dolphins were seen further offshore, and although there were some sightings of common dolphin along the southern Moray Firth between 2006 to 2009, the numbers are too low to give abundance estimates.

52. A full account of each species is given in the Marine Mammal Technical Report (Annex 12A), but below is a summary of the five key species in the southern Moray Firth most likely to be affected by the cable route.

24.1.1.13 Bottlenose Dolphin

Distribution

53. Most of the bottlenose dolphins encountered during the surveys were located along coastal areas in the inner Moray Firth. The University of Aberdeen's POD data combined with the visual survey data showed that the south shore of the Moray Firth (between Chanonry Point to Macduff) was a key area for bottlenose dolphin. Bottlenose represented the main species of dolphin along this coast (Plate 24.2) and they were recorded on a high proportion of days (>75%) at the POD deployment sites along this coast (Plate 24.3).

Plate 24.2 Dolphin sightings made by the CRRU between 2001 and 2008 (from Thompson et al., 2010a; see SMRU, 2011)

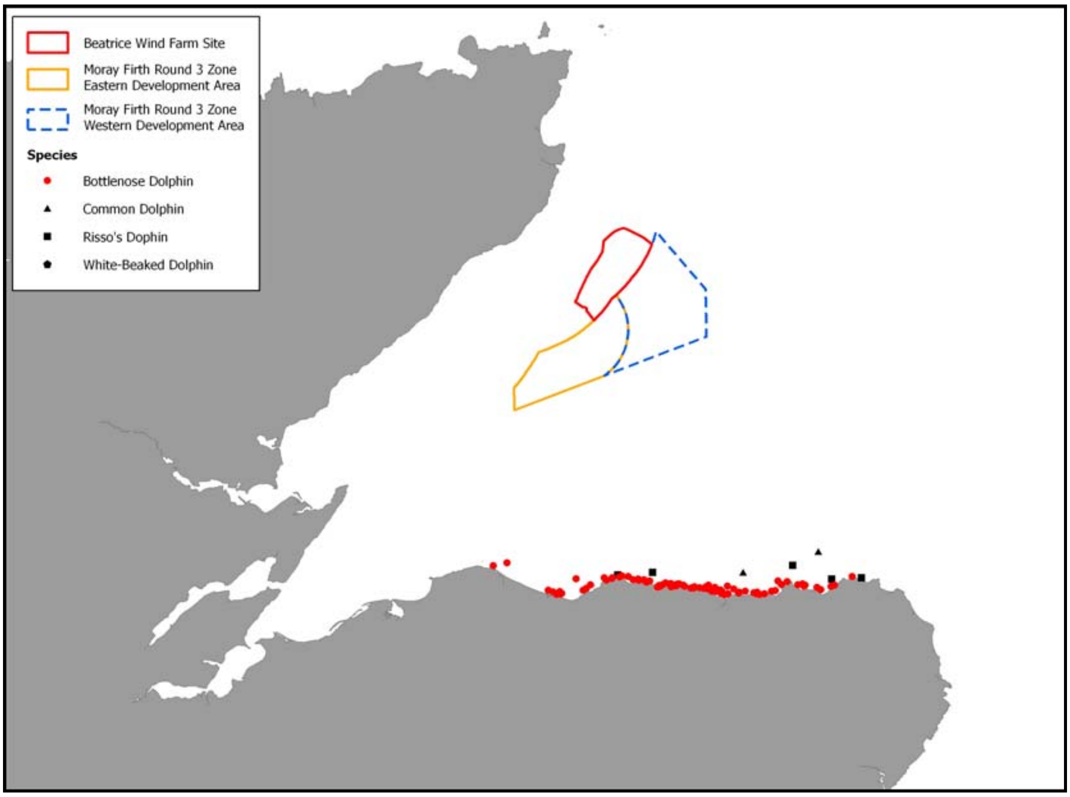
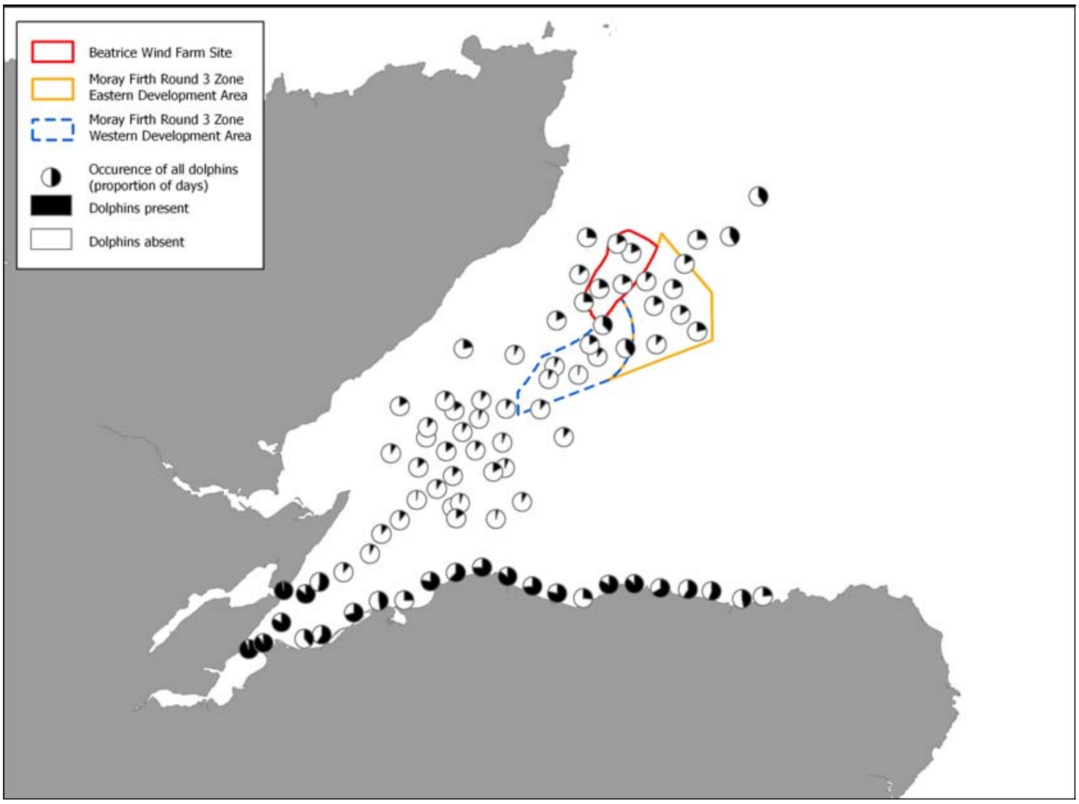


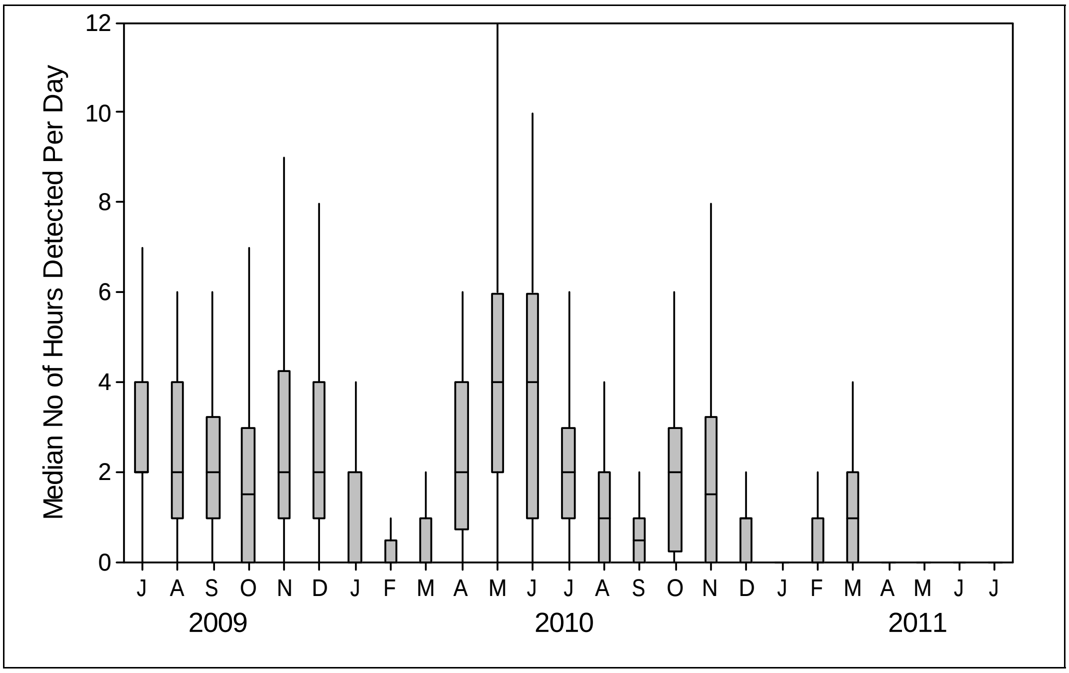
Plate 24.3 Spatial variation in the occurrence of all dolphins encountered in April-October of 2009 and 2010. The pie charts show the proportion of days that dolphins were detected on PODs at each sampling location (Thompson and Brookes, 2011).



Seasonal Variation

54. Bottlenose dolphin occurred year-round in the Moray Firth, utilising the same range in winter as they do in summer, albeit with lower rates of occupancy. The most likely explanation for this is that bottlenose dolphins extend their range to other unknown areas over winter. However, there is also a possibility that their behaviour changes in the winter making them less detectable than during summer months. The CRRU data showed similar sighting over all survey months (May to October) (Culloch and Robinson, 2008), however, acoustic POD detections at Spey Bay suggest seasonal peaks occur in summer and early winter (Plate 24.4). Data from the year-round POD site closest to the landfall of the cable route show that dolphins are present on 65% of days.

Plate 24.4 Monthly variation in the median number of hours that dolphins were detected at the Spey Bay POD site from 2009 to 2011 (Thompson, 2011)



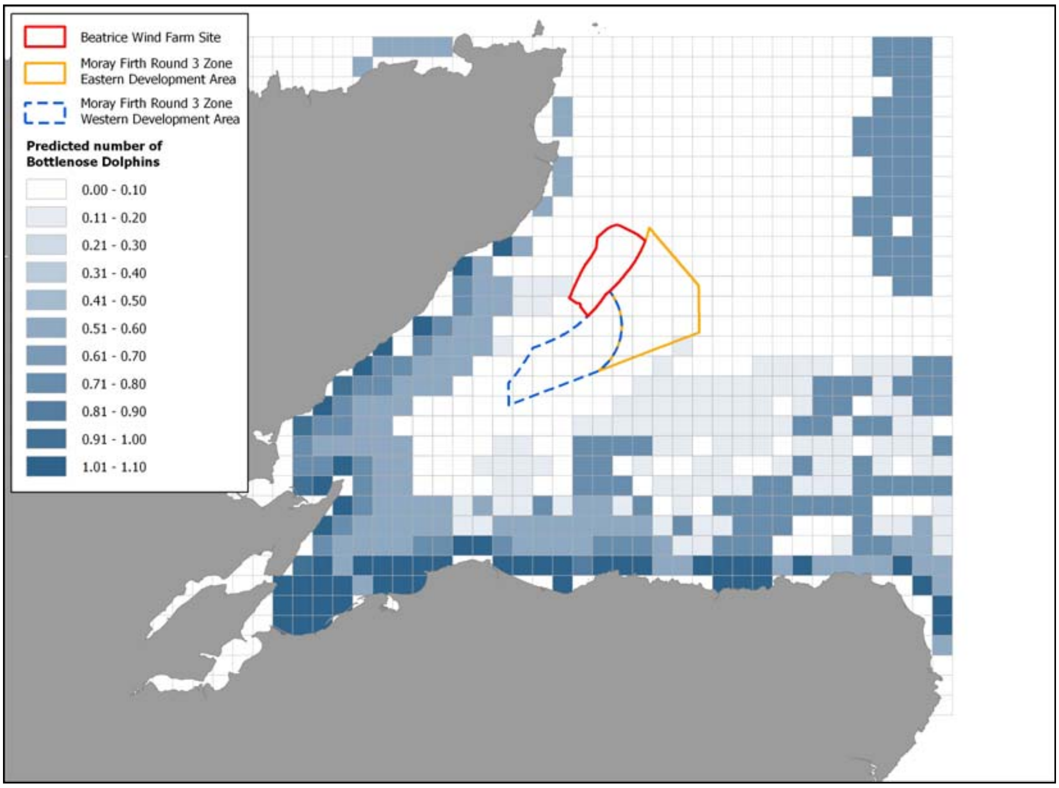
Abundance

55. There have been several estimates of population size of bottlenose dolphin but the most reliable figures come from a 2006 study using data from photo-identification work. This study suggested that the population in the Moray Firth is around 193 individuals (95% Probability Interval 162-245) (Cheney et al., 2011). The study was subsequently updated with a further year of photo-identification work and the estimate was very similar with 195 individuals (95% Highest Posterior Density Intervals 162 – 253) (Cheney et al., in press).

Density

56. Although habitat association modelling can provide a good way of estimating density estimates for marine mammals, this was problematic for bottlenose dolphin due to the patchiness of their distribution and highly mobile nature. A study commissioned on behalf of BOWL adopted an approach using density estimates of all dolphins in the Moray Firth combined with classification tree analysis to estimate bottlenose dolphin numbers in each 4 x 4 km square (Annex 12A). The resulting map clearly shows higher densities along coastal areas including the area surrounding the cable route landfall site (Plate 24.5).

Plate 24.5 Bottlenose dolphin density estimates across the Moray Firth (Thomson et al, 2011)



Movement Between the BOWL Project Area and the Moray Firth SAC

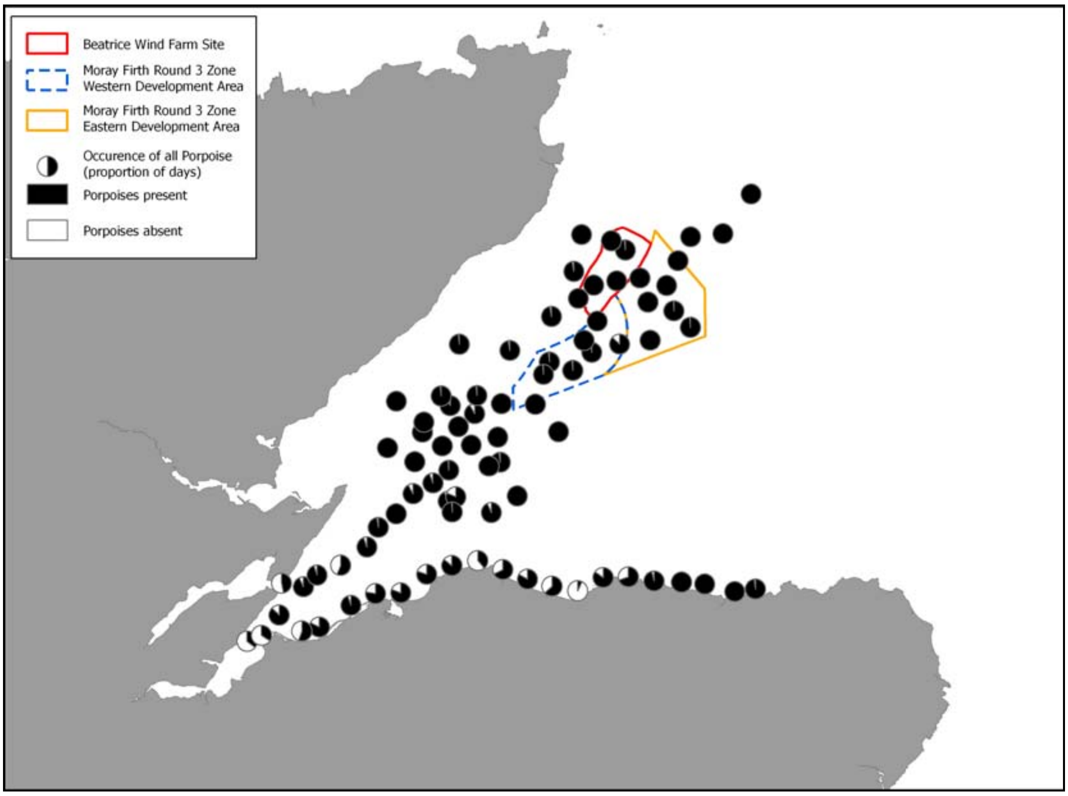
57. A whistle-classifier system was constructed to distinguish bottlenose dolphins from other dolphin species that may be encountered within the Project Boundary (Annex 12A, Section 4.1.6). None of the recordings made over the 88 day survey period were attributed to bottlenose dolphins and this supports previous evidence that they are not generally present within the Project Boundary. However, the density map (Plate 24.5) shows that bottlenose dolphins are abundant around the coastal areas and therefore there are considered to be links between the SAC population and the southern part of the cable route.

24.1.1.14 Harbour Porpoise

Distribution

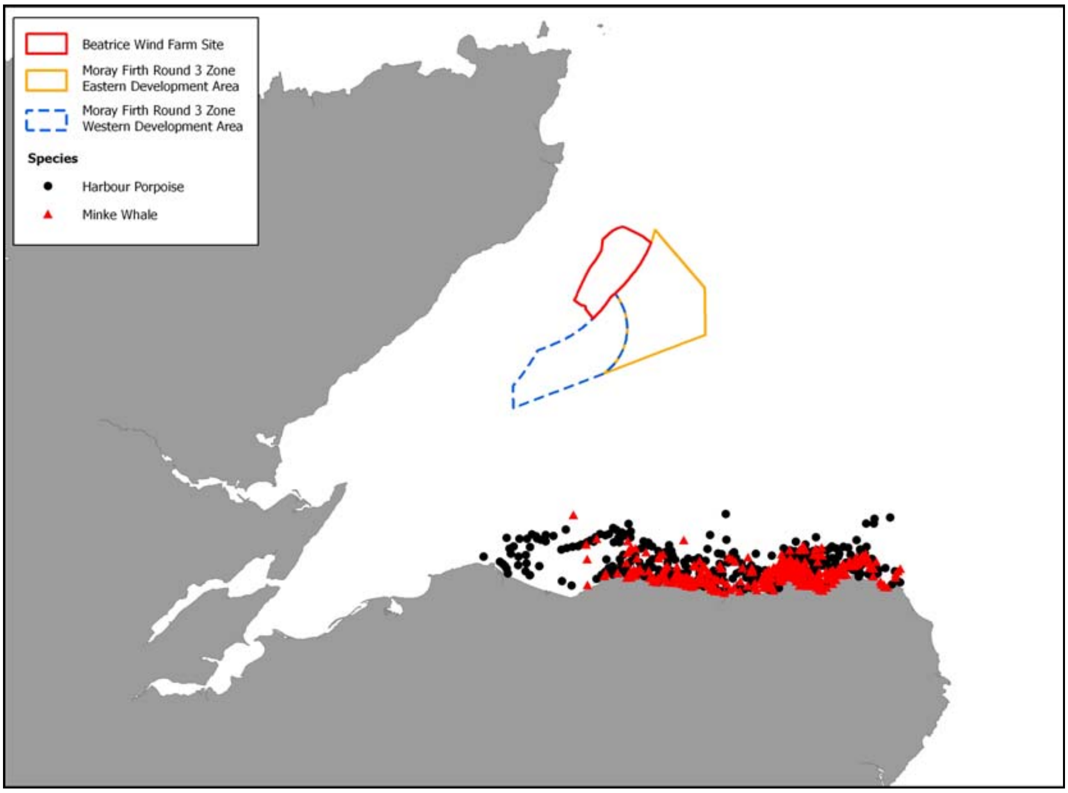
58. Harbour porpoises are widespread around UK waters and were the most commonly encountered species in all the Moray Firth studies, both inshore and offshore (Annex 12A). The University of Aberdeen's POD data for April-October 2009 and 2010 show that harbour porpoises are present along the southern Moray Firth coast on a high proportion of days (>75% of days at 65% of POD sites) although the occurrence is lower around Buckie, in east Spey Bay (Plate 24.6).

Plate 24.6 Spatial variation in the occurrence of porpoises in the Moray Firth (April-October 2009 and 2010). The figure shows the proportion of days that porpoises were detected on PODS at each sampling location (Thompson and Brookes, 2011)



59. The surveys undertaken by CRRU between May to October along the southern shore of the Moray Firth found that porpoises were the most commonly sighted species, although as with the POD data the sightings were lower around Spey Bay (Plate 24.7).

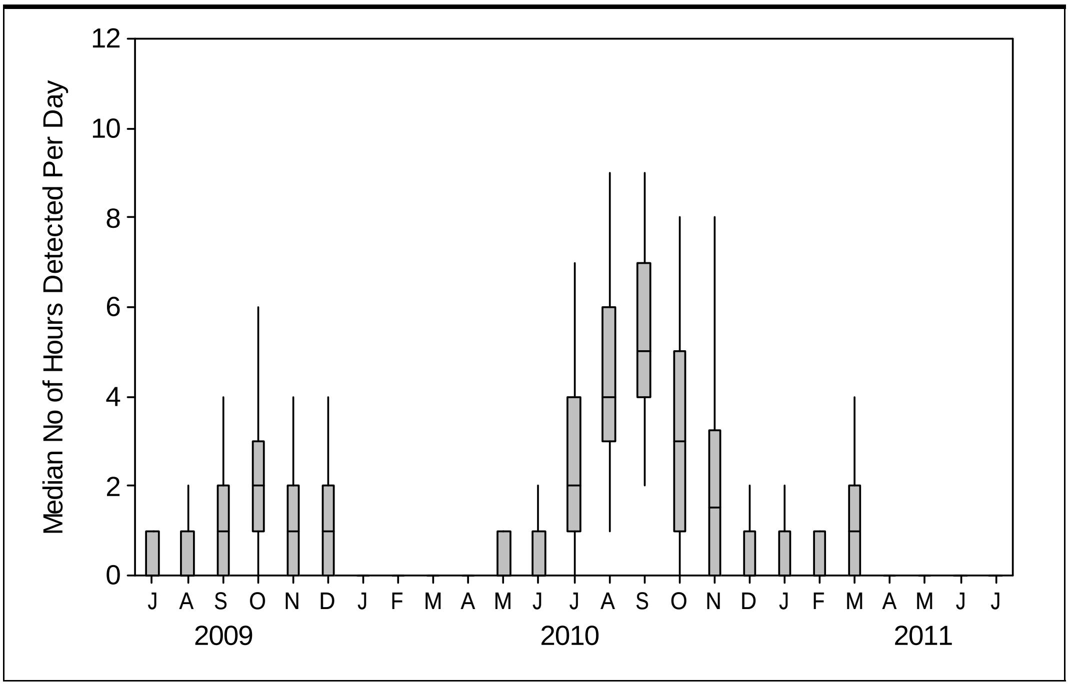
Plate 24.7 Harbour porpoise and minke whale sightings made by the CRRU between 2001 and 2008(from Thompson, et al., 2010a; see SMRU, 2011)



Seasonal Variation

60. Harbour porpoises occur year-round in the southern Moray Firth with seasonal peaks observed by CRRU along the southern coastline between May and July, consistent with the known calving period for this species in the North Sea (Robinson et al., 2007). In Spey Bay, porpoises were detected on 52% of days and there appeared to be seasonal patterns in the POD detections at this site with peaks in late summer/autumn in 2009 and 2010 (Plate 24.8).

Plate 24.8 Monthly variation in the median number of hours that porpoises were detected at the Spey Bay POD site 2009 to 2011 (Thompson and Brookes, 2011)

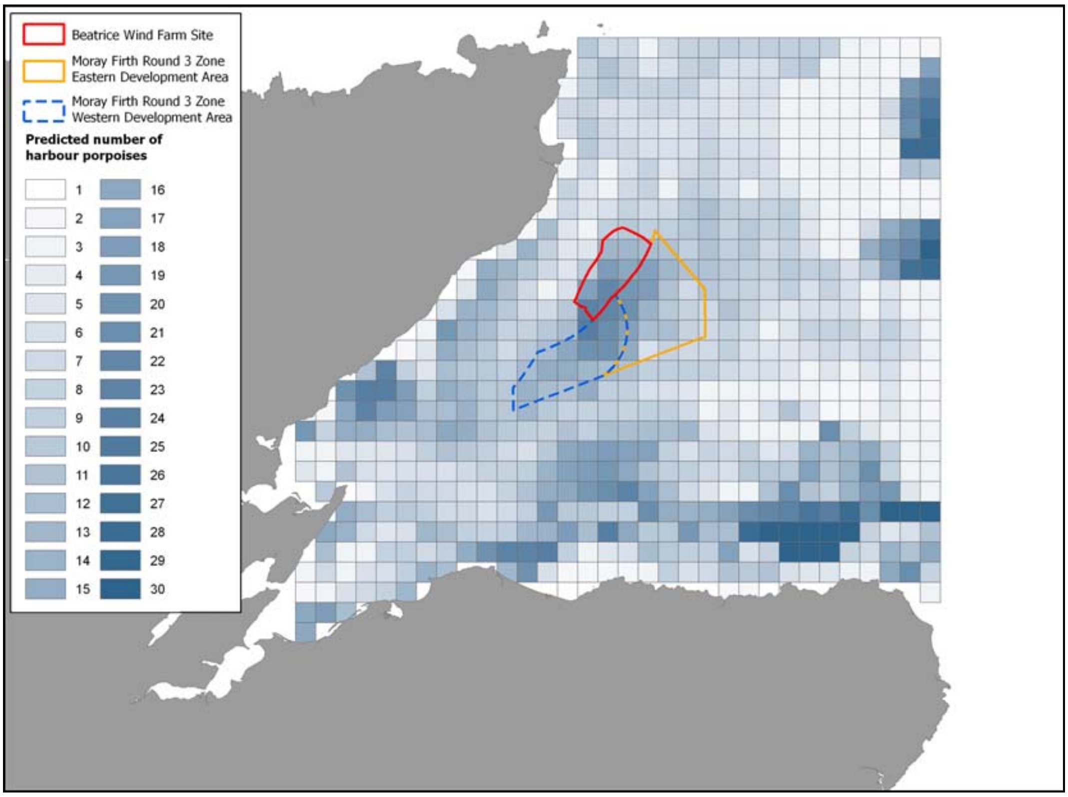


Abundance and Density

61. Abundance estimates for the SCANS Block J (Moray Firth, Orkney and Shetland) are given as 24,335 in 1994 and 10,254 in 2005. There are no abundance estimates available for the Moray Firth alone. However, information on encounter rate from the CRRU surveys has been used to provide density estimates for harbour porpoise (Robinson et al., 2007). These show that densities are lowest on the survey track nearest the shore (0.077 porpoises per km effort) and higher on the three survey tracks further offshore (between 0.22 and 0.24 porpoises per km effort) (Plate 24.1).

62. Habitat association modelling was also used to predict numbers across the Moray Firth (see Annex 12A, Section 4.2.1). The resulting map shows the predicted number of porpoises in each 4 x 4 km cell. For the majority of cells the density is in the range 0 to 5 individuals per cell but along parts of the cable route the numbers exceed 20 individuals per cell (Plate 24.9).

Plate 24.9 The predicted number of harbour porpoises in each 4 x 4 km cell. Values are based upon measures of relative abundance derived from habitat association modelling, scaled according to estimates of absolute abundance from aerial line transect surveys and extrapolated to other areas according to predicted relative abundance (Thomson and Brookes, 2011).



24.1.1.15 Minke Whale

Distribution

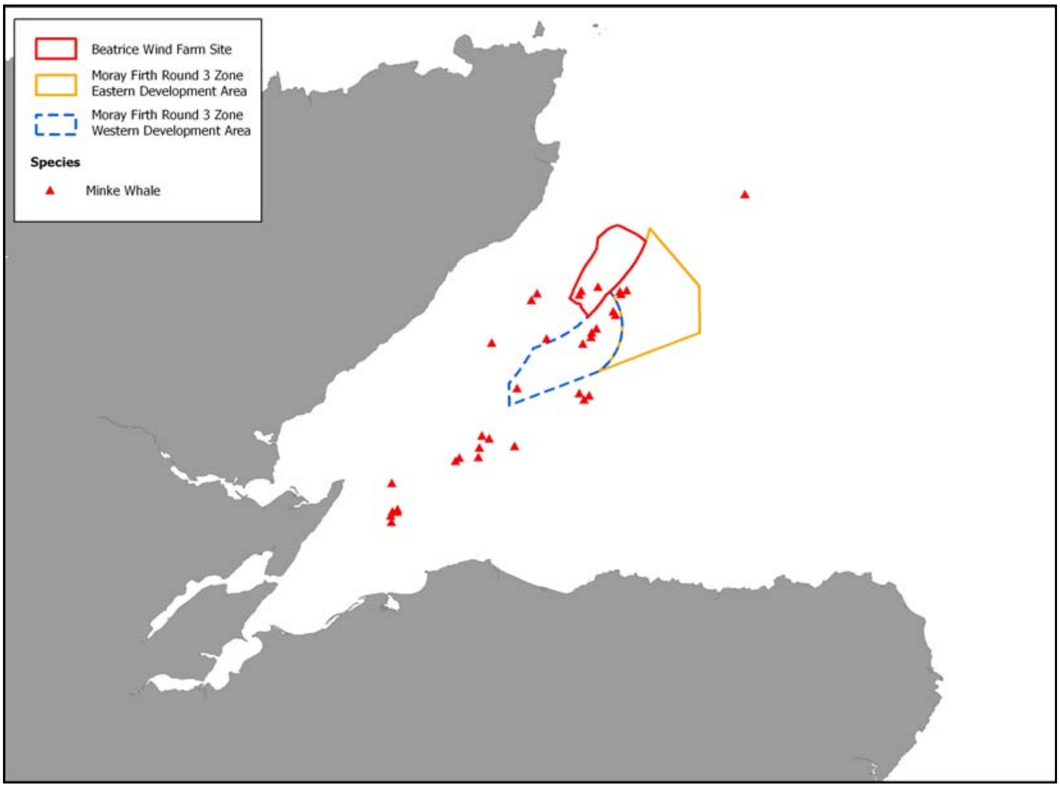
63. Minke whales are distributed along the central and northern North Sea and along the Atlantic seaboard of Britain and Ireland. Minke whales were the second most commonly sighted species (after harbour porpoise) in offshore waters of the outer Moray Firth, although this may reflect a more recent trend as there were comparatively fewer sightings in earlier datasets.

64. Aerial surveys conducted throughout the BOWL Study Area in 2009 by Aberdeen University suggest that most sightings are offshore (Plate 24.10). The track lines associated with this study are presented in Annex 12A, Figure 34. However, the CRRU surveys also showed a significant distribution along the southern Moray Firth coastline, although minke whales largely occurred to the east of Spey Bay where the cable route landfall site is located (Plate 24.7).

65. The distribution of minke whales in the southern Moray Firth has been found to be shaped by a strong preference to water depths between 20 to 50 m, steep slopes (>60^{0}), a northerly facing aspect and sandy-gravel sediment type (Robinson et al., 2009). Sediments of coarse sand and fine gravel are the preferred habitat for the minke whales key prey species in the Moray Firth - the lesser sandeel *Ammodytes*

marinus – and the arrival of minke whales in the Study Area each year may be synchronised with the emergence of sandeels into the water column to feed (Robinson et al., 2009).

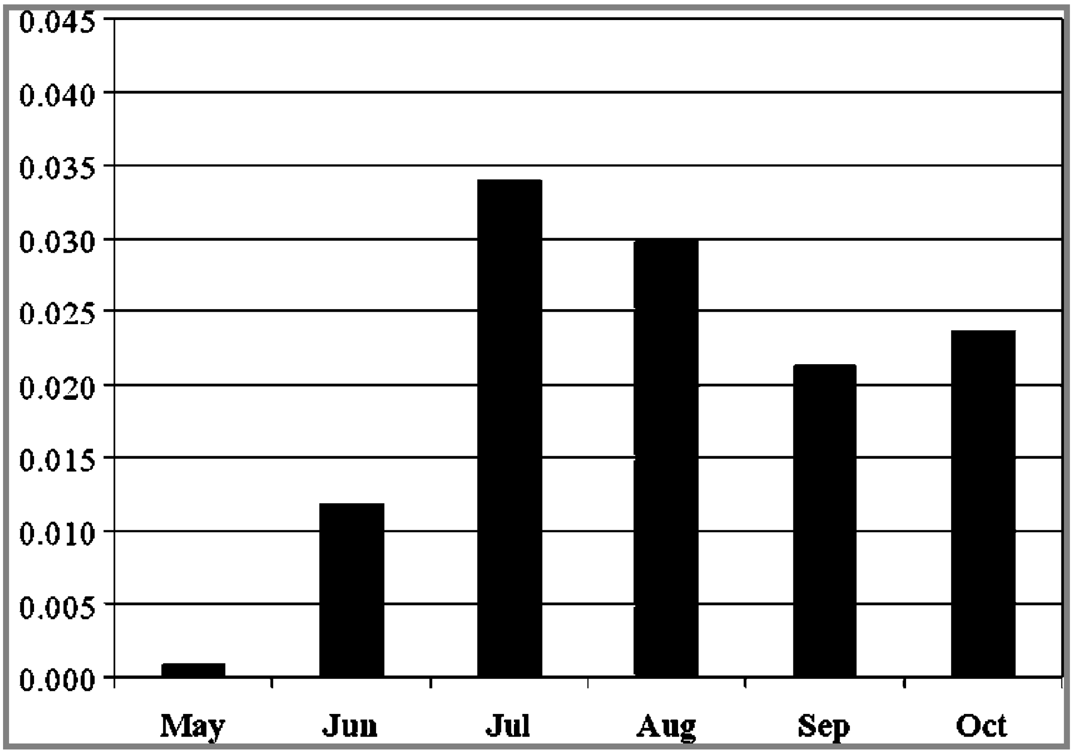
Plate 24.10 Sightings of minke whales made during the University of Aberdeen's boat based surveys (from Thompson et al., 2010a; see SMRU, 2011)



Seasonal Variation

66. Most sightings of minke whales in the Moray Firth have been made between May and September, with few records between October and April (see Annex 12A, Section 4.3.2). Minke whales are typically recorded along the southern Moray coast from mid-June onwards with numbers remaining fairly consistent from July to October (Plate 24.11). The occurrence of minke whale during this time is associated with warm water plumes which trigger a rise in the levels of phytoplankton, and consequently in the numbers of sandeel and other key prey items for the minke whale (Tetley et al., 2008).

Plate 24.11 The number of minke whale encounters per km of survey effort between the months of May and October 2001 to 2006 (from Tetley* et al.*, 2008; see SMRU, 2011).



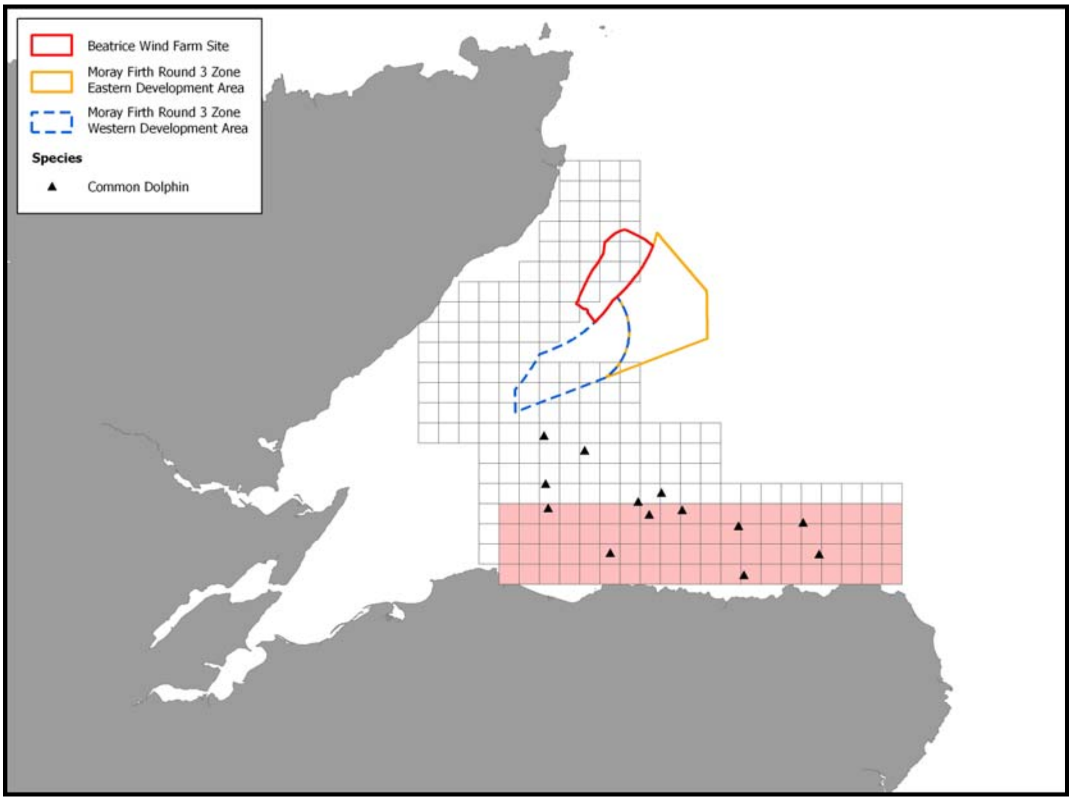
Abundance

67. The most recent estimate of abundance of minke whale was for SCANS II Block J (Moray Firth, Orkney and Shetland) data which gave an abundance of 835 animals, equating to a density of 0.0223 animals per km^2. Along the southern Moray Firth coast the CRRU data (Plate 24.1) gave abundance estimates of 0.011 animals per km effort on the survey track nearest the shore rising up to 0.044 animals per km effort at the outermost survey track (Robinson et al., 2007).

24.1.1.16 Common Dolphin

68. Most sightings of common dolphins are around the UK's west coast with very few in the North Sea. The few sightings that were made in the Moray Firth were predominately on the north side of the Moray Firth. In the southern Moray Firth, the CRRU data showed 13 sightings of common dolphins between 2001 and 2009 to the east of Lossiemouth (Plate 24.12). Seasonal peaks may occur in this area in June and July due to the birth of newborn calves (Robinson et al., 2010). There were too few sightings to estimate abundance.

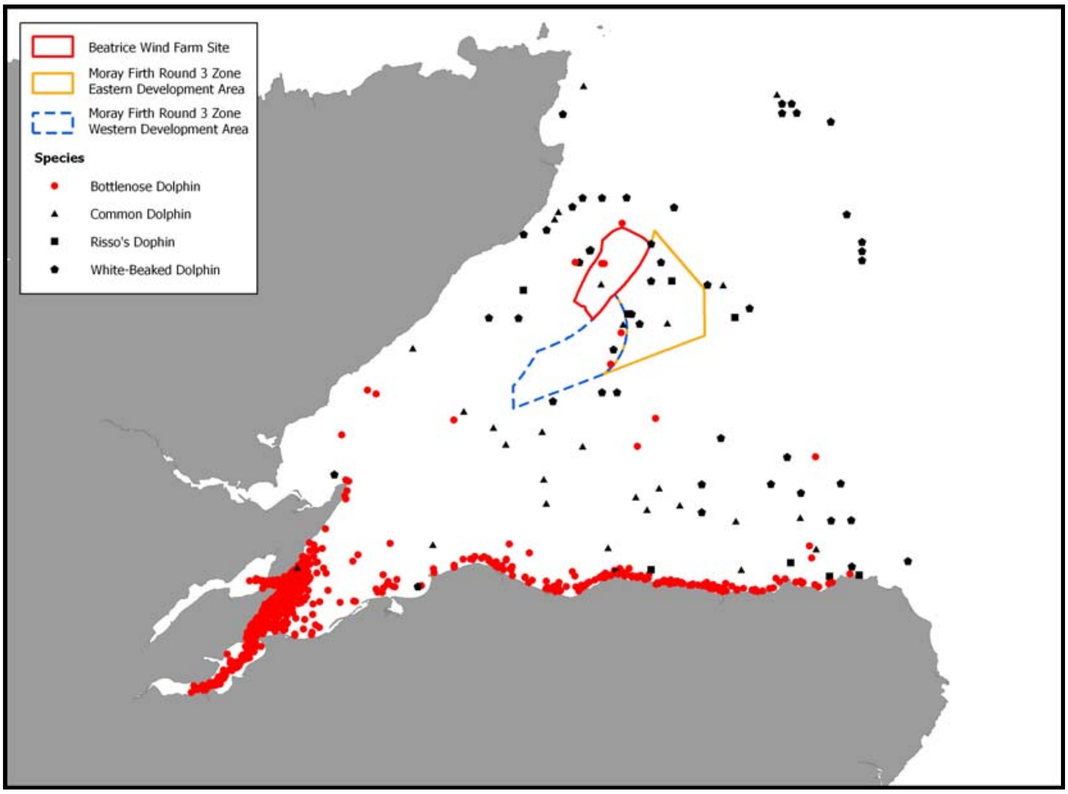
Plate 24.12 The distribution of common dolphin sightings recorded during surveys carried out between February and November in 2001 to 2009 by the CRRU (area covered shown by the shaded boxes) and WDCS (area covered by all the boxes) (from Robinson* et al*., 2010; see SMRU, 2011)



24.1.1.17 White-Beaked Dolphin

69. White-beaked dolphins occur through the central and northern North Sea and off the northwest coast of the British Isles and Ireland. This is the most commonly sighted dolphin in the outer Moray Firth but there have been very few sightings in the inner Moray Firth (Plate 24.13).

Plate 24.13 Sightings of dolphins in the Moray Firth 1980 – 2010 (Thompson and Brookes, 2011)



70. The white-beaked dolphin estimates for SCANS II Block J (Moray Firth, Orkney and Shetland) in 2005 give a figure of 682 animals, equating to a density of 0.0182 animals per km^2. There were too few sightings in the Moray Firth to assess seasonal variation or to provide density estimates for this area.

24.1.1.18 Risso's Dolphin

71. Most Risso's dolphins in UK waters occur around the coast of western Scotland and the Outer Hebrides. Of the few sightings in the Moray Firth, most occurred offshore (Plate 24.13). During the 2001-2005 CRRU surveys between May to October, only five sightings of Risso's dolphin were made along the southern Moray Firth coastline. These were all made during September and between the 20 to 50 m isobaths (Robinson et al., 2007).

24.3.3 PINNIPEDS

72. Two species of seal are widely distributed and abundant within the Study Area. The harbour (or common) seal is a primary citation feature of the Dornoch Firth and Morrich More SAC which lies within the inner Moray Firth (Para 44). There are no statutory designations within the Study Area for grey seal, however, due to the large distance that this species travels there may be links between the Isle of May SAC population in the Firth of Forth and the Moray Firth Study Area.

24.1.1.19 Harbour Seal

73. Britain is home to 30% of the population of the European harbour seal and Scotland holds 84% of the British population. Harbour seals are present in the Moray Firth

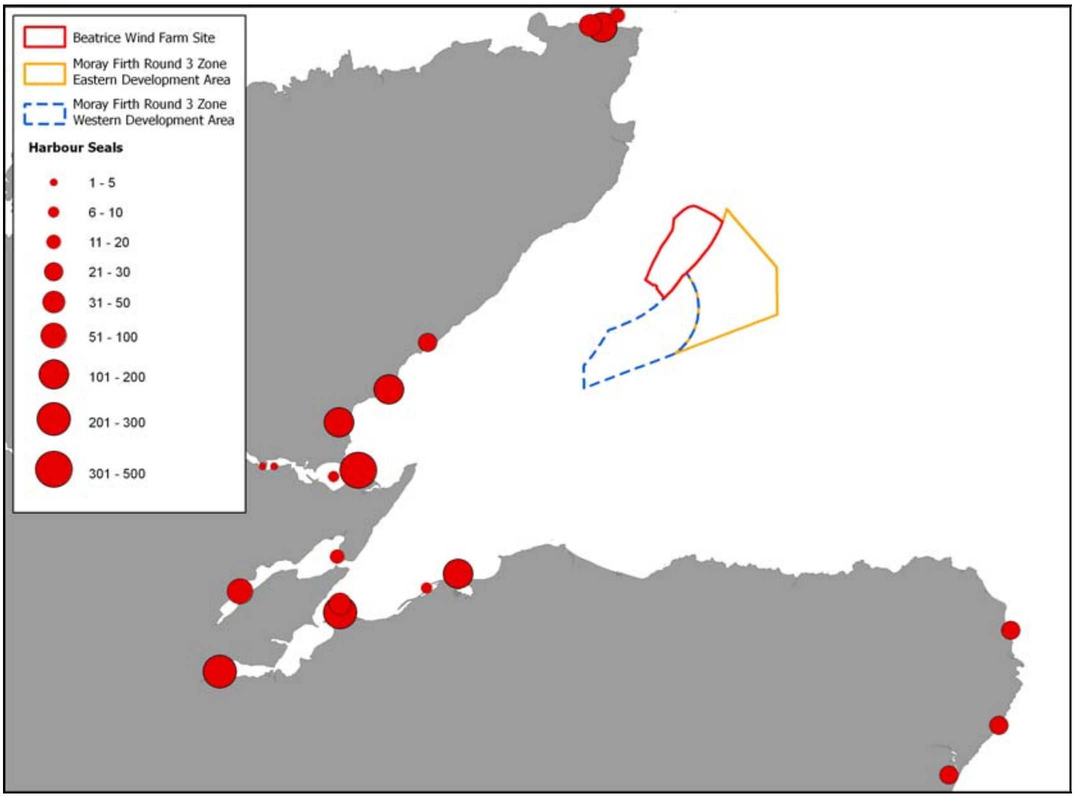
all year round and use intertidal haul-out sites to rest between foraging trips, to breed in June/July and to moult in August/September.

74. As an Annex II species, protection of harbour seals in this region is afforded through designation within the Dornoch Firth and Morrich More SAC (Para 44).

Distribution and Seasonal Variation on Land

75. The SMRU August moult surveys show the distribution and abundance of harbour seals on land during the moult. The data show that whilst they are distributed throughout the northern and southern shores of the inner Moray Firth, there are no haul-out sites at Spey Bay near the cable route landfall site. The nearest haul-out location is at Findhorn and this lies approximate 34.8 km from the nearest point along the cable route (Plate 24.14). Approximately 100 animals use this haul-out site during the August moult and the site is also used for pupping.

Plate 24.14 The number and distribution of harbour seals counted during SMRU thermal imaging surveys between August 2007 and 2009 (from Duck and Thompson, 2009; see SMRU, 2011)



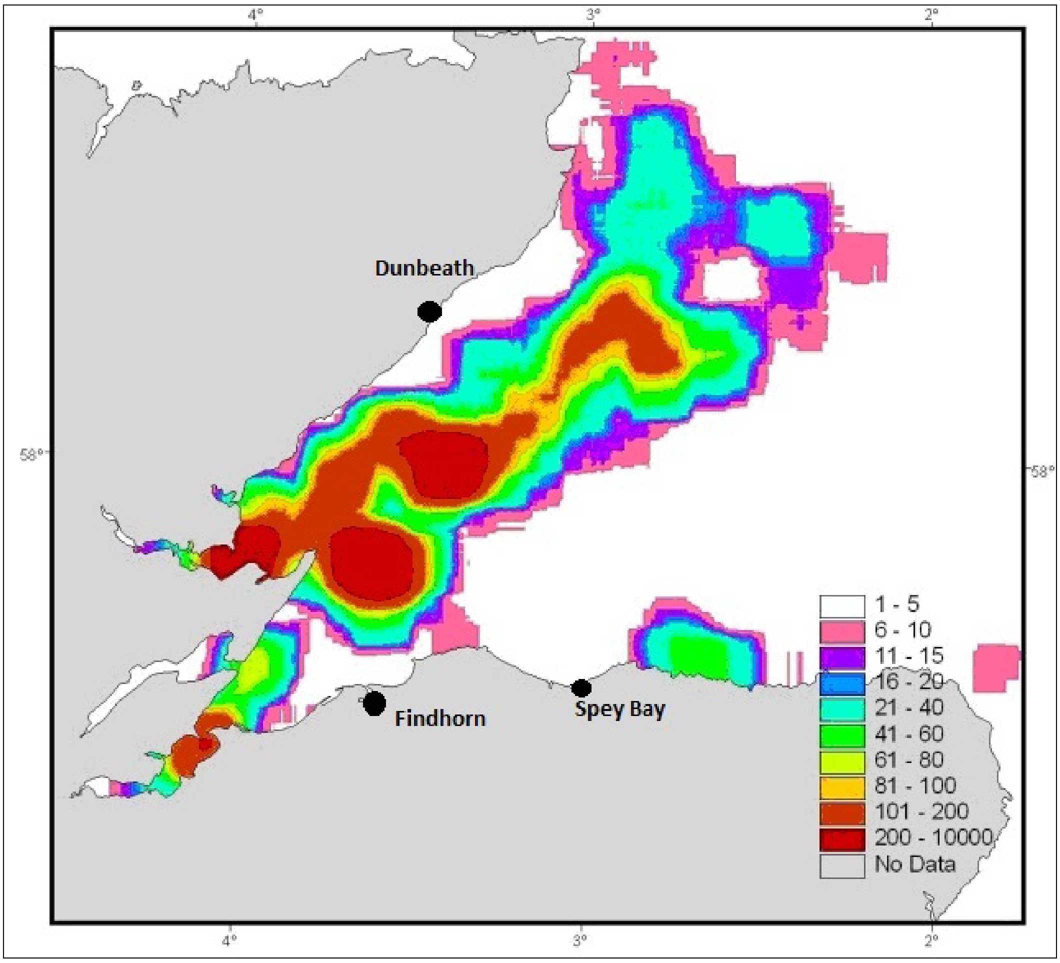
76. Harbour seals are present at these haul-out sites throughout the year although seasonal peaks coincide with the breeding and moulting seasons in July and August. Their distribution throughout the sites vary both seasonally and between years and is thought to be linked to proximity to foraging areas (outside the breeding season) and site characteristics (during the breeding season) (Thomson et al., *1996*).

Distribution and Seasonal Variation at Sea

77. Radio tagging studies show that harbour seals forage throughout the Moray Firth with most animals foraging between 30 and 70 km from haul-out sites. Areas showing dense seal activity were in the inner Moray Firth north of Findhorn and to the south of Dunbeath (Plate 24.15). This latter area coincides with the Wind Farm site.

78. The telemetry tracking study carried out for BOWL also provided evidence that animals from the Dornoch Firth and Morrich More SAC were foraging in the area to the east of Spey Bay (Plate 24.16).

Plate 24.15 Density of foraging locations of harbour seal at sea based on tracking data (from Sharples** et al.**, 2008; SMRU, 2011)



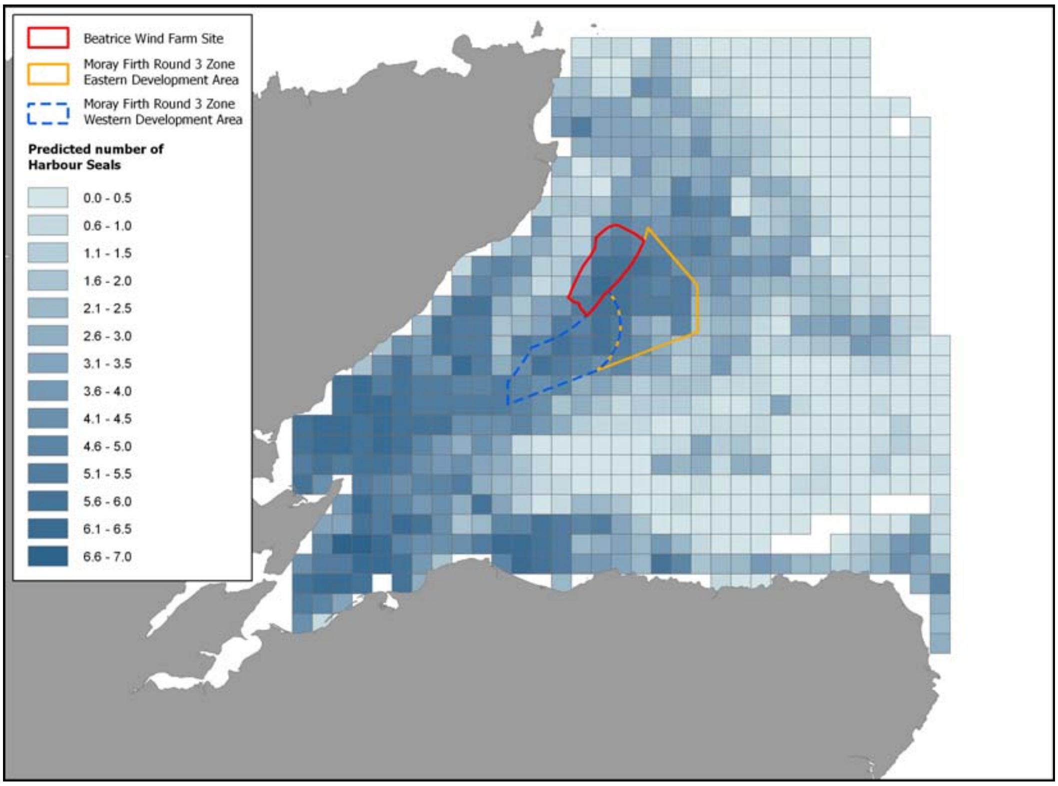
Abundance

79. Although the population of harbour seals is stable in some parts of Scotland (Strathclyde and the west Highland coast), major declines have occurred in many regions since the 1990s and in the Moray Firth the population has declined by 40%. The Moray Firth supports approximately 4% of the British population, equating to less than 1,000 individuals (Special Committee on Seals (SCOS), 2010). Counts during the breeding season showed that 500 animals were breeding in 2008, increasing to 671 animals in 2009 (Duck et al., 2010). Whilst there has been an increase these figures are lower than in 1993 when approximately 1000 breeding animals were counted in the Moray Firth. Similarly, there has also been a decrease over the last 15 years in the number of harbour seals counted during the August moult.

Density

80. Habitat association modelling was used to predict the density of harbour seals in the Moray Firth (see Annex 12A, Section 4.8.5). Telemetry data from 37 tagged seals from the Dornoch Firth and Morrich More SAC showed that the seals were dispersed widely across the Moray Firth with up to eight individuals occurring in some 4 x 4 km squares, representing a density of 0.5 individuals per km^2 (Plate 24.16).

Plate 24.16 Predicted numbers of harbour seals from the Dornoch Firth SAC and Loch Fleet NNR in different 4 x 4km grid cells across the Moray Firth (Bailey and Thompson, 2011)



Movement Between the Wind Farm and OfTW and SAC/NNR

81. The tracking study described above (Para 80) illustrated that seals from the Dornorch Firth and Morrich More SAC (and the Loch Fleet NNR) are distributed widely across the Study Area and are likely to forage within the Project Boundary, including the area around Spey Bay. In addition, further tagging studies have shown that a small number of harbour seals tagged in other SACs (e.g. Orkney) may infrequently venture down to the Moray Firth, presumably to forage, including areas along the southern Moray Firth coast.

24.1.1.20 Grey Seal

82. Approximately 45% of the world population of grey seals is found in Britain, 90% of which breed in Scotland (SCOS, 2008). In contrast to harbour seals, the number of grey seal pup production has increased steadily since the 1960s, and continues to increase in the North Sea, although this growth is now levelling off in Orkney and the Hebrides.

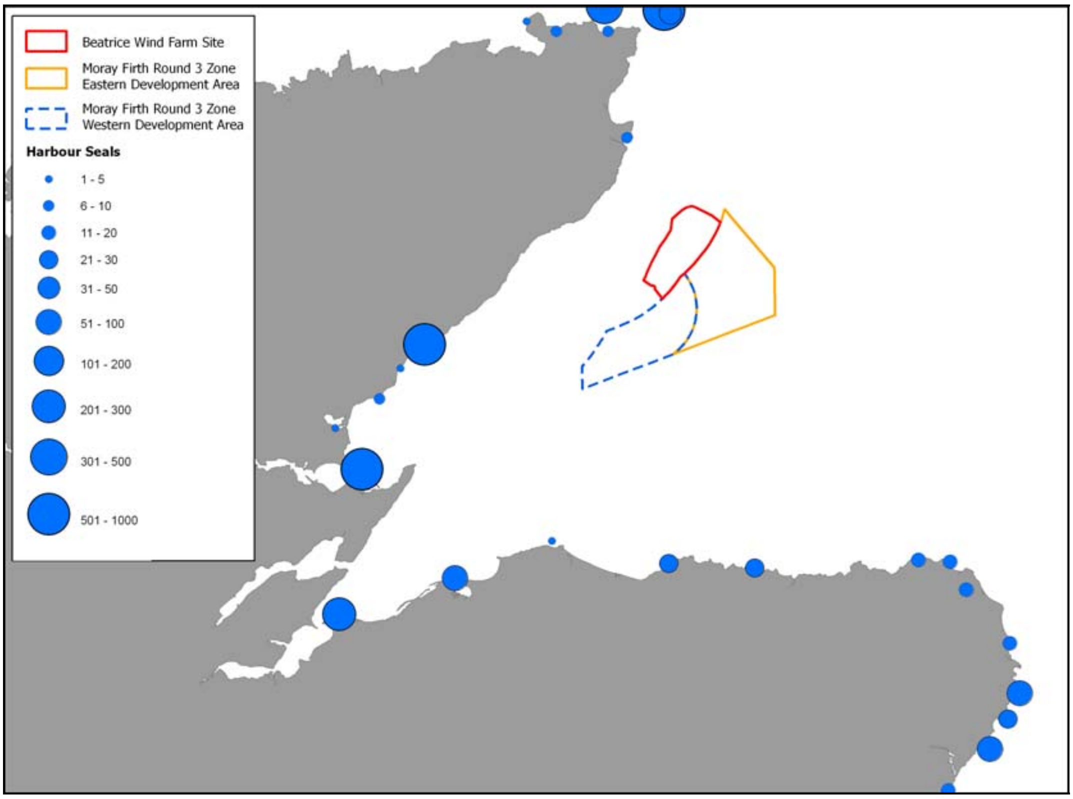
83. Grey seals are present in the Moray Firth year-round, hauling out at intertidal sites between foraging trips and breeding on beaches (or in caves) above the high water mark along the Helmsdale coastline (along the north shore of the Moray Firth) in Autumn.

84. Like harbour seals, this species is listed on Annex II of the Habitats Directive and as such is protected by a network of SACs. None of these SACs fall within the Study Area, however, based on consultation with the statutory authorities, this assessment has considered the possibility that grey seals from SACs further afield may be using the Moray Firth during foraging trips (See Para 90).

Distribution and Seasonal Variation on Land

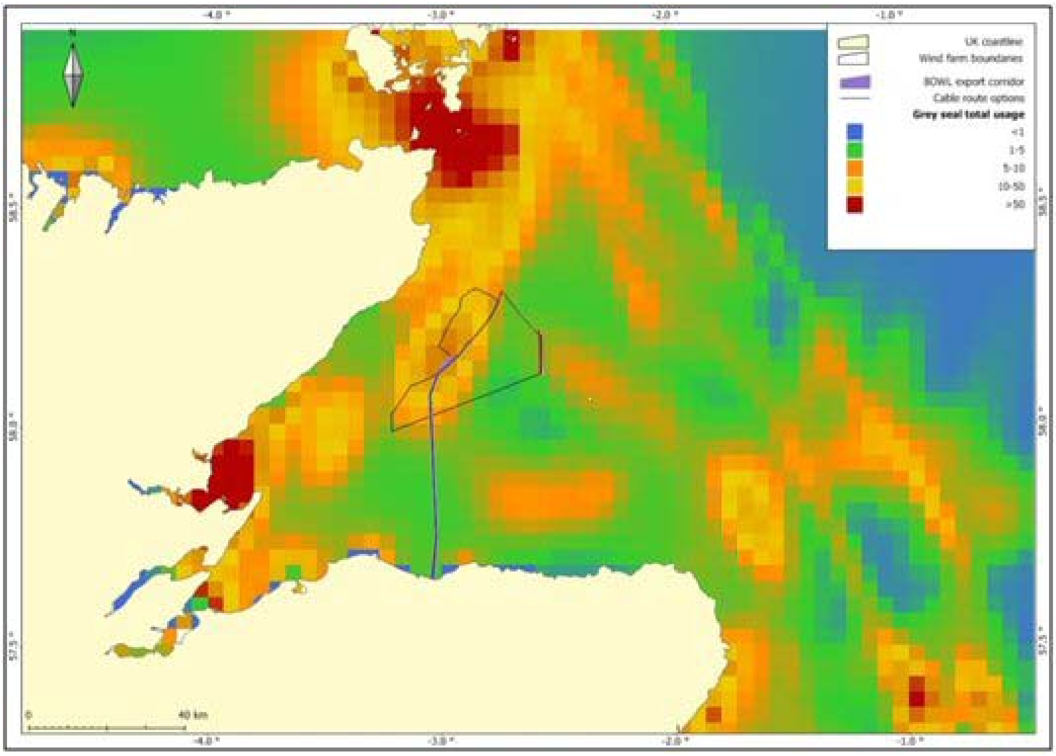
85. Haul-out sites for grey seal are distributed around the coastline of the Moray Firth with largest numbers along the northern coastline particularly around Dornoch Firth, Brora and Duncansby Head (Plate 24.17). During the summer the numbers are greatest around Dornoch Firth, where the largest breeding colony is located, whist during the winter period the numbers are higher along the Helmsdale coastline, on the northern shore of the Moray Firth. Along the southern Moray coastline the numbers are much lower, but the closest large haul-out site (with 101-200 individuals) is at Findhorn, which lies approximately 34.8 km from the cable route (Plate 24.17). There is also a much smaller haul-out site approximately 6.1 km to the east of the cable route, but the numbers here are much lower (21-30 individuals). However, there are no grey seal breeding colonies in this area.

Plate 24.17 The number and distribution of grey seals counted during SMRU thermal imaging surveys of the Moray Firth in August 2007 and 2009 (from Duck and Thompson, 2009; see SMRU, 2011)



86. These data were further supported by the grey seal usage study which showed the key haul-out sites around Dornoch Firth and Duncansby Head (Plate 24.18). Again this showed much lower use around the southern coastline of the Moray Firth.

Plate 24.18 Grey seal total usage (hauled out and at-sea) around the BOWL proposed development site (Russell, 2011)



Distribution and Seasonal Variation at Sea

87. The grey seal usage study showed that grey seals forage throughout the Moray Firth with numbers greatest along the northern coastline. There was very low grey seal activity along the cable route (Plate 24.18).

Abundance and Density

88. As mentioned previously, the number of grey seal pups produced every year has risen steadily in the North Sea since 1960, however, pup production at Helmsdale (on the north Moray Firth coastline) has remained fairly steady in the last five years, with approximately 1000 pups in total (see Annex 12, Figure 54).

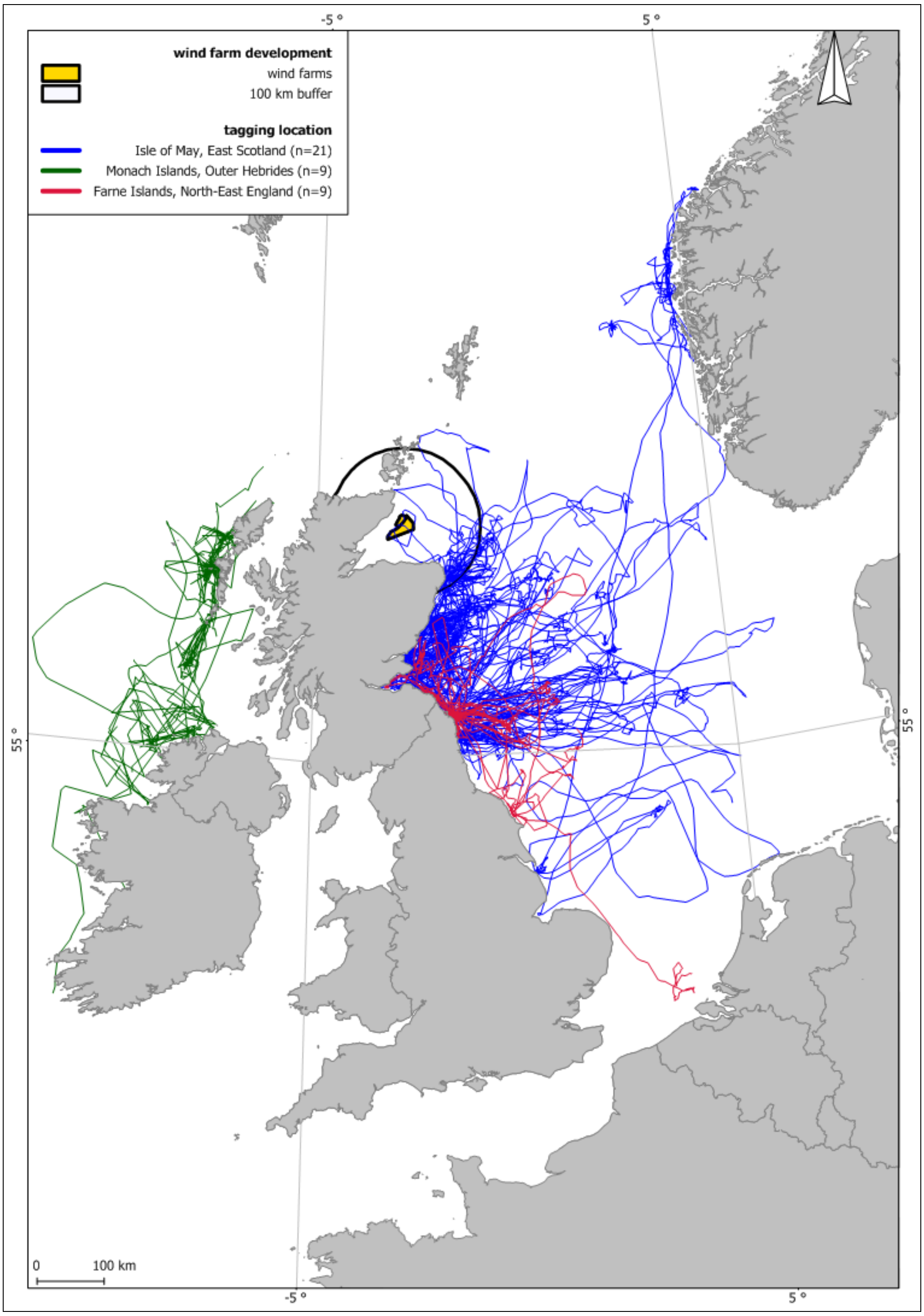
89. Densities of grey seal are greatest around the main breeding colonies at Dornoch Firth and Duncansby Head with greater than 50 animals in each 4 x 4 km grid cell (Plate 24.18). Along the cable route most grid cells were in the range of 1-5 individuals.

Movement between the Project Boundary and Grey Seal SACs

90. Published studies relating to grey seal movements at sea show that, while grey seals often forage close to shore in areas local to the sites they are using to haul-out, they also make long distance movements (McConnell et al., 1999). A tagging study from different SAC locations in Scotland showed the potential for grey seals to use haul-out sites within SACs other than the one in which they were tagged (Plate 24.19). Thus there is considered to be a high probability that grey seals using the

Moray Firth and/or Project Boundary will haul-out, at some point, at one or more of the six Scottish grey seal SACs.

Plate 24.19 The extent of grey seal pup (n=39) movements from the breeding sites where they were tagged (Russell, 2011). The tracks are colour coded by tagging location (see legend). The solid black line shows a 100km buffer zone around the BOWL (and MORL) wind farm sites.



24.3.4 PREY SPECIES

91. The prey items of marine mammals is varied, ranging between small planktonic copepods for species within the suborder *Mysticeti* (baleen) to large-bodied pelagic fish, giant squid and other marine mammals for larger species of toothed (*Odontoceti*) whales. Table 24.8 summaries the diet of marine mammals for the species occurring within the Moray Firth.

Table 24.8 Key prey items for the main species of marine mammals found within the BOWL Study Area. (Harris and Yalden, 2008)

Marine Mammal	Key Prey Items in the Moray Firth
Odontoceti	
Bottlenose dolphin	Preferred item in the Moray Firth is salmon *Salmo salar*, but also opportunistic exploiting a wide variety of fish and shellfish.
Harbour porpoise	Target pelagic shoaling fish (sandeel *Ammodytes spp*, whiting *Merlangius merlangus* and herring *Clupea harengus*) as they aggregate along tidal channels.
Mysticeti	
Minke whale	Sandeel constitutes the largest part of the diet in the Moray Firth (Pierce et al., 2004) but this species generally targets whichever fish is most abundant in the area, primarily small fish and krill.
Pinnipeds	
Grey seal	Mainly sandeels but also other pelagic species such as cod, whiting, and squid are taken.
Harbour seal	Sandeel, cod, herring, sprat, flatfish, octopus and squid.

24.3.5 ASSESSMENT LIMITATIONS

92. This assessment is based upon the best available information on marine mammal populations within the Moray Firth. However, as with all ecological data samples represent a snapshot of the ecology in the Study Area, particularly where the study animals are highly mobile and therefore more difficult to survey. In addition, there remains some uncertainty with respect to identification of different dolphin species during the 2010 ICES boat-based surveys of the Project Boundary, such that some individuals may have been incorrectly identified as bottlenose dolphin and therefore this data was excluded from the analyses.

93. There is also an element of uncertainty associated with extrapolating field data to predict marine mammal numbers using habitat-association modelling. For example, in some 4 x 4 km grid cells there were no habitat data available and therefore these had to be removed from the analyses. A description of the approach to habitat association modelling and its caveats is given in Thompson and Brookes (2011) (see Appendix 2 in Marine Mammal Technical Report, Annex 12A).

94. Finally, there is limited knowledge of the sensitivity of many marine mammal species to noise effects in particular and therefore in some instances species assumed to have similar sensitivities, and for which more detailed information is

available, have been used as surrogates. The use of surrogates to undertake the noise assessment is detailed in Annex 7A.

24.4 ASSESSMENT OF EFFECTS

95. An assessment of effects on marine mammal receptors is presented below for each potential effect during the construction/decommissioning and operational phases. The potential effects are described for each receptor and justification provided based on the best available scientific knowledge at the time of writing. A summary of the significance of the effect is given for each receptor based on the EIA assessment guide described in Section 24.2 above.

24.4.1 ASSESSMENT OF EFFECTS DURING CONSTRUCTION/ DECOMMISSIONING

24.1.1.21 Injury, Displacement and Disturbance from Noise Emissions during Cable Laying (and Removal) Activities

96. The noise modelling study presents effect ranges for the 90 and 75 dB_{ht} (species) and M-weighted SEL bands for each of five cable laying activities (Tables 5.1 to 5.10; Annex 7A). Whilst the M-weighted SELs have been modelled for both stationary and fleeing animals, the most realistic scenario is for the fleeing animal model since such highly mobile animals are more likely to move away from a noise disturbance rather than stay in the area.

97. The duration of noise effects varies according to each activity (see Annex 7B). For example, trenching (the activity resulting in the greatest noise effects) is predicted to progress at a speed of 100 m per hour and therefore will take approximately 40 (including 3 days post lay survey) to 120 days (including 9 days post lay survey) for one to three export cables respectively. The potential noise effects from each activity were compared quantitatively for the dB_{ht} metric using km^2-hours (described in paragraph 32 above) to give an indication of the area expected to be excluded to an animal over a period of time for each activity.

98. The significance of the effect on each species has been considered based on the distribution and abundance of the key marine mammals within the Study Area. In general, the effect ranges for each species were predicted to be very localised and restricted to small distances either side of the cable route. Whilst there is limited information on the extent to which marine mammals respond to construction noise in the marine environment, a number of scientific studies have been reviewed to understand how responses to construction noise may affect the population of marine mammals both during and after construction.

99. In addition, it should be noted that the noise from the three cable laying vessels over the 120 day construction period represents a negligible increase compared to the already high level of vessel noise in the area (e.g. shipping, fishing, recreation) and therefore marine mammals in the area are likely to have habituated to vessel noise.

100. An assessment of the effects for each of the key marine mammal species and their significance is given below.

Bottlenose Dolphin

101. The greatest numbers of bottlenose dolphin, which are of high ecological value, are around the coastal areas and therefore effects are likely to be greater along the southern part of the cable route. Bottlenose dolphin are sensitive to a broad bandwidth of frequencies from 150 Hz to 160 kHz, and also sensitive to a relatively lower sound pressure level of approximately 40 dB re. 1 Pa (see Figure 10.1 in Annex 7A). Due to the very small area over which PTS is predicted (<1 m) auditory injury from noise impacts is unlikely to occur as construction works would provide an audible cue to avoid such activities before injury could occur. Therefore this small to negligible magnitude effect on a high value receptor is considered to be negligible and not significant in terms of the EIA Regulations. In terms of displacement and avoidance, the density/noise maps show that in the last 8 km of the cable route (approaching the landfall site) between 0.8 to 1.1 individuals (0.41 to 0.56% of the SAC population) may be totally excluded from a distance of 81 m either side of the cable route during the trenching activity and may result in behavioural avoidance an area out to 350 m (Table 24.9; Figure 24.1). These impact distances are very small and the duration of the noise impacts very short-term. For example, for trenching the area of seabed affected is predicted to be <1 km^2-hours for total exclusion and 9 km^2-hours for behavioural avoidance (Table 24.9).

102. In terms of what this means for the population, the most useful information comes from studies at other offshore wind farms. Although a study was undertaken to look at the effect on bottlenose dolphin from the Beatrice demonstrator project, due to the low detection rates within the Wind Farm site it was not possible to provide a robust analysis of the data (Thompson et al., 2010b). However, the study also looked at harbour porpoise and found that whilst there was a short-term reduction in the detection of animals during piling activity there were no significant long-term changes in the use of the area around the Wind Farm (Thompson et al., 2010b). This was also found during the pre- and post-construction studies of harbour porpoise populations at Horns Rev and Nysted wind farms in Denmark where animals were observed to avoid the wind farm sites during piling events, but there was still porpoise activity in the wider Study Area, and numbers returned to normal following cessation of the activity (Teilman et al., 2006). Since construction related noise from the transmission works will be considerably less than during piling and since harbour porpoise is more noise sensitive than bottlenose dolphin it is considered that the short-term displacement of bottlenose dolphin will not result in any long-term population level effects.

103. Similarly, whilst there is potential for the noise impacts to result in a barrier to migration for bottlenose dolphins moving along the coast, this is not considered to be significant due to the short-term nature of the noise disturbance and very small area of ensonification (maximum 81 m radius for 90 dB_{ht}). In this way, individuals travelling east or west along the coast could pass to the north or south of the ensonified area at any time.

104. In summary, there is predicted to be a small to negligible magnitude negative effect of temporary displacement on a small number of bottlenose dolphin (a high value

receptor), equating to 0.56% of the SAC population for a very short period of time which is probable. Due to the short-term and reversible nature of the effect, the effect is considered to be negligible and not significant in terms of the EIA Regulations.

Table 24.9 Summary of the dB_{ht} (bottlenose dolphin) and Southall PTS impact ranges predicted for the different activities associated with the transmission works

Activity	90 dB_{ht} (species)		75 dB_{ht} (species)		Auditory injury - PTS (Southall)	
	Impact range (m)	Area of sea affected (km^2-hours)	Impact range (m)	Area of sea affected (km^2-hours)	Fleeing animal impact range(m)	Stationary animal impact range (m)
Cable laying	9	<1	75	<1	<1	65
Trenching	81	<1	350	9	<1	65
Backhoe dredging	<1	<1	1	<1	<1	8
Cable protection	31	<1	170	2	<1	120
Vessel noise	29	<1	260	5	<1	84

Harbour Porpoise

105. Audiogram data for the porpoise indicate that it is responsive at frequencies from 100 Hz – 170 kHz, with peak hearing sensitivity occurring over the frequency range 20 kHz – 150 kHz. As the marine mammal with the highest noise perception ability (i.e. the most hearing sensitive species), the areas affected by elevated noise during the construction works are greatest for harbour porpoise. At the higher end of the scale, trenching activity was predicted to cause 100% exclusion of animals out to 140 m, whilst behavioural avoidance could occur out to an impact range of 640 m for some individuals (Table 24.10). These equate to 1 km^2-hours for total exclusion and 31 km^2-hours for behavioural avoidance. The range for potential auditory injury (from PTS) is less than 1 m (Table 24.10).

106. Harbour porpoise were abundant throughout the Study Area, with high numbers predicted along parts of the cable route (Figure 24.2). At the most northerly point where the cable route connects to the Wind Farm site, the numbers of harbour porpoise are in the range 20 to 30 individuals per 4 x 4 km^2 grid cell. Along the central part of the cable route there are also relatively high numbers with 15 to 20 individuals per grid cell. In contrast, nearer to the coast the numbers drop off and there were less than 5 individuals in the two grid cells nearest the landfall site. Although these numbers seem fairly high, the harbour porpoise is very abundant and widespread through British waters and the number within SCANS II Block J (Moray Firth, Orkney and Shetland) was recorded as 10,254 in 2005. Thus, 30 individuals represents only a small proportion (<0.3%) of the highly transient population that occurs within SCANS II Block J.

107. Due to the very small area over which PTS is predicted (<1 m) auditory injury from noise impacts is considered unlikely to occur as construction works would provide an audible cue to avoid such activities before injury could occur. Displacement and avoidance occurs over larger areas, but these are still minimal compared to the extent of available habitat throughout the Moray Firth. Even considering the noise sensitivity of harbour porpoise, displacement and avoidance will be very short term and as discussed previously, studies of harbour porpoise at other offshore wind farms show that numbers are likely to return to normal following cessation of the activities (Teilman et al., 2006; Thompson et al., 2010b).

108. In summary, there is predicted to be a small to negligible magnitude negative effect of temporary displacement on a small proportion of the harbour porpoise (a high value receptor) population for a very short period of time which is probable. Due to the short-term and reversible nature of the effect, the effect is considered to be negligible and therefore not significant in terms of the EIA Regulations.

Table 24.10 Summary of the dB$_{ht}$ (harbour porpoise) impact ranges predicted for the different activities associated with the transmission works

Activity	90 dB$_{ht}$ (species)		75 dB$_{ht}$ (species)		Auditory injury - PTS (Southall)	
	Impact range (m)	Area of sea affected (km2-hours)	Impact range (m)	Area of sea affected (km2-hours)	Fleeing animal impact range(m)	Stationary animal impact range (m)
Cable laying	29	<1	220	4	<1	55
Trenching	140	1	640	31	<1	55
Backhoe dredging	1	<1	9	<1	<1	7
Cable protection	99	1	550	23	<1	110
Vessel noise	41	<1	350	9	<1	69

Harbour Seal

109. Harbour seal and grey seal have similar hearing sensitivity with a frequency range of approximately 100 Hz to 100 kHz, with peak hearing sensitivity over the range 1 kHz to 40 kHz, and minimum sound pressure level of approximately 60 dB re. 1 Pa (Nedwell et al, 2007b). Therefore, seals are not considered to be as hearing sensitive as cetaceans. The activity predicted to have the greatest effect on harbour seal was cable protection (e.g. the protection of cables through use of concrete mattress, rock armour or rock nets, described in detail in Section 7) and the impact ranges were 17 m for total exclusion and 99 m for behavioural avoidance (Table 24.11). Harbour seal numbers were highest towards both the northern and southern end of the cable route with up to 0.4% of the SAC population within the 4 x 4 km2 grid cells in these areas (Figure 24.3). Along the central part of the cable route, the densities of grey seals were lower with less than 0.1% of the SAC population in many of the grid cells. Considering the area of sea affected, it can be predicted that up to 0.4% of the

harbour seal population will be excluded or avoid the impact area for less than 1 km2-hour (Table 24.11). In addition, harbour seal haul-out sites lie far enough away from the cable route, so there is unlikely to be any noise effects for seals on land (Figure 24.3).

110. The numbers of harbour seals are predicted to return to normal with no population level effects. This is based on the same premise as for harbour porpoise, whereby during construction harbour seals were observed within their key foraging areas which overlapped with the Horns Rev and Nysted Offshore Wind Farms, (although they avoided the areas during piling activities), and populations recovered following cessation of the activities (Tougaard et al., 2006a; Tougaard et al., 2006b).

111. In summary, there is predicted to be a small to negligible magnitude negative effect of temporary displacement on a small proportion (<0.4%) of the harbour seal SAC population (high value receptor) whilst at sea for a very short period of time which is probable. Due to the short-term and reversible nature of the effect, the effect is considered to be negligible and therefore not significant in terms of the EIA Regulations.

Table 24.11 Summary of the dB_{ht} (harbour seal) impact ranges predicted for the different activities associated with the OfTW

Activity	**90 dB_{ht} (species)**		**75 dB_{ht} (species)**		**Auditory injury - PTS (Southall)**	
	Impact range (m)	**Area of sea affected (km2-hours)**	**Impact range (m)**	**Area of sea affected (km2-hours)**	**Fleeing animal impact range (m)**	**Stationary animal impact range (m)**
Cable laying	2	<1	29	<1	<1	91
Trenching	12	<1	87	<1	<1	57
Backhoe dredging	<1	<1	<1	<1	<1	9
Cable protection	17	<1	99	<1	<1	120
Vessel noise	1	<1	43	<1	<1	86

Grey Seal

112. The predicted noise ranges for grey seal are the same as those given for harbour seal (Table 24.11). The densities of seals vary little along the cable route with numbers ranging between 1.27 to 4.39 individuals per 4 x 4 km^2 grid cell (Figure 24.4).

113. Key foraging areas for grey seal are throughout the inner Moray Firth and along the top half of the outer Moray Firth (Figure 24.4). The noise modelling predicted a maximum exclusion range of 17 m and behavioural avoidance range of 99 m for the activity with the greatest magnitude of noise effects (cable protection). This equates to the exclusion/behavoural avoidance of <1 km^2-hours of seabed for up to

4 individuals as a worst case. As described for harbour seals, the scientific evidence suggests that seals are likely to continue normal activity throughout the Study Area over the construction period, and any displacement or avoidance will be short term, with densities returning to normal following cessation of the noise-related activity (Tougaard et al., 2006a and b).

114. The noise contours were also compared to the grey seal haul-out sites across the Moray Firth, and the results showed that whilst there was a grey seal haul-out within Spey Bay, this was of sufficient distance from the cable route (6.1 km) such that noise impacts are not predicted for grey seals on land (Figure 24.4).

115. In summary, there is predicted to be a small to negligible magnitude negative effect of temporary displacement on a small number of grey seal (high value receptor) for a very short period of time whilst at sea, which is probable. Due to the short-term and reversible nature of the effect, the effect is considered to be negligible and therefore not significant in terms of the EIA Regulations.

Minke Whale

116. Although density and noise maps were unavailable for the minke whale construction noise may still represent a potential effect due to the relatively low population of minke whale in northwest Scotland (835 individuals in SCANS II Block J - Moray Firth, Orkney and Shetland) and the importance of the southern Moray Firth coastline for this species. The Moray Firth is thought to represent an transitory feeding area for this species in the summer months only.

117. Minke whales are within the order *Mysticetes* (baleen whales) which often show regular avoidance behaviour to noise impacts, to the extent that they may alter migration routes. However, the surveys showed most whales were sighted east of Spey Bay (Plate 24.7) and outside the potential noise ranges given for the other marine mammal species. Therefore, it is considered that whilst minke whale may occasionally occur near the cable route, they are likely to behaviourally avoid this area. Also, since the cable route lies outside the key area for minke whales along this coastline any displacement/ avoidance is unlikely to affect the population in this area. Effects are only likely to occur on minke whales if the cable laying is carried out during the summer months, otherwise no significant effects are predicted.

118. In summary, there is predicted to be a small to negligible magnitude negative effect of temporary displacement on a small number of minke whale (high value receptor), for a very short period of time, which is probable. Due to the short-term and reversible nature of the effect, the effect is considered to be negligible and therefore not significant in terms of the EIA Regulations.

24.1.1.22 Ship strike and potential injury from ducted propellers

119. Collision risk from vessel strikes in general during the construction period is considered to be low for all marine mammal species. This is considered in the context of the existing level of vessel activity in the Moray Firth from oil industry support, shipping, fisheries and recreation, where there are in excess of 4000

shipping movements per year, with a range of vessel speeds, size, activities and routes (see Shipping and Navigation, Section 18). As such marine mammals are likely to have habituated to the current levels of activity such that the additional two construction vessels (over 240 days) for the OfTW represent a negligible increase compared to the already high level of vessel activity in the area. In addition, it is likely that the noise generated by the construction vessels will deter marine mammals from the immediate vicinity and therefore collision is unlikely.

120. A recent review has highlighted concerns that harbour and grey seals may be vulnerable to "corkscrew" injuries from ducted propellers, such as a Kort nozzle or some types of Azimuth thruster (Thompsen et al., 2010). These propellers are used on a wide range of vessels used in offshore industries including tugs, self-propelled barges, rigs, offshore support vessels and research boats. Currently the links between the use of such vessels and corkscrew mortalities remains unproven. Furthermore the circumstances in which such injuries might occur remain speculative and subject to further research. It is not, therefore, possible to assess at this stage what the potential effect of the use of ducted propellers on project vessels might be although it should be noted that no confirmed cases of seals with corkscrew injuries were located in the Moray Firth despite the extensive use of ducted propellers in this area (Thompsen, et al., 2010).

121. The issue of vessel strike and potential injury from ducted propellers has been discussed during the EIA process with statutory consultees in light of outcomes of meetings and advice notes, specifically: the stakeholder meeting on corkscrew injuries (5th July 2011); the letter on seal mortalities in UK waters from JNCC (9th May 2011); and more recently the meeting between BOWL and Marine Scotland (1st February 2011).

122. In summary, there is predicted to be a small magnitude negative effect of short-term duration related to potential mortality of seals from collision with ducted propellers, which has the potential to affect a small proportion of the grey and harbour seal populations in the area (both high level receptors), although this is considered to be unlikely. In acknowledgement of the levels of uncertainty discussed above the effect is considered to be minor and not significant in terms of the EIA Regulations.

24.1.1.23 Suspended Solids Impairing Foraging Efficiency

123. Elevation of suspended sediments is predicted to be very localised for gravels and medium grains (maximum of 13 m and 125 m respectively) and short term (maximum of 50 seconds and 8 minutes duration respectively). Finer sediments may be dispersed over a wider area (up to one tidal excursion) but will be dispersed rapidly, persisting for a couple of days at most or just a few hours at lower ejection heights (see Table 21.6, Section 21, OfTW Physical Processes and Geomorphology). The resulting bed loads for all sediment types are negligible compared to natural variability in the area.

124. Marine mammals are unlikely to be within the range affected by SSC as the vessel noise is likely to displace them from the area before jetting commences. Given their

highly mobile nature marine mammals are easily able to avoid these areas of turbidity.

125. In summary, there is predicted to be a small to negligible magnitude negative effect of very short-term duration on marine mammals (high level receptor), which is probable and negligible, and is not considered to result in a significant effect in terms of the EIA Regulations.

24.1.1.24 Indirect Effects Due to Loss of Foraging Area/Reduction of Prey Species

126. The construction of the export cable route may result in indirect effects on marine mammals. The key prey species for marine mammals include a number of clupeids (e.g. herring), gadoids (e.g. cod, whiting), flatfish and *Ammodytes* (sandeel). Fish may be vulnerable to injury or displacement resulting from construction noise, which may result in reduced prey availability for marine mammals. However, the noise modelling work showed that displacement is likely to be very localised such that even for the most hearing sensitive species (herring) the area of significant avoidance (75 dB_{ht}) extends only 66 m either side of the cable route and total exclusion (90 dB_{ht}) extends to 8 m for the activity with the greatest noise impact (cable laying) (see Section 23: OfTW Fish and Shellfish Ecology). As with marine mammals these effects are likely to occur over a very short timescale with full recovery likely following cessation of the activity. The total duration of the activity will be up to 120 days but over this time the area of total exclusion during cable laying amounts to 1 km^2-hours and the area of significant avoidance amounts to 5 km^2-hours for the most hearing sensitive species (see Section 23: OfTW Fish and Shellfish Ecology). All other species will be affected to a considerably lesser degree and all other activities associated with the offshore transmission works (i.e. trenching, dredging, cable protection, and vessel noise) will result in smaller magnitude effects. Consequently the assessment concluded that the effects of noise on fish and shellfish resources are likely to be limited to the immediate vicinity of where the works are being carried out and would be of negligible significance.

127. Since the areas over which fish are displaced were predicted to be smaller than the areas over which marine mammals are displaced (Table 24.9, Table 24.10 and Table 24.11) it is considered unlikely that any effects of noise on fish populations will affect marine mammals as the latter will have moved a greater distance from the noise source.

128. In summary there is predicted to be a small to negligible magnitude, indirect negative effect of very short-term duration on prey species which will result in a probable negligible effect on marine mammals (high value receptor) and is therefore not significant in terms of the EIA Regulations.

24.4.2 ASSESSMENT OF EFFECTS DURING OPERATION

24.1.1.25 Behavioural Effects Arising from EMF

129. The effects of EMF on marine mammals are poorly understood. The more common concerns are that species that rely on EMF for finding food, such as elasmobranchs, may become confused and hence reduce food intake, or that EMF may cause migratory species to deviate from their migration. It is not thought that marine

mammals are electro-sensitive, however, they may be sensitive to magnetic fields, produced by the current flow on the cable. Theoretical evidence suggests that some species of cetacean may use the Earth's magnetic field to aid with long distance migration (Kirshvinck et al., 1986). These include bottlenose dolphin and harbour porpoise both of which have a predicted sensory range of 0.05 µT (Kirshvinck et al., 1986). In addition, cetaceans may use ambient magnetic stimuli for several life-history dependant functions including determination of feeding locations, reproduction, and refugia (Normandeau et al., 2011).

130. CMACS suggests that the magnetic effect of subsea cables is unlikely to affect magnetically sensitive species to any great extent and would likely be perceived as a variation to the Earth's natural field (Normandeau et al., 2011). In contrast, studies of bottlenose dolphins suggest that there may be behavioural responses to DC magnetic fields including sharp exhalations, acoustic activity and movement (Normandeau et al., 2011). Modelling suggests that the magnetic field produced by DC cables buried to 1 m and separated by 0.5 m are within the range of sensitivity for bottlenose dolphin (<0.05 µT). In contrast, magneto-sensitive species are less likely to respond to a similar level of magnetic field from AC cables because the rate of change of the field (polarity reversal) would be too rapid for a behavioural response to occur (Normandeau et al., 2011).

131. The Normandeau et al. (2011) study showed that magnetic fields reduced significantly over distance horizontally and vertically (with depth) from the source (Table 24.12). For a DC cable that is 0 m (on the seabed), there would be a magnetic field of 78.27 µT at the source, and this reduces to 1.02 µT at 10 m horizontally and 0.83 µT at 10 m depth (Normandeau et al., 2011). For AC cables the magnetic field is predicted to be 7.85 µT at 0 m, decreasing to 0.22 µT at 10 m horizontally and 0.13 µT at 10 m depth (Table 24.12). These figures were based on the findings from other offshore wind farms which show significant declines by a distance of 10 m either side of the subsea cable and with depth (Normandeau et al., 2011).

Table 24.12 Magnetic fields arising from typical export cables (Normandeau et al. 2011)

Cable specification	MF at source (µT)	MF horizontally (µT)	MF at depth (µT)
132 kV DC	78.27	5.97 @ 4m 1.02 @ 10m	2.73 @ 5m 0.83 @ 10m
132 kV AC	7.85	1.47 @ 4m 0.22 @ 10m	0.35 @ 5m 0.13 @ 10m

132. Magnetic fields may only be minimally attenuated by the cable sheath and seabed and therefore the ambient magnetic fields in the vicinity of the cable are likely to be altered slightly. Likely effects would be seen as changes in behaviour including sharp exhalations, acoustic activity and slight deviations in their swimming route (Normandeau et al., 2011). Sensitivity of a species depends on the water depth that it generally inhabits, such that species' that are known to inhabit relatively shallow water and those that feed near the bottom may be more exposed to EMF than species found in the pelagic zone in deeper water. Consequently, since bottlenose

dolphins in the Moray Firth are more likely to inhabit shallower coastal waters they may be exposed to EMF.

133. The Normandeau et al. (2011) study suggests that for an average AC cable buried to a depth of 1 m would emit magnetic fields within the range of sensitivity of bottlenose dolphin at 15-20 m above the cable. However, magneto-sensitive species are less likely to respond to a similar level of magnetic field from AC cables because the rate of change of the field (polarity reversal) would be too rapid for a behavioural response to occur (Normandeau et al., 2011). A previous study by Adair (1994) suggests that dolphins are unlikely to detect magnetic fields of much less than 5 μT (at a frequency of 60 Hz) since at levels below this there is unlikely to be enough force on magnetite particles to produce a change in ambient magnetic fields. At these levels, bottlenose dolphins would have to be less than 2 m from the cable to detect a difference. At higher frequencies the polarity reversal will be more rapid and therefore less likely to be detectable. The export cable may be AC or DC and up to 55 % of this will be buried to a maximum depth of 2.5 m. The export cable route lies in water depth between 38 to 100 m and there is the potential for a DC export cable to have an effect on bottlenose dolphins.

134. In summary, there is scant empirical evidence for the effects of EMF on bottlenose dolphins but there is the potential for animals to detect changes in magnetic fields arising from DC cables and this is most likely to occur in Spey Bay along the inshore section of the export cable route where dolphins are feeding and transiting in relatively shallow coastal waters. Potential effects include a temporary change in swimming direction or deviation from a swimming route, however, modelling work undertaken suggests that the likelihood of such changes affecting a large enough area to cause a significant course alteration is low (Normandeau et al., 2011). Although it should be noted that both the orientation of the cable in relation to the earth's geomagnetic field and the distance between buried cables can influence the change in magnetic field. Modelled results show that DC cables that are buried touching can emit a magnetic field of 20 μT less than if they were separated by 20 m (Normandeau et al. 2011). Similarly, cables that run roughly parallel to the earth's geomagnetic field in some locations may cause an increase in the intensity of the magnetic field whereas cables running perpendicular to the earth's geomagnetic field will cause a decrease in magnetic field below ambient levels (Normandeau et al., 2011).

135. Subject to the uncertainties discussed above, there is predicted to be a small magnitude, localised, negative effect over the duration of the operation phase, which will result in reversible effects of minor significance on marine mammals (high level receptor), although is unlikely and is not considered to be significant in terms of the EIA Regulations.

24.5 MITIGATION AND MONITORING

136. BOWL will work closely with the statutory authorities to further the understanding of the potential risk to grey seals from DP vessels using ducted propellers. This is an issue that has been discussed throughout the EIA process and it is understood

that a number of research initiatives have been proposed including a MS funded programme by SMRU and an MMO funded programme. The results of such programmes will be useful in determining mitigation measures should these vessels be found to be responsible for seal mortalities.

137. In order to minimise the potential risk of mortality (given the uncertainty of effects), in the first instance operators of all vessels involved in construction of the OfTW will be made aware of the risks. BOWL will continue to monitor research being carried out in respect of corkscrew injuries and will liaise with MS, SNH and JNCC throughout the construction period.

138. The use of cable sheathing to reduce the strength of magnetic fields arising from the subsea cable route will be investigated as these may mitigate the behavioural effects arising from EMF. For example, the choice of a more permeable material (such as Mu-metal) or a more conductive shielding for the cable would both reduce the magnetic field. Higher voltage cables with a lower current requirement are also being considered. These options will be explored with the regulators to discuss the best solutions.

139. The development and implementation of a comprehensive marine mammal monitoring programme for the Wind Farm will provide an opportunity to undertake monitoring on key marine mammal populations in the wider Study Area which includes the OfTW. BOWL will work with MS, SNH, JNCC and other key stakeholders to develop the specification for an appropriate monitoring programme.

24.6 RESIDUAL EFFECTS

140. The assessment has found that none of the effects arising from construction, operation and decommissioning activities were significant in terms of the EIA Regulations and therefore since no mitigation is required the residual effects remain the same.

141. However, should BOWL vessels be found to pose a risk to seals through the use of ducted propellers during construction operations measures will be developed to minimise risks to seals during the construction/decommissioning works and therefore the magnitude of effect will be negligible. Due to the paucity of scientific understanding on this issue, as a precaution the residual effects are assessed as being of minor significance and unlikely.

24.7 SUMMARY OF EFFECTS

142. The effects on marine mammals resulting from the construction/ decommissioning and operational phases of the BOWL development are summarised in Table 24.13. This includes the degree of confidence on which the assessment has been based.

143. The effects have also been summarised in terms of their Likely Significant Effect (LSE) on features of the European designated sites (Table 24.14) in order to highlight those effects that will be carried forward for further assessment under the

Habitats Regulations (to be presented in a Report to Inform an Appropriate Assessment).

Table 24.13 Summary of Effects on Marine Mammals from BOWL alone. Note: all receptors are high sensitivity and high conservation status

Residual Effect	Receptor	Magnitude	Nature	Probability	Significance of Effect
Construction/Decommissioning					
Short term Injury/displacement from noise emissions during cable laying	Bottlenose dolphin	Small to negligible	Negative	Probable	Negligible
	Harbour Porpoise	Small to negligible	Negative	Probable	Negligible
	Harbour seal	Small to negligible	Negative	Probable	Negligible
	Grey seal	Small to negligible	Negative	Probable	Negligible
	Minke whale	Small to negligible	Negative	Probable	Negligible
Short term physical injury/ mortality from vessels with ducted propellers and ship strike	Seals	Small	Negative	Unlikely	Minor
Short term suspended solids impairing foraging efficiency	All marine mammals	Small to negligible	Negative	Probable	Negligible
Short term indirect effects due to temporary loss of foraging area/reduction in prey spp	All marine mammals	Small to negligible	Negative	Probable	Negligible
Operation					
Long term behavioural impacts arising from EMFs	All marine mammals	Small	Negative	Unlikely	Minor

Table 24.14 Screening matrix for the Moray Firth SAC and Dornoch Firth and Morrich More SAC

Designated Site and Qualifying Feature	Conservation Objectives	Potential Impacts and Effects	Proposed Generic Mitigation Measures	Likely Significant Effects Alone	Likely Significant Effects in Combination
Moray Firth SAC Bottlenose Dolphin *Tursiops truncatus*	To avoid deterioration of the habitats of the qualifying species (Bottlenose dolphin *Tursiops truncatus*) 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 interest.	Behavioural effects arising from EMF along export cable; Increase in suspended solids impairing foraging efficiency; Indirect effects due to loss of foraging area as well as a change or reduction of prey species;	No mitigation required	No likely significant effect	No likely significant effect
	To ensure for the qualifying species that the following are established then maintained in the long term: o Population of the species as a viable component of the site; o Distribution of the species within the site; o Distribution and extent of habitats supporting the species; o Structure, function and supporting processes of habitats supporting the species; No significant disturbance of the species.'	Behavioural effects arising from EMF along export cable; Increase in suspended solids impairing foraging efficiency; Indirect effects due to loss of foraging area as well as a change or reduction of prey species;	No mitigation required	No likely significant effect	No likely significant effect

Designated Site and Qualifying Feature	**Conservation Objectives**	**Potential Impacts and Effects**	**Proposed Generic Mitigation Measures**	**Likely Significant Effects Alone**	**Likely Significant Effects in Combination**
Dornoch Firth and Morrich More SAC Harbour Seal *Phoca vitulina*	To avoid deterioration of the habitats of the qualifying species (common seal *Phoca vitulina*) 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 interests	Collision risk which has the potential to cause injury/mortality from increased vessel activity during construction and operation Behavioural effects arising from EMF along export cable Increase in suspended solids impairing foraging efficiency; Indirect effects due to loss of foraging area as well as a change or reduction of prey species; and,	No mitigation required	No likely significant effect	No likely significant effect
	To ensure for the qualifying species that the following are maintained in the long term: o Population of the species as a viable component of the site; o Distribution of the species within the site; o Distribution and extent of habitats supporting the species; o Structure, function and supporting processes of habitats supporting the species; o No significant disturbance of the species.	Behavioural effects arising from EMF along export cable; Increase in suspended solids impairing foraging efficiency; Indirect effects due to loss of foraging area as well as a change or reduction of prey species;	No mitigation required	No likely significant effect	No likely significant effect

24.8 STATEMENT OF SIGNIFICANCE

144. The impacts of activities during the construction, operation and decommissioning phases of the OfTW are predicted to result in negligible to minor effects, and are not significant in terms of the EIA Regulations.

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