EDF RENEWABLES

Neart na Gaoithe Offshore Wind farm

Construction Phase - European Protected Species Risk Assessment

Revision 1.0

April 2020

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Neart na Gaoithe Offshore Wind Farm

Construction Phase - European Protected Species Risk Assessment and Marine Mammal Mitigation Plan

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Acronyms and Abbreviations

TERM	DESCRIPTION
AC	Alternating Current
ADD	Acoustic Deterrent Device
CI	Confidence Interval
CLV	Cable Lay Vessel
CMS	Construction Method Statement
CoP	Construction Programme
CTV	Crew Transfer Vessel
dB	Decibel
dBht	Decibel relative to hearing threshold (Species specific weighted scale)
DP	Dynamic Positioning
DSLP	Development Specification and Layout Plan
ECOMMAS	East Coast Marine Mammal Acoustic Study
EPS	European Protected Species
ES	Environmental Statement
FCS	Favourable Conservation Status
HDD	Horizontal Directional Drilling
HRA	Habitats Regulations Appraisal
IAMMWG	Inter-Agency Marine Mammal Working Group
ILT	Internal Lifting Tool
JNCC	Joint Nature Conservation Committee
JUV	Jack-up Vessel
Knots	Speed of 1 Nautical Mile per hour
KP	Kilometre Point
MBES	Multibeam Echosounder
MHWS	Mean High Water Springs
MS-LOT	Marine Scotland Licensing Operations Team
MW	Megawatt
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OfTI	Offshore Transmission Infrastructure
OSP	Offshore Substation Platform
PAM	Passive Acoustic Monitoring
PIF	Pile Installation Frame

TERM	DESCRIPTION
PTS	Permanent Threshold Shift
SBP	Sub-bottom Profiler
SEL	Sound Exposure Level
SNH	Scottish Natural Heritage
SPL	Sound Pressure Level
SSCV	Semi-submersible Crane Vessel
SSS	Side Scan Sonar
SST	Sub-sea Template
SSVBM	Sub-sea Vertical Boring Machine
TTS	Temporary Threshold Shift
USBL	Ultra-short Baseline
UXO	Unexploded Ordnance
WTG	Wind Turbine Generator

Defined Terms

TERM	DESCRIPTION
Addendum	The Addendum of Additional Information submitted to the Scottish Ministers by NnGOWL on 26 July 2018.
Application	The Environmental Impact Assessment Report, Habitats Regulations Appraisal Report and supporting documents submitted to the Scottish Ministers by NnGOWL on 16 March 2018, and the Addendum of Additional Information submitted to the Scottish Ministers by NnGOWL on 26 July 2018.
Company	Neart na Gaoithe Offshore Wind Limited (NnGOWL) (Company Number SC356223). NnGOWL has been established to develop, finance, construct, operate, maintain and decommission the Project.
Consent Conditions	The terms that are imposed on NnGOWL under the S36 Consent or Marine Licenses that must be fulfilled throughout the period that the Consents are valid.
Consent Plans	The plans, programmes or strategies required to be approved by the Scottish Ministers (in consultation with appropriate stakeholders) in order to discharge conditions attached to the Offshore Consents.
Contractors	Any Contractor/Supplier (individual or firm) working on the Project.
EIA Report	The Environmental Impact Assessment Report, dated March 2018, submitted to the Scottish Ministers by NnGOWL as part of the Application as defined above.
Inter-array Cables	The offshore cables connecting the wind turbines to one another and to the offshore substations.
Interconnector Cables	The offshore cables connecting the offshore substations to one another.
Marine Licences	The written consents granted by the Scottish Ministers under the Marine (Scotland) Act 2010, for construction works and deposits of substances or objects in the Scottish Marine Area in relation to the Wind Farm (Licence Number 06677/18/0) and the OfTW (Licence Number 06678/18/0), dated 3 December 2018.
Offshore Consents	The Section 36 Consent and the Marine Licences.
Offshore Export Cable Corridor	The area within which the offshore export cables are to be located.
Offshore Export Cables	The offshore export cables connecting the offshore substations to the landfall site.
Offshore Substations	The offshore substations that collect and export the power generated by wind turbines.
OfTW	The Offshore Transmission Works. The OfTW includes the offshore substations and offshore interconnector and offshore export cables required to connect the Wind Farm to the Onshore Transmission Works at the landfall.
OfTW Area	The area outlined in red and blue in Figure 1 attached to Part 4 of the OfTW Marine Licence.
OnTW	The onshore transmission works from landfall and above Mean High Water Springs, consisting of onshore export cables and the onshore substation.
Project	The Wind Farm and the OfTW.
Section 36 Consent	The written consent granted by the Scottish Ministers under Section 36 of The Electricity Act 1989 to construct and operate the Wind Farm, dated 3 December 2018.
Subcontractors	Any Contractor/Supplier (individual or firm) providing services to the Project, hired by the Contractors.
Wind Farm	The offshore array as assessed in the EIA Report including wind turbines, their foundations and inter-array cabling.
Wind Farm Area	The area outlined in black in Figure 1 attached to the Section 36 Consent Annex 1, and the area outlined in red in Figure 1 attached to Part 4 of the Wind Farm Marine Licence.

Consent Plans

CONSENT PLAN	ABBREVIATION	DOCUMENT REFERENCE NUMBER
Decommissioning Programme	DP	NNG-NNG-ECF-PLN-0016
Construction Method Statement and Construction Programme	CMS & CoP	NNG-NNG-ECF-PLN-0002
Piling Strategy	PS	NNG-NNG-ECF-PLN-0011
Development Specification and Layout Plan	DSLP	NNG-NNG-ECF-PLN-0003
Design Statement	DS	NNG-NNG-ECF-PLN-0004
Environmental Management Plan	EMP	NNG-NNG-ECF-PLN-0006
Operation and Maintenance Programme	OMP	NNG-NNG-ECF-PLN-0012
Navigational Safety Plan and Vessel Management Plan	NSVMP	NNG-NNG-ECF-PLN-0010
Emergency Response Cooperation Plan	ERCoP	NNG-NNG-ECF-PLN-0015
Cable Plan	CaP	NNG-NNG-ECF-PLN-0007
Lighting and Marking Plan	LMP	NNG-NNG-ECF-PLN-0009
Project Environmental Monitoring Programme	PEMP	NNG-NNG-ECF-PLN-0013
Fisheries Management and Mitigation Strategy	FMMS	NNG-NNG-ECF-PLN-0008
Offshore Written Scheme of Investigation and Protocol for Archaeological Discoveries	WSI & PAD	NNG-NNG-ECF-PLN-0005
Construction Traffic Management Plan	CTMP	NNG-NNG-ECF-PLN-0014

1 Introduction

1.1 Project Background

1. The Neart na Gaoithe Offshore Wind Farm (Revised Design) received consent under Section 36 of the Electricity Act 1989 from the Scottish Ministers on 03 December 2018 and was granted two Marine Licences by the Scottish Ministers, for the Wind Farm and the associated Offshore Transmission Works (OfTW), on 03 December 2018. The S36 consent and Wind Farm Marine Licence were revised by issue of a variation to the S36 Consent and Marine Licence 06677/19/0 on 4 June 2019, and the OfTW Marine Licence by the issue of Marine Licence 06678/19/1 on the 5 June 2019. The revised S36 Consent and associated Marine Licences are collectively referred to as 'the Offshore Consents'.

2. The Project (the Wind Farm and the OfTW) is being developed by Neart na Gaoithe Offshore Wind Limited (NnGOWL).

3. The Wind Farm Area is located to the northeast of the Firth of Forth, 15.5 km directly east of Fife Ness on the east coast of Scotland (see Figure 1-1). The Wind Farm Area covers approximately 105 km^2. Offshore Export Cables will be located within the 300 m wide Offshore Export Cable Corridor, running in an approximately southwest direction from the Wind Farm Area, making landfall at Thorntonloch beach to the south of Torness Power Station in East Lothian. Figure 1-1 shows the Wind Farm Area and Offshore Export Cable Corridor.

4. The Offshore Consents allow for the construction and operation of the following main components, which together comprise the Project:

   - 54 wind turbines with a maximum generating output of around 450 Megawatts (MW);
   - 54 jacket substructures installed on pre-piled foundations, to support the wind turbines;
   - Two alternating current (AC) substation platforms, referred to as Offshore Substation Platforms (OSPs), to collect the generated electricity and transform the electricity from 66 kV to 220 kV for transmission to shore;
   - Two jacket substructures installed on piled foundations, to support the OSPs;
   - A network of inter-array subsea cables, buried and/or mechanically protected, to connect strings of turbines together and to connect the turbines to the OSPs;
   - One interconnector cable connecting the OSPs to each other;
   - Two buried and/or mechanically protected subsea export cables to transmit the electricity from the OSPs to the landfall at Thorntonloch and connecting to the onshore buried export cables for transmission to the onshore substation and connection to the National Grid network; and
   - Minor ancillary works such as the deployment of metocean buoys and permanent navigational marks.

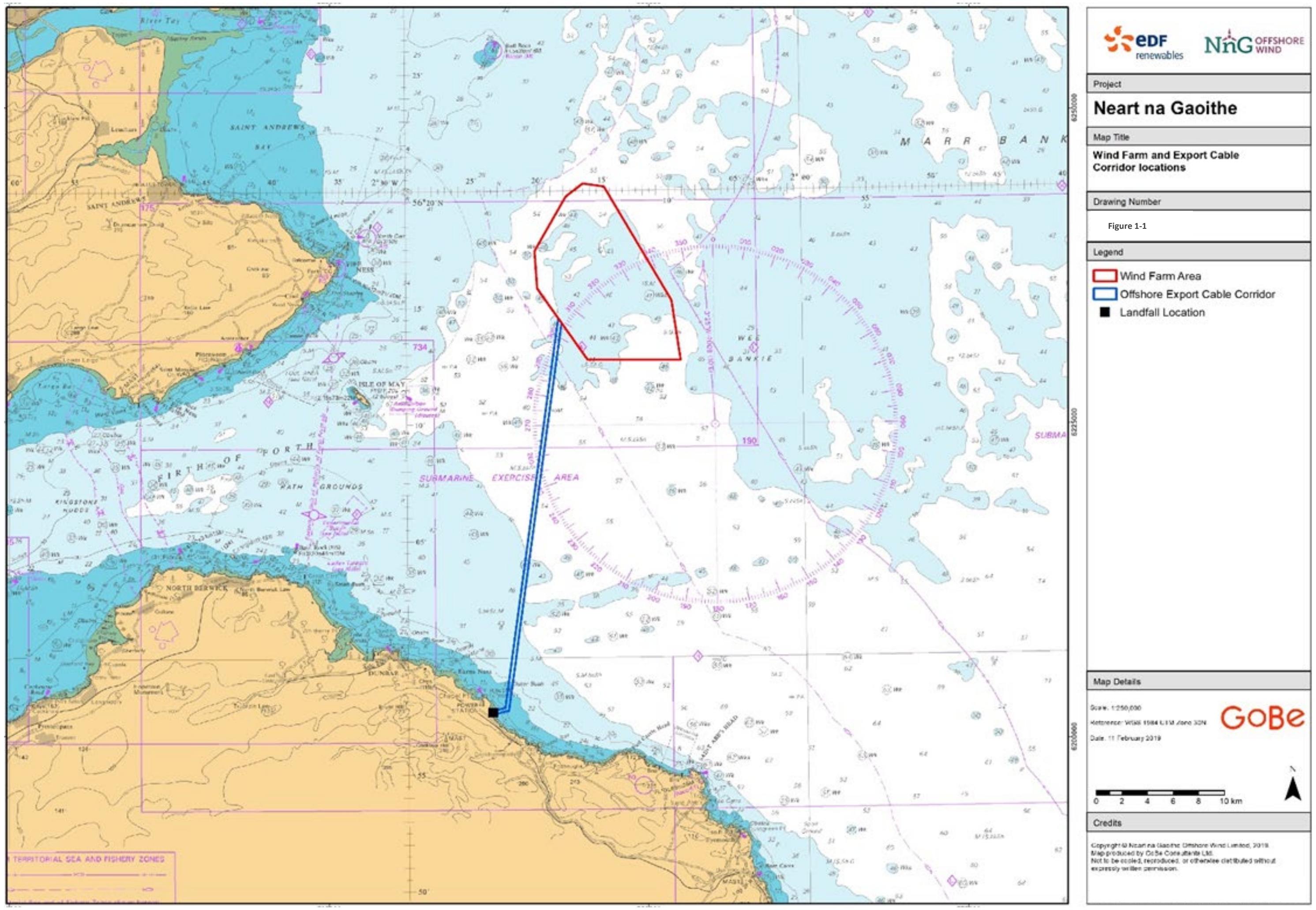

Figure 1-1: Wind Farm Area and Offshore Export Cable Corridor locations

1.2 Document Purpose

5. NnGOWL has determined that certain aspects of the proposed construction works will utilise equipment that emits underwater noise and has confirmed with Marine Scotland Licensing Operations Team (MS-LOT) that these activities are subject to European Protected Species (EPS) licensing requirements under the Conservation of Habitats and Species Regulations 2017. This document has been prepared to support an application to MS-LOT for an EPS Licence.

6. The objective of this report is to assess the risk of death, injury and deliberate disturbance to EPS[1] as a result of proposed works required during construction of the Project. The report provides an assessment of the risk to EPS, both individually and in respect to the favourable conservation status (FCS) on EPS populations. The assessment is based on the frequency and density of occurrence of EPS in the vicinity of the Wind Farm Area and Offshore Export Cable Corridor.

7. Specific construction (and construction-related) activities deemed to have the potential to disturb EPS, which are considered within this assessment are:

- Installation of Wind Turbine Generator (WTG) and OSP pin pile foundations;
- Use of acoustic deterrent devices (ADDs) in relation to mitigating effects of percussive piling;
- Geophysical surveys;
- Horizontal directional drilling (HDD) for export cable landfall installation;
- Export and inter-array cable installation;
- Rock placement for cable protection and seabed preparation for OSP jack up locations.
- Use of Ultra-short Baseline (USBL) positioning devices on installation vessels and equipment; and,
- Vessel activity during construction.

8. Further information on construction activities considered within this risk assessment is provided in Section 3. These activities are also described in relevant NnGOWL Consent Plans.

9. To date, assessments of NnG Offshore Wind Farm have focused on four species likely to be present within the project area, as identified through extensive baseline studies. These assessments have focused on harbour porpoise, minke whale and bottlenose dolphin. Whilst the risk to other species is low, there is the potential for white-beaked dolphin to be present. Therefore, this document assesses the risk of disturbance to the following species of EPS:

- Harbour porpoise;
- Bottlenose dolphin;
- Minke whale; and
- White-beaked dolphin.

[1] All species of cetacean (whale, dolphin and porpoise) occurring in UK waters are listed in Annex IV of the Habitats Directive as European Protected Species (EPS), meaning that they are species of community interest in need of strict protection, as directed by Article 12 of the Directive.

1.3 Document Structure

10. This document provides information in support of the EPS licence application. The structure and scope of sections is summarised below in Table 1-1.

Table 1-1: Structure of this document

Section		Overview
1	**Introduction**	Provides an overview of the project background, the purpose of this document and a summary of the works.
2	**Legal Requirement**	An overview of the legislation and guidance relevant and referred to within this document.
3	**Description of Works**	A description of the construction-related activities with potential to injure or disturb EPS.
4	**European Protected Species**	Detail of the presence and abundance European Protected Species relevant to this application and their conservation status.
5	**Predicted Impacts on EPS**	An assessment of the potential for construction activities to injure or disturb EPS.
6	**EPS Risk Assessment**	A description of how the activities meet criteria under the Habitats Regulations that allow them to be licensed.
7	**Proposed Mitigation**	Proposed mitigation strategy designed to reduce the risk of injury to EPS.
8	**Conclusion**	A summary of the results of the EPS Risk Assessment and mitigation proposed.

2 Legal Requirement

2.1 Legislation

11. All species of cetacean are listed as EPS under Annex IV of the Habitats Directive. The requirement to consider EPS in the marine environment around Scotland arises from the Conservation (Natural Habitats &c.) Regulations 1994 (as amended in Scotland) which transposes the Conservation of Natural Habitats and Wild Fauna and Flora Directive (Council Directive 92/43/EEC; referred to as the Habitats Directive) into Scottish law.

12. This Regulation provides for the designation of protected European sites (SACs) and the protection of EPS as designated under the Habitats Directive. These Regulations state, under Part 3, that it is an offence (amongst other things) to:

- Deliberately capture, kill or injure a wild EPS;
- Damage or destroy, or cause deterioration of the breeding sites or resting places of an EPS; and
- Deliberately disturb EPS (in particular disturbance which is likely to impair their ability to survive, breed, reproduce, nurture their young, migrate or hibernate, or which might affect significantly their local distribution or abundance).

13. Any means of capturing or killing which is indiscriminate and capable of causing the local disappearance of - or serious disturbance to - any population of EPS is not allowed. Licences may be granted by MS-LOT which would allow otherwise illegal activities to go ahead. Under Regulation 53(9) of the Habitats Regulations, licences can only be issued where the proposed activity meets certain criteria. Before a licence can be granted MS-LOT must be satisfied that:

- The licence relates to one of the purposes specified in the Regulations;
- There is no satisfactory alternative; and
- The action authorised will not be detrimental to the maintenance of the population of the species concerned at a FCS in their natural range.

14. FCS is defined in the Habitats Directive as the following:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable element of its natural habitats;
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

2.2 Guidance

15. Marine Scotland has issued guidance on 'The protection of Marine European Protected Species from injury and disturbance' (2014) which specifically applies to Scottish Inshore Waters. Additionally, Scottish Natural Heritage (SNH) has published guidance on the preparation of EPS licence applications which provides guidance on key considerations which must be undertaken when applying.

16. JNCC provided guidance on mitigation measures designed to minimise the risk of injury to marine mammals from piling noise (JNCC, 2010a). This guidance was used to inform the mitigation strategy outlined in Section 7.

3 Description of Works

3.1 Introduction

17. This section provides an overview of the construction and construction-related activities considered in this risk assessment (see Table 3-1). Further detail on some of these activities is provided within NnGOWL Consent Plans.

Table 3-1: Activities considered in this risk assessment

ACTIVITY	UNDERWATER NOISE SOURCE	RELEVANT PROJECT AREA	ACTIVITY ALSO DESCRIBED IN CONSENT PLAN
Installation of wind turbine and OSP foundation piles (Section 22)	Drill Percussive hammer	Wind Farm only	Piling Strategy
Use of ADDs as mitigation during percussive piling (Section 3.4)	ADD	Wind Farm only	Piling Strategy
Geophysical surveys (Section 3.5)	Multi-beam echosounder (MBES) Side Scan Sonar (SSS) Sub-Bottom Profiler (SBP)	Wind Farm Export Cable Corridor	N/A
HDD (Section 3.6)	Drill	Export Cable Corridor (landfall only)	Cable Plan
Cable installation (Section 3.7)	Vessel noise Trenching noise	Wind Farm Export Cable Corridor	Cable Plan
Rock placement (Section 3.8)	Vessel noise Rock chute	Wind Farm Export Cable Route	Cable Plan
Vessel and equipment positioning (Section 3.9)	Vessel noise USBL	Wind Farm Export Cable Corridor	N/A
Vessel activity during construction (Section 3.10)	Vessel noise	Wind Farm Export Cable Corridor	N/A

3.2 Timing and Duration of the Works

18. The NnGOWL Construction Method Statement (CMS) and Construction Programme (CoP) details the scheduled timings and sequencing of construction work for all elements of the Wind Farm, including those activities presented in Table 3-1 above.

19. Summary timescales for each of the proposed activities covered by the Construction EPS Licence, are outlined in Table 3-2. The anticipated activity periods do not represent activity durations but the window within which each would take place. These timescales incorporate contingency to account for any unforeseen circumstances. The estimated duration of works represents an estimation of the duration of the activity, to provide context.

20. Offshore construction works will be carried out year-round and on a 24-hour, 7-day per week basis unless otherwise noted.

Table 3-2 Summary timescales for each of the proposed activities to be covered by the Construction EPS Licence

EPS Licenced Activity	Anticipated Activity Periods	Estimated Duration of Works
Installation of wind turbine and OSP foundation piles by percussive piling	Q2 2020 – Q3 2021	Up to 12 hours split over six discrete events (i.e. two rounds of 'driving' at each of the three pin pile locations) for 1 location
Installation of wind turbine and OSP foundation piles by drive-drill-drive method	Q2 2020 – Q3 2021	11 months for 56 locations
Use of ADDs as mitigation during percussive piling	Q2 2020 – Q3 2021	5 – 10 minutes prior to each piling event
Geophysical surveys	Q2 2020 – Q1 2023	Pre-construction surveys: as required MBES survey for OSP seabed preparation: as required Pre-installation MBES surveys: as required Post-installation survey: as required
HDD for export cable landfall installation	Q2 2020 – Q4 2020	Up to 2 months
Cable installation	Q2 2021 – Q2 2022	Export cable installation: 2 months Inter-array and interconnector cable installation: 4 months
Rock placement for cable installation	Q2 2021 – Q2 2022	Export cable installation: as required Inter-array and interconnector cable installation: as required
Rock placement for OSP seabed preparation	Q2 – Q4 2021	Up to 2 days
Vessel and equipment positioning	Q2 2020 – Q1 2023	Up to 33 months
Vessel activity during construction	Q2 2020 – Q1 2023	Up to 33 months

21. As outlined within Table 3-2, it is assumed that vessel activity will be ongoing throughout construction. However, vessel activity during this period is expected to be variable. It is assumed, on a worst-case scenario that vessel and equipment positioning will also occur throughout this period.

22. As described later in the document, geophysical survey activity would be expected prior to, and following, offshore installation. The activity is shown in the table above as occurring throughout and following the offshore construction period in case that the pre- and post-installation surveys are undertaken in a phased approach (for instance, prior to, and after, each element separately).

3.3 Installation of pin piles

23. Pile installation methods are described in full in the NnGOWL Piling Strategy. Relevant excerpts from the Piling Strategy are presented below.

3.3.1 Overview of pile installation activities

24. The pile foundations will comprise two main elements: a steel tubular casing which will be installed first and then the steel pile which will be installed through the casing and rock socket. The dimensions of these are summarised in Table 3-3.

Table 3-3: Summary of foundation components to be deposited or installed

COMPONENT	NUMBER	KEY DIMENSIONS
Turbine and OSP foundation casings	56 x 3	Outer diameter: up to 3.5m Average Length: 11.5m
Turbine and OSP foundation piles	56 x 3	Pile Outer Diameter: Up to 3.2 m Pile Length: up to 60 m

25. A review of the geophysical and geotechnical data has identified a layer of sedimentary deposits of varying depths overlying bedrock. A detailed analysis of the data has confirmed that the following methods of pile installation will be used:

- Drill-only, whereby casings and piles will be fully installed using a drilled method; and
- Drive-drill-drive, whereby the casings installation process will involve use of driven and drilled methods in combination. Piles will be installed using the drilled method.

26. The drill-only method will be used across the majority of locations, with the drive-drill-drive method implemented at only one location. Pile and casing installation using solely driven methods will not be undertaken. This approach represents a significant reduction in the amount of driving than was assessed in the EIA.

27. The drill-only method involves use of a drilling tool (a Subsea Vertical Boring Machine (SSVBM)) that can move vertically beneath the seabed through a variety of ground conditions to create an empty 'socket' into which the pile casing and then the pile can be installed. Drilled casing and pile installation techniques have to date typically been used in combination with driven techniques (e.g. in the drive-drill-drive method as described below.

28. This method involves application of successive driving (using a hydraulic hammer) and drilling (using the SSVBM) phases to ensure the sacrificial casing is installed to target depth, and then drilling is undertaken to deepen the socket to pile target depth.

3.3.2 Pile Installation Method

29. An indicative number of locations at which each method will be employed is set out in Table 3-4 below; the number of drive-drill-drive locations is not expected to be exceeded.

Table 3-4: Number of locations using each pile installation method

METHOD	NUMBER OF PILE LOCATIONS
Drill-only	55 x 3
Drive-drill-drive	1 x 3

30. Table 3-5 sets out the key pile dimensions associated with each turbine and OSP foundation.

Table 3-5: Details of piling parameters

DESIGN FEATURE	PARAMETER
Maximum number of pin piles per jacket structure	3
Maximum casing diameter (m)	Up to 3.5
Maximum pile diameter (m)	Up to 3.2
Maximum embedded length of pile (m)	50
Maximum distance between piles within a jacket foundation (m)	30

31. Analysis of geotechnical data has been undertaken to determine maximum installation durations. Table 3-6 sets out durations for each of the pile installation methods.

Table 3-6: Approximate installation durations of pile and casing installation

PILING ACTIVITY	DRILL-ONLY METHOD	DRIVE-DRILL-DRIVE METHOD
Number of foundation locations	55	1
Installation of three pin piles (hours) (i.e. a single foundation location)	140	220
Duration of impact pile installation per foundation with three pin piles	Not applicable	Up to 12 hours split over 6 discrete events (i.e. two rounds of 'driving' at each of the three pin pile locations)
Cumulative duration of impact piling (hours)	Not applicable	12

32. The maximum hammer energy permitted under the Offshore Consents is 1635kJ as set out in the Application. Analysis of geotechnical data has determined a maximum hammer energy of 1635kJ will be sufficient to drive the pile casings to the required depth at all of the locations where the drive-drill-drive method will be employed. The hammer energy will be optimised at the drive-drill-drive location

to minimise the required blow energy. No hammer would be used where the drill-only method is employed.

33. The flow chart below summarises intended operations, from vessel set up through to the pile installation and finishing with jacket substructure installation (Figure 3-1).

34. Stages 1 – 2 and 4 – 5 will be the same for the drill-only and drive-drill-drive installation methods of the pile installation methods being used. Stage 3A sets out the casing and pile installation scenario using a drill-only method. Stage 3B outlines the alternative solution using a drive-drill-drive technique.

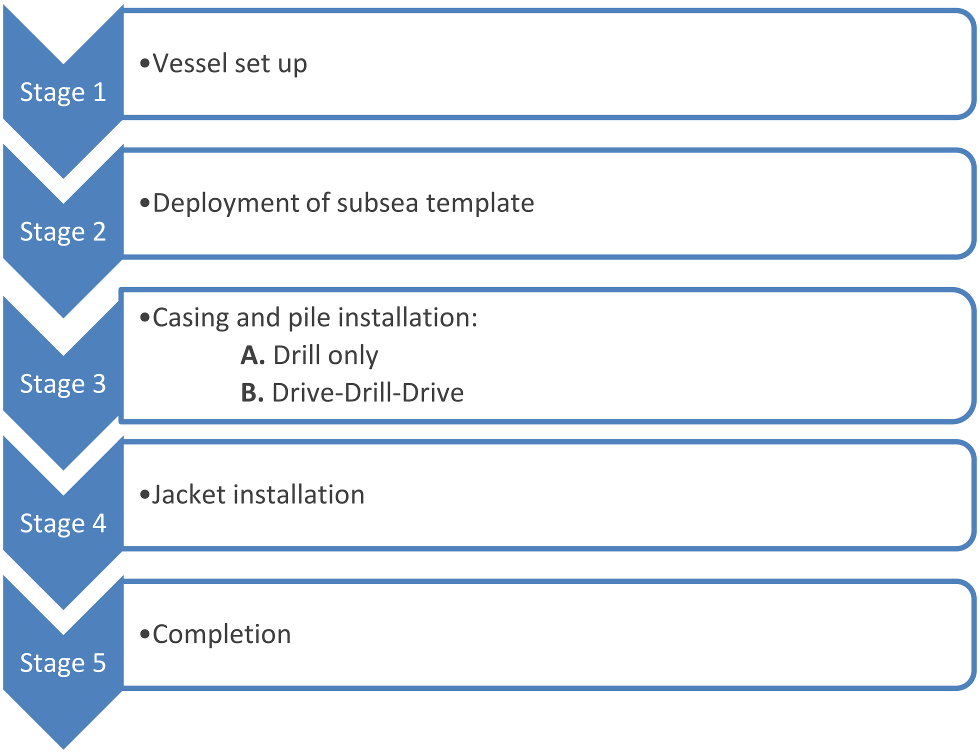

Figure 3-1: Pile foundation (and jacket substructure) installation sequence.

3.3.2.1 Stage 1 - Vessel Set Up

35. A Semi-Submersible Crane Vessel (SSCV) will be mobilised to the Wind Farm Area with all installation equipment on board. Dynamic positioning (DP) will be used to ensure the SSCV is in the correct position.

36. The piles will be delivered to the SSCV using a Heavy Lift Vessel (HLV). The HLV will also assist with post-installation surveys.

37. The installation vessel will require several support vessels.

38. The SSCV arrives at the proposed turbine location and is positioned in readiness for the foundation pile installation works. Note that seabed surveys may be performed prior to vessel set-up to ensure the seabed is clear of debris that could be hazardous to pile installation operations. Survey work may be carried out from the SSCV or from the HLV or another support vessel.

39. The SSCV activates its DP system which will be used to maintain position during installation of the piles.

3.3.2.2 Stage 2 – Deployment of the Subsea Template (SST)

40. Pile installation will be guided by a SST placed on the seabed by the SSCV crane and then self-levelled to accommodate seabed slopes, an illustration of which is shown in Figure 3-2. The SST will be used to temporarily stabilise and handle the pile casings.

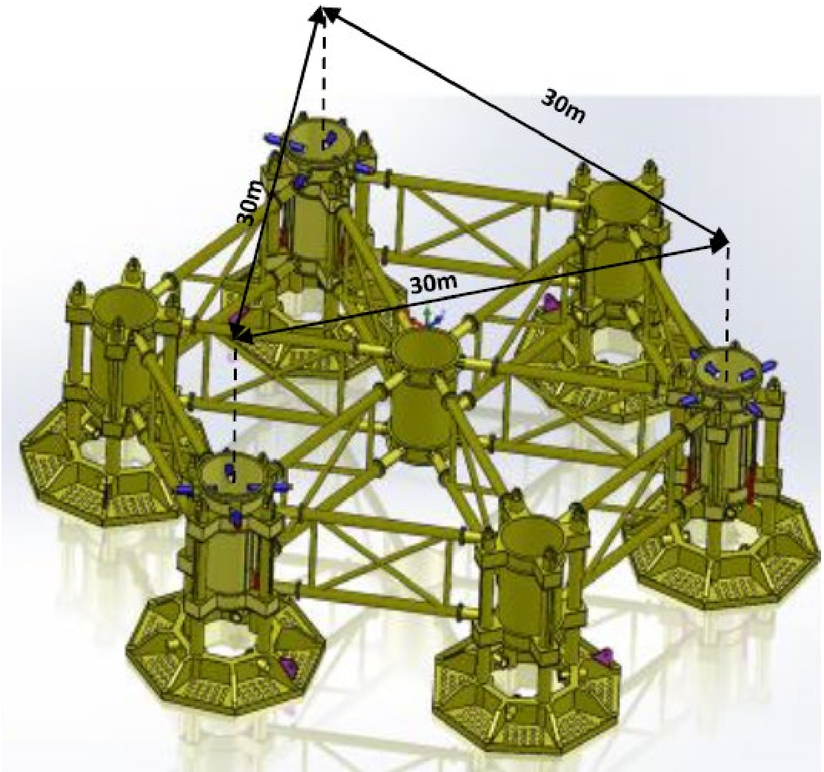

Figure 3-2: Illustration of SST

3.3.2.3 Stage 3A – Casing and Pile Installation (Drill-only Method)

41. Steel 'casings' (steel tubulars) will be used to prevent loose soil and fractured rock layers from collapsing into the rock socket.

42. Once the SST is in position, the SSCV crane will lift a casing and place this onto the drill string that will be used to drill the pile socket. The casing and drill string will then be lowered through a sleeve of the SST and into the seabed sediment. The casing will penetrate the seabed sediment under its own weight and be further installed into the seabed using a rack and pinion system (i.e. a circular gear that when actuated travels vertically along a toothed upright) integrated with the drill and SST. The drill has an under-reaming capability and is used to enlarge the socket below the casing and in harder ground conditions, enabling further penetration of the casing into the seabed to the desired depth.

43. The SST will be fitted with guide that can be controlled by a rack and pinion system to control the verticality of the casing. Once the casing is at target depth and stable, the drill tool progresses to drill the pile socket to the target depth. Drill spoil will be released into the water column at the top of the drill tool. Once the target socket depth is achieved the drill is recovered and this process is then repeated for the remaining piles at that location.

44. The SSCV crane will then upend the first pile and lower it through the casing into the drilled socket using an Internal Lifting Tool (ILT) which grips the inside of the pile for lifting. The pile will be centralised within the casing using the lower SST guides.

45. Once the piles are in position within the rock sockets grouting operations commence, with a grout such as ordinary Portland cement inserted into the annulus using a specialised grouting tool to fix the pile within the rock socket. Once grouting of the socket is completed the SST is then raised above the pile stick up and retrieved to the vessel using the SSCV crane. The SSCV relocates to the next foundation location.

46. When the SSCV has installed all piles loaded out at first mobilisation, an HLV will deliver additional piles to the Wind Farm Area. Both vessels will maintain positioning using DP and the piles and grout will be loaded onto the SSCV by the SSCV crane.

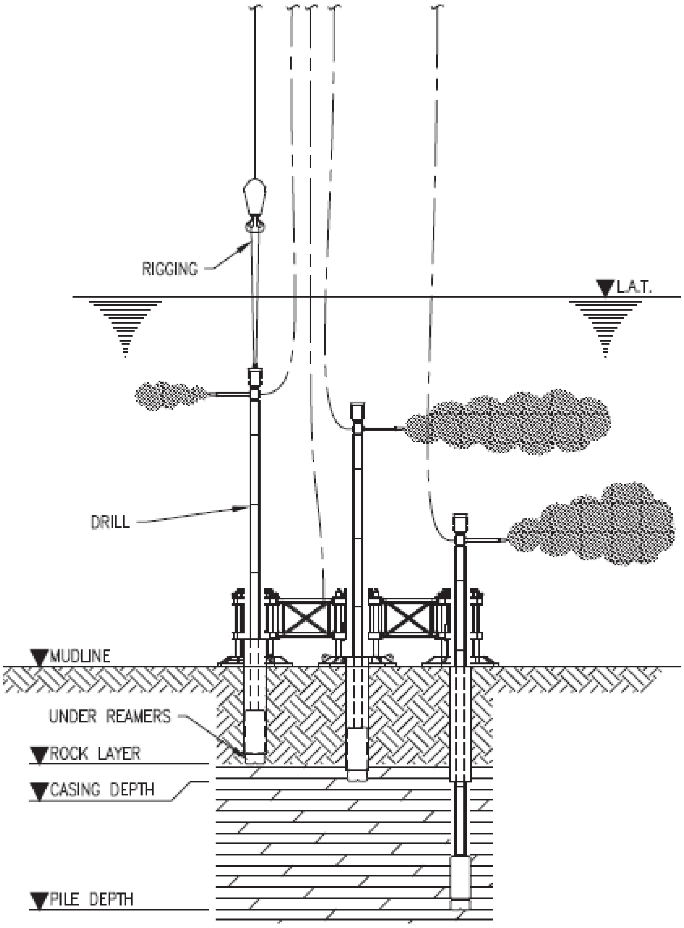

Figure 3-3: Illustration of drilling operations

3.3.2.4 Stage 3B – Casing and Pile Installation (Drive-Drill-Drive Method)

47. Where installation is by drive-drill-drive, the casing will be placed into the SST using an ILT and will penetrate the seabed under its own weight. A follower (a member between the hammer and the casing to transmit blows to the casing when the top of it is below the reach of the hammer) and hydraulic hammer will then be lifted onto the casing and will drive the casing to a pre-defined depth within the overburden layer (specific to each location). The follower and hammer will then be recovered and the drill will be deployed to remove the soil heave and if required perform under-reaming ahead of the casing. The drill is then recovered and the follower and hammer are deployed again to drive the casing further into the ground. This cycle is repeated until the casing reaches the target penetration. The number of cycles is case specific but it is anticipated that most locations will require one cycle.

48. The hammer is then recovered and the drill is inserted through the casing. Drilling is undertaken to remove the remaining soil plug within the casing and it continues into the bedrock until target pile penetration depth is reached.

49. At this point, the method of pile installation within the casing is as described in Section 4.5.3 above, with the pile upended and placed into the casing, and grouting undertaken.

50. Piling mitigation as detailed in Section 7.2 will be implemented throughout all casing driving operations.

3.3.2.5 Stage 4 - Jacket Installation

51. Once piling is complete at all locations, the SSCV will prepare for the installation of the jacket substructures onto the pre-installed piles. For jacket installation the SSCV may be supported by two Offshore Construction vessels (OCVs). Further details on the jacket substructure installation process are set out in the NnGOWL CoP and CMS.

3.3.2.6 Stage 5 – Completion and Post-Construction Inspection

52. Personnel on the jacket will install aids to navigation in accordance with the NnGOWL Lighting and Marking Plan (LMP) and to cover the installation flange. A post installation Remote Operated Vehicle (ROV) survey will also be conducted from the OCV to confirm that the pile connections are all intact.

3.4 Use of ADDs in percussive piling mitigation

53. Within the NnGOWL Piling Strategy, a mitigation strategy is presented, which is intended to mitigate the potential effects on marine mammals resulting from underwater noise associated with percussive piling. The strategy has been designed to avoid reliance on visual surveys by Marine Mammal Observers (MMOs). It is proposed that ADDs are used instead, to displace marine mammals prior to the commencement of percussive piling. The aim of the ADD deployment will be to remove animals from an area where there is potential for injury or fatality to be caused by piling noise. Following advice received from SNH it is proposed that the use of the ADD will be limited to 5 - 10 minutes prior to the commencement of the 'soft-start' pile-driving (SNH 2020).

3.5 Geophysical Surveys

54. It is expected that geophysical survey equipment will be used in preparation for and immediately following construction of the Project; in the following scenarios:

- Additional pre-construction, targeted surveys to inform final detailed design;
- Additional pre-construction, targeted surveys to inform final seabed preparation requirements (specifically at OSP locations);
- Pre-installation surveys to confirm no change in seabed conditions; and
- Post-installation surveys to confirm the status of installed infrastructure.

55. Further information on each of these forms of survey is provided below.

3.5.1 Pre-construction surveys to inform design

56. NnGOWL is currently undertaking an additional geophysical survey, further to that which was undertaken in Summer 2019, in order to enable re-routing of inter-array cable corridors . NnGOWL may undertake further geophysical surveys within the Neart na Gaoithe Offshore Wind Farm Site and Export Cable Corridor if required to inform final detailed design, if further changes in re-routing of

cable corridors or micro-siting of infrastructure within wind turbine survey boxes occurs, due to any unforeseen circumstances.

57. The survey would be targeted and undertaken within the following infrastructure boundaries;

- A 300m x 300m box around the centre of planned wind turbine locations;
- 50m each side of additional inter-array and interconnector cable routes;
- A 300m x 300m box around the centre of planned offshore substation locations; and
- The entire 300m-wide export cable corridor into Kilometre Point (KP) P01 (i.e. to one kilometre offshore from the landfall).

58. It is not expected that the full area would be subject to further geophysical survey and it is not currently anticipated that additional surveys would be required. Further information regarding the duration and extent of any additional surveys would be provided once the requirement for the survey is confirmed.

59. It is likely that a single dedicated geophysical survey vessel would undertake the survey. A smaller, alternative vessel may be used in shallower waters in the nearshore area of the Export Cable Corridor. The survey vessel will tow an array of equipment several metres above the seabed in parallel lines across the defined survey areas. The array will include the following underwater noise-emitting equipment:

- Multi-beam echosounder (MBES);
- Side Scan Sonar (SSS); and
- Sub-Bottom Profiler (SBP).

60. Whilst survey data will only be gathered within the Wind Farm boundary and Export Cable Corridor, in making turns to achieve parallel survey lines, the survey vessel and towed equipment will be required to manoeuvre outwith these boundaries on occasion.

3.5.2 Surveys to inform OSP seabed preparation

61. Exposed bedrock within the Wind Farm Area at the two proposed OSP locations could inhibit the safe placement of the spud cans of the jack-up which will be used during the hook-up and commissioning of the platforms during construction. As a result, NnGOWL plan to place clean crushed gravel from an onshore quarry onto the seabed in the locations of each spud can, prior to arrival of the jack-up during construction, to prevent damage to the spud cans.

62. It is expected that the seabed will require preparation in specific areas within up to 400m x 400m box around the centre of the planned OSP locations. NnGOWL is planning to undertake, pre- and post-placement surveys. The pre-placement survey will determine the topography of the un-touched seabed and be used to estimate the required quantity of infill material (crushed rock/gravel).

63. During construction, intermediate surveys will be performed to verify the progress, i.e. build-up of backfill, and the quality of the work. The progress of the construction will be monitored ‘on-line’ by comparing the results of the intermediate survey with data from the corresponding pre-rock placement survey.

64. After completion of the placement scope, a post-placement survey will be carried out. The data gathered will be compared with the corresponding infill design data and pre-placement survey to ensure that the operation is built within specifications.

65. All surveys described above will be performed using a MBES survey spread.

3.5.3 Pre-installation surveys

66. A pre-lay survey will be undertaken as part of the inter-array and interconnector cable installations, this will be done after the vessel is loaded and has arrived at site to ensure no changes that will affect the cable installation have occurred since the previous surveys. A Remote Operated Vehicle (ROV) will be used to carry out the pre-lay survey. The vessel will also be equipped with geophysical survey equipment (e.g. a multi-beam echosounder) should it be required.

67. Pre-installation surveys using a multi-beam echosounder may also take place prior to certain infrastructure coming into contact with the seabed, including the pile installation frame and jack-up vessel spud cans.

3.5.4 Post-installation surveys

68. It is expected that geophysical survey equipment will also be used as part of post-installation surveys across the Wind Farm Area and Export Cable Corridor, and to undertake the post-installation hydrographic survey of the site in line with the requirements attached to the Project Offshore Consents. For the purposes of this Risk Assessment, it is assumed the same equipment would be used in these surveys as presented above and that up to two survey vessels may be present on site at any one time.

69. Whilst survey data will only be gathered within the Wind Farm boundary and Export Cable Corridor, in making turns to achieve parallel survey lines, the survey vessel and towed equipment will be required to manoeuvre outwith these boundaries on occasion.

3.6 Horizontal Directional Drilling

70. At the landfall site, the export cables will be routed through two pre-installed horizontal ducts beneath the seabed and under Thorntonloch beach, installed using HDD.

71. HDD involves drilling a bore underground between two points, into which ducting for electrical cable can be installed. To achieve this, an onshore drill rig will commence drilling at the onshore end of the underground channel, above Mean High Water Springs (MHWS) landward of the beach at Thorntonloch.

72. The HDD drilling process will comprise the following stages:

- A small diameter pilot hole will be drilled from the onshore drill site, for the purpose of defining the path of the channel into which the ducts and later the cable is to be installed;
- The pilot hole will be enlarged using a steel reamer to accommodate a duct larger than the diameter of the export cable;
- The ducting will be floated offshore and then attached to the reamer and pulled through the channel from the seaward entry point to the onshore drill site, at which point it will be sealed and protected for cable pull in at a later date.

73. The length of the ducting is subject to further engineering analysis following recent survey. It is expected that the ducting, from onshore entry above MHWS to offshore exit below MHWS, will be between 150 m and 800 m long.

74. The majority of the length of each drill hole will be drilled at a depth of greater than 10 m below the seabed, with the depth profile shallowing towards the offshore exit location. Drilling activity will take approximately 2 months to complete the two duct installations, however, it is anticipated that only the final shallow section of the drill would be at a depth where drilling noise or vibration would be detectable within the marine environment.

3.7 Cable Installation

75. Once cables are laid on the seabed, cable burial will be conducted by a hybrid trenching tool that can be set to use water jetting and / or mechanical cutting to achieve required burial depths. The trenching tool can use jetting or mechanical cutting modes simultaneously to account for highly variable seabed conditions. A jetting tool will be used in softer ground conditions and a mechanical cutting tool over harder ground; slightly different tools may be used to support the same process in the nearshore area between the 10 m depth contour and the cable duct exits.

76. The cable will then be positioned between jetting arms or loaded into a cable trough for mechanical cutting depending on the seabed conditions. The cable trenching tool will follow the path of the cable lowering the cable into the seabed using the jetting arm, cutting swords or a combination of both. If depth of lowering has not been achieved alternative burial tools will be considered. If practicable in certain sections, to minimise cable protection, use of an alternative mass flow/jetting/plough tool deployed from an OSV or CLV may be used.

3.8 Rock Placement

3.8.1 Cable protection

77. Following cable burial, a post-lay survey of the cables will be completed to determine the depth of lowering. Where the target burial depth is not achieved alternative protection methods will be considered. The following materials will be considered for cable protection:

- Durable crushed or original rock of defined size range;
- Concrete ‘mattresses’; and
- Bags (high strength nylon fibre) of gravel, hardened sand-cement grout, or concrete (grout/concrete pre-filled and hardened onshore).

3.8.2 OSP seabed preparation

78. Exposed bedrock within the Wind Farm Area at the two proposed OSP locations could inhibit the safe placement of the spud cans of the jack-up which will be used during the hook-up and commissioning of the platforms during construction. As a result, NnGOWL plan to place clean crushed gravel from an onshore quarry onto the seabed in the locations of each spud can, prior to arrival of the jack-up during construction, to prevent damage to the spud cans.

79. It is expected that the seabed will require preparation in specific areas within up to 400m x 400m box around the centre of the planned OSP locations.

3.9 Vessel and Equipment Positioning

80. Installation and survey vessels and equipment can be expected to utilise USBL positioning systems, which provide a method of highly accurate underwater acoustic positioning.

81. The USBL system consists of a transceiver, which is mounted at the end of a transducer pole either to the side of, or beneath the survey vessel, and a transponder on the magnetometer array (note the transponder can be placed on other survey equipment or on the seabed depending upon its intended application). The USBL calculates the position of the array by measuring the range and bearing from the vessel mounted transceiver to the transponder. The transceiver emits a signal (a ping) at predetermined periods which is returned by the transponder and allows for the bearing and distance to be calculated.

3.10 Vessel Activity during Construction

82. Vessel activity associated with construction is described in full in the NnGOWL Navigational Safety and Vessel Management Plan. Relevant excerpts from the Navigational Safety and Vessel Management Plan. are presented below.

83. Construction of the Project will require vessels to undertake the following key activities, as well as vessels to support these activities:

- Piled foundation, jacket and OSP topside installation;
- Turbine installation;
- Export cable installation and protection;
- Inter-array and interconnector cable installation and protection;
- Construction support;
- Transport vessels; and
- Support vessels.

84. Offshore construction works are set to commence in Summer 2020 and last up to 3 years. Vessel activity during this period is expected to be variable. The number of vessels within the Wind Farm Area at any one time will vary over the course of the construction period, with peaks in vessel activity reflecting the timing of major installation works.

85. It should be noted that the daily movements of construction vessels have not yet been determined as construction ports are still to be confirmed.

86. Table 3-7 below details the anticipated main construction vessels required to undertake the construction activities detailed within the CoP and CMS. For each vessel type predicted to be entering the Wind Farm Area, Table 3-7 presents the indicative number of vessels involved in construction, the main construction activities they will be involved in, and the anticipated number of return journeys they will make (where this information is available). One return journey equates to the vessel transiting to the Wind Farm Area once, and then returning to port. It should be noted that the number of transits given is a best estimate based on the available information at the time of writing, and that the actual numbers may differ during the construction phase.

87. In addition to the vessels detailed within this table, it is anticipated that a number of ancillary vessels may be required throughout construction to support these main vessels. For example, additional CTVs may be required during Construction and dedicated guard vessels may be employed during certain stages of construction. The number of guard vessels may vary depending on the level of activity being undertaken at any one time.

Table 3-7: Indicative Construction Vessel Numbers, Key Construction Activities and Return Journeys

VESSEL TYPE	ANTICIPATED TOTAL NUMBER	VESSEL SPECIFICATIONS	KEY CONSTRUCTION ACTIVITIES	APPROXIMATE NUMBER OF RETURN JOURNEYS
Pile and Jacket Installation and Delivery				
SSCV	1	Length: 198m Breadth: 87m Depth 43.5m Transit draft: 10.5m Capable to cruise at (knots): 9.5	Mobilise with first batch of piles, casings and grout. Stay on site for the duration of pile and jacket installation. May utilise local port for shelter as required.	4
HLV	1	Length: 199m Breadth: 48 Depth 15 m Transit draft: 7.5 m Capable to cruise at (knots): 13.5	May be mobilised as an alternative to the SSCV for jacket installation.	1
HLV / OCV	1	Length: 216m Breadth: 43m Depth: 13m Transit draft: 8.5m (expected) Capable to cruise at (knots): 12.5	Pile, casing and grout load delivery from marshalling harbour to main installation vessel. Will assist main installation vessel by undertaking pre-installation and post-installation at each foundation location.	9
OCV	2	Length: 98.6m Breadth: 19m Draft max: 6.6m Design draught: 6.0m Capable to cruise at (knots): 15.5	Clean piles prior to jacket installation, grouting and surveys	6
HTV	6	Length: 225m Breadth: 48m Draft with design load: 10.64m Capable to cruise at (knots): 14.5	Direct delivery of jacket foundations to wind farm site. Will seek shelter until the jackets are ready to be installed and then travel to the array. The delivery will be staggered to meet the installation window.	6
Barge	1	To be determined.	Direct delivery of jacket foundations to wind farm site. Will seek shelter until the jackets are ready to be installed and then travel to the array.	1 – 8 depending on final tug and barge specification

VESSEL TYPE	ANTICIPATED TOTAL NUMBER	VESSEL SPECIFICATIONS	KEY CONSTRUCTION ACTIVITIES	APPROXIMATE NUMBER OF RETURN JOURNEYS
Tug	**1**	To be determined.	The delivery will be staggered to meet the installation window.	
Barge	1	Length: 80m Breadth: 22m Transit draft: 1.5m	Will seek shelter until the OSP topsides are ready to be installed and then travel to the Wind Farm Area.	2
Tug	1	Length: 89m Breadth: 22m Depth: 9.10mCapable to cruise at (knots): 16.4 Bollard pull max (tonnes): 200		
Tug	1	Length: 89 m Breadth: 22 Depth: 9.1 Capable to cruise at (knots): 16.4	Assist with mooring lines from HTV / barge	2
Bunkering	1	To be determined	Bunkering to pile and jacket installation vessels	N/A – as required
Rock placement vessel	1	To be determined	OSP Seabed preparation –rock placement at spud can locations	1
Inter-Array and Interconnector Cabling Delivery and Installation				
Cable Lay Vessel (CLV)	1	Length: 124.32m Breadth: 31.6m Depth: 6.8m Transit draft: 4.938m	Collect inter-array cables and install at wind farm site	1
Walk to Work (WTW) Vessel	1	Length: 107.95 Breadth: 16.00 Depth: 9.3 Transit draft: 5.5 Capable to cruise at (knots): 12	Assist in pull in operations, termination, testing and preparation	1

VESSEL TYPE	ANTICIPATED TOTAL NUMBER	VESSEL SPECIFICATIONS	KEY CONSTRUCTION ACTIVITIES	APPROXIMATE NUMBER OF RETURN JOURNEYS
Crew Transfer Vessel (CTV)	2	Length: 25.75 Breadth: 10.06 Depth: 1.5 Capable to cruise at (knots): 25	Transfer personnel to and from and around the wind farm site	Daily
Anchor Handling Tug (AHT)	1	Length: 35.1 Breadth: 15.00 Depth: 4.07 Transit draft: 3.0 Capable to cruise at (knots): N/A	Seabed preparation – pre lay grapnel run	5
Survey Vessel	1	Length: 62m Breadth: 13m Summer draft: 4.65m	To undertake pre- and post-lay surveys	5
Rock placement / cable protection installation vessel	1	Length: 62m Breadth: 13m Summer draft: 4.65m	Installation of cable protection as required.	5
Export Cable Delivery and Installation				
CLV	1	Length: 161 Breadth: 32.2 Depth: 11.5 Transit draft: 7.1 laying speed: up to 100m/hr	Deliver and install export cables	2
Dive support vessel	1	To be determined	The Project do not intend to undertake any diver operations as part of planned construction activities. However, dive support may be required to assist with intertidal cable pull in.	N/A – as required

VESSEL TYPE	ANTICIPATED TOTAL NUMBER	VESSEL SPECIFICATIONS	KEY CONSTRUCTION ACTIVITIES	APPROXIMATE NUMBER OF RETURN JOURNEYS
AHT	1	Length: 35.1 Breadth: 15.00 Depth: 4.07 Transit draft: 3.0 Capable to cruise at (knots): N/A	Seabed preparation – pre lay grapnel run	1
OSV	1	To be determined	Deployment of burial and trenching tools	N/A – as required
Rock placement / cable protection installation vessel	1	To be determined	Installation of cable protection as required.	N/A – as required
Wind Turbine Delivery and Installation				
Jack-up Vessel (JUV)	1	Length: 115m Breadth: 50m Depth: 9.75m Loadline draft: 5.20m Capable to cruise at (knots): 8-10	Installation of turbines. Will transfer wind turbine components from the marshalling harbour.	Will transfer to marshalling port every 6 – 8 days. Up to 25 journeys anticipated in total.
OSP Hook Up and Commissioning				
JUV	1	To be determined	Support of OSP hook up and commissioning.	1
Service Operation Vessel (SOV)	1	To be determined	May be used as an alternative to the JUV for OSP hook up and commissioning activities.	1

4 European Protected Species in the Project area

4.1 Species within the Wind farm Area and Export Cable Corridor

88. Site specific marine mammal surveys were undertaken for three years between November 2009 and October 2012. Monthly surveys were undertaken by boat along a series of transects running in a north west to south easterly direction across the offshore site plus an 8 km buffer area and spaced 2 km apart.

89. A total of 10,400 km of transect was surveyed for marine mammals over a period of three years. The total number of European Protected Species recorded during each survey including within the 8 km buffer area are presented in Tables Table 4-1 to Table 4-3. Figure 4-1 presents the combined total number of each cetacean species recorded each month during the three years of survey.

Table 4-1: Number of European protected Species recorded each month during Year 1 surveys.

Species	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Harbour porpoise	15	37	2	1	7	7	0	0	0	8	1	11	89
White-beaked dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Minke whale	0	0	0	0	0	0	0	0	0	0	0	2	2
Unidentified dolphin	0	5	0	0	0	0	0	0	0	0	0	0	5

Table 4-2: Number of European Protected Species recorded each month during Year 2 surveys.

Species	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Harbour porpoise	0	1	0	6	15	15	0	0	4	22	11	9	83
White-beaked dolphin	0	0	1	0	0	0	12	3	0	0	0	0	16
Minke whale	0	0	0	0	0	0	0	3	0	4	1	1	9
Orca	0	0	0	0	0	0	0	0	0	0	0	1	0
Unidentified dolphin	0	0	1	0	0	0	0	0	0	0	0	0	0

Table 4-3: Number of European Protected Species recorded each month during Year 3 surveys.

Species	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Harbour porpoise	7	0	4	51	14	16	2	0	0	4	2	7	107
White-beaked dolphin	6	0	0	0	0	0	1	1	0	0	0	0	8
Minke whale	0	0	0	0	0	0	0	2	0	0	0	0	2
Unidentified dolphin	0	0	0	0	0	0	0	2	0	0	0	0	2

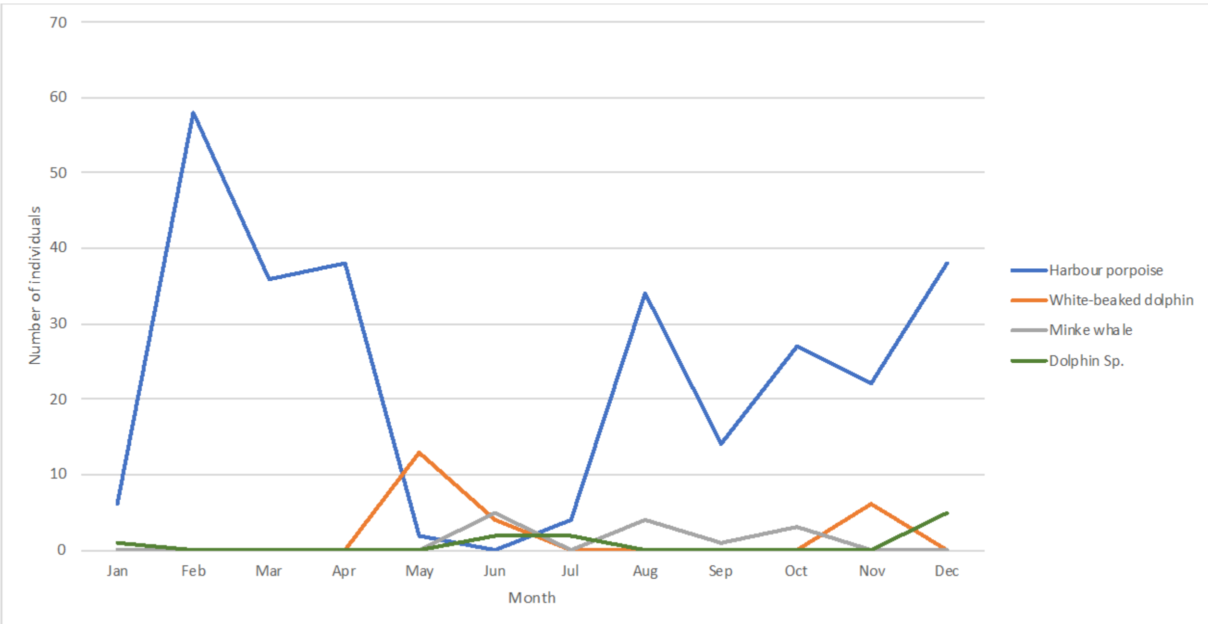

Figure 4-1: Combined total number of cetaceans recorded each month during three years of surveys.

90. The results show that overall relatively few EPS were recorded over the three years of surveys.

91. Harbour porpoise were recorded throughout the year with peak numbers occurring between December and April. Highest numbers of harbour porpoise occurred during February with the maximum of 51 individuals recorded in any single year (Table 4-3). However, there was some inter-annual variation.

92. Peak numbers of white-beaked dolphin occurred during May, with 12 recorded during the Year 2 surveys. However, no white-beaked dolphin were recorded at all during the Year 1 surveys and no more than one was recorded in each of the surveys undertaken during Year 3.

93. Minke whales were only recorded in small numbers between June and October, with a peak count of four during August in Year 2 (Table 4-2).

94. Data from the East Coast Marine Mammal Acoustic Study (ECOMMAS) C-POD arrays located along the east coast of Scotland including off St Andrews and St Abb's, the closest locations to the proposed surveys, indicate there is greater potential for harbour porpoise and bottlenose dolphin to occur in nearshore waters. Between 2013 and 2016 harbour porpoise were recorded on a daily basis at the C-POD arrays located at both St Andrews and St Abb's. Bottlenose dolphins were less frequently recorded with detections typically less than 5% of the days and no more than 8% of the time at St Abb's and 18% at St Andrews (Brookes 2017).

95. Evidence indicates that it may be possible for a European Protected Species to be present during the period in which the proposed activities will be undertaken with harbour porpoise the more frequently occurring species and bottlenose dolphin occurring for no more than 20% of the time in nearshore waters.

96. The estimated densities of marine mammals relevant to the area of potential impact are presented in Table 4-4. These densities are those that were used in the EIA undertaken in support of the application for Offshore Consents (NnGOWL 2018) and no revised density estimates are available.

Table 4-4: Densities of European Protected Species.

Species	Density (ind./km^2)	Source
Harbour porpoise	0.599	SCANS III Block R (Hammond *et al.* 2017)
Bottlenose dolphin	0.07	Calculated (NnGOWL 2018)
White-beaked dolphin	0.24	SCANS III Block R (Hammond *et al.* 2017)
Minke whale	0.039	SCANS III Block R (Hammond *et al.* 2017)

4.2 Favourable Conservation Status

97. The favourable Conservation Status (FCS) is defined under Article 1 (i) of the Habitats Directive as follows:

- Conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in Article 2.

98. The conservation status will be taken as 'favourable' when:

- Population dynamics data on the species concerned indicates that it is maintaining itself on a long-term basis as a viable component of its natural habitats,
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future,
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

99. Table 4-5 summarises the conservation status of cetaceans in the area of potential disturbance. The status of a population becomes unfavourable should it decline by more than 1% per year or if there is an overall decrease in the population by more than 25% (European Commission 2005).

Table 4-5: Favourable Conservation Status and regional Management Unit population of cetaceans relevant to this application.

Species	FCS Assessment	Management unit population
Harbour porpoise	Favourable	227,298 (95% CI 176,360 - 292,948) **333,808**
Bottlenose dolphin	Unfavourable	195 (95% HDPI 162 – 253)
White-beaked dolphin	Favourable	15,895 (95% CI 9,107 – 27,743) **35,908**
Minke whale	Favourable	23,528 (95% CI=13,989-39,572) **11,819**

Regional Management Unit population is based on IAMMWG (2015).

Bottlenose dolphin population is based on the Coastal East Scotland population from Cheney *et al*. (2013).

Favourable Conservation Status assessment from JNCC (2010b) and JNCC (2013).

Figures in bold are the latest management unit population estimates (JNCC 2017).

5 Predicted impacts on EPS

5.1 Introduction

100. This section provides a summary of the predicted levels of impact arising from the construction activities identified in Table 3-1, that could affect EPS. A summary of the noise levels for each activity and marine mammal hearing frequencies is shown in Figure 5-1.

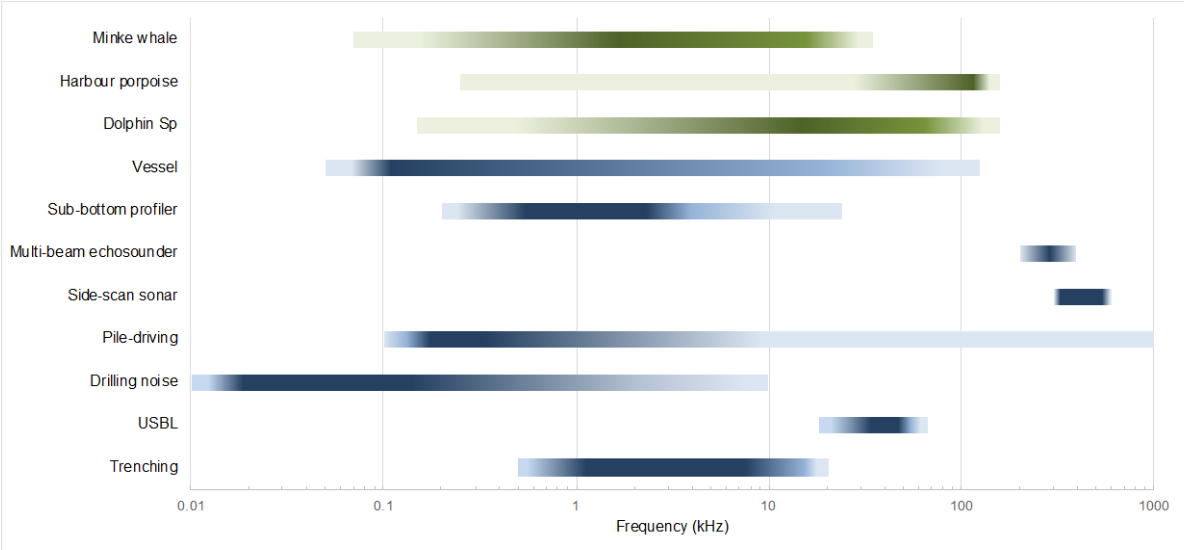

Figure 5-1: Marine mammal hearing frequencies and sound produced by construction activities.

5.2 Installation of pin piles

5.2.1 Drilling noise

101. Sound generated during drilling will be transmitted into the water column through two mechanisms: either by sound transmitted from the drill-bit sediment interface and into surrounding seabed layers, or through vibrations which travel up the drill shaft and into the water column (Kongsberg, 2015). The SSVBM will not be active in the water column; only within the pile casing, within the seabed.

102. Underwater noise associated with pile drilling has been measured in several studies and these are summarised in Table 5-1. These published studies identify the measurements of sound levels for drilling activity as varying between 100 to 162 dB re 1 µPa (rms) at ranges of between 1 m and 179 m from the drilling operation.

Table 5-1: Summary of reports documenting foundation drilling operations

SOURCE TYPE	ACTIVITY	REPORTED NOISE MEASUREMENT	MEASUREMENT BANDWIDTH (KHZ)	NOISE CHARACTERISTICS	REFERENCE
Drill Ship – converted freighter	Logging	125 dB (rms) re 1 µPa @ 170 m	0.02-1	Continuous tones up to 1850 Hz	Greene, 1987
	Drilling	134 dB (rms) re 1 µPa @ 200 m	0.02-1	Continuous strong tones at 277 Hz	

SOURCE TYPE	ACTIVITY	REPORTED NOISE MEASUREMENT	MEASUREMENT BANDWIDTH (KHZ)	NOISE CHARACTERISTICS	REFERENCE
Drill Ship '*West Navion*' 250 m long	Drilling	195 dB (rms) re 1 µPa @ 1 m	0.001-139	Continuous low frequency 100-400 Hz band	Nedwell and Edwards, 2004
Semi-Submersible	Active not drilling	117 dB (rms) re 1 µPa @ 125 m	0.01-10	Continuous low frequency	McCauley, 1998
	Drilling	115 dB (rms) re 1 µPa @ 405 m	0.01-10	Tones produced from drill string in low frequency bands <70 Hz	
Platform	Drilling, production and water injection	162 dB (rms) re 1 µPa @ 1 m	0.01-10	Broadband noise	Hannay et al. 2004
	Drilling	148 dB (rms) re 1 µPa @ 1 m	Not available	Not available	Bach et al. 2013
Jack up platform	Pile drilling at Strangford Lough Tidal device to 7.4 m	139 dB re 1 µPa (rms) at 28 m; Source Level of 162 dB re 1 µPa at 1 m	7 Hz to 80 kHz	Frequency components of 20 Hz to 100 Hz	Nedwell and Brooker, 2008
Jack up platform	Drilling of anemometry hub foundation	100 dB re 1 µPa (rms)	Not reported	Highest sound levels between 100hz – 600 hz	Broudic et al, 2014
Large diameter drill rig	Installation of Oyster 800 Array wave energy devices, Orkney	153.8 ± 12.1 dB re 1 Pa at 1m	Not available	Not available	Kongsberg, 2011 (Cited from Xodus, 2015)

103. The level of sound arising from drilling is relatively low, occurring predominantly at low frequencies and is a continuous sound source (Table 5-1).

104. Although underwater sound levels increase during periods of drilling in comparison to non-drilling periods, the sound levels during these periods are still relatively low (and certainly when compared to conventional piling operations for example) (Genesis, 2011).

105. Southall *et al*. (2007) found sound levels from all types of drilling platforms were all below the threshold levels for TTS in cetaceans and pinnipeds. From the available information on noise measurements, drill-ships are considered to produce the highest sound levels in comparison to semi-submersibles and fixed platforms, with a maximum SPL of 195 dB re 1 µPa @ 1 m (rms). Semi-submersibles, equivalent to the sub-surface drilling methods that will be used during pile drilling for

the Project, and fixed drilling platforms produce relatively low sound levels and are predominantly low frequency (Table 5-1) (Genesis, 2011).

106. Sorensen *et al.* (1984) (cited in Hammond *et al.* 2003) reported that, although there was little data on the reactions of marine mammals to drilling noise, there was no clear evidence of avoidance behaviour by small odontocetes. Bottlenose dolphins, Risso's dolphins and common dolphins were all recorded close to platforms and sighting rates were similar in areas with and without drilling rigs.

107. Studies using Passive Acoustic Monitoring (PAM) at drill platforms located on the Dogger Bank did not record any decrease in harbour porpoise activity at the platforms when drilling was being undertaken, compared to when there was no drilling (Todd *et al.* 2007) and indicated that porpoises appeared to use oil and gas platforms as feeding refuges (Todd *et al*. 2009). Similar results have been reported from studies undertaken at two platforms in Danish waters (Bach *et al.* 2013).

5.2.2 Percussive piling noise

108. Percussive pile-driving may be required for up to one foundation location (see Section 3.3.1).

109. For drive-drill-drive operations there is no evidence available on the noise levels produced by comparison to standard pile driving operations. However, it is expected that the noise will be lower as a result of the drill operations reducing the resistance to piling resulting in the need for relatively low hammer energies for at least a proportion of the time.

110. The worst-case scenario considered in the EIA Report prepared in support of the Application for the Project Offshore Consents (which was set out for a drive only scenario rather than a drive-drill-drive scenario) identified that a maximum hammer energy of 1635 kJ would generate a source peak sound pressure level (SPL) of 242.5 dB re 1 µPa-m and a sound exposure levels (SEL) of 219.4 dB re 1 µPa2s-m.

111. Under the drive-drill-drive scenario, the total driving duration at each location will be of up to 12 hours with up to 4 hours of impact driving required for each casing. Further the 4-hour impact driving duration required for each casing will be split with a break in driving of approximately 14 hours occurring whilst drilling into the underlying rock is completed. Driving of the casing will then recommence until the target depth is reached.

112. The pile-driving noise modelling used to inform the Offshore Consents Application and the subsequent modelling applied PTS thresholds published by the National Oceanic and Atmospheric Administration (NOAA) (NMFS, 2016) were used to predict PTS impact ranges.

113. Current guidance advises that when assessing potential impacts from impulsive underwater noise both unweighted zero-to-peak SPL and weighted cumulative SEL metrics should be considered (e.g. Southall et al. 2019). Consequently, the predicted distances at which the onset of PTS are predicted to arise based on unweighted zero-peak SPL are presented in Table 5-2 and weighted cumulative SEL in Table 5-3.

Table 5-2: Predicted PTS (un-weighted SPL) impact ranges resulting from pile driving on marine mammals based on the revised noise modelling (Genesis 2018)

SPECIES OR GROUP	PTS CRITERIA (NMFS, 2016)	DISTANCE TO THRESHOLD EXCEEDANCE (M)		
		MINIMUM	MEAN	MAXIMUM
Harbour porpoise	Unweighted SPL $_{(0-p)}$ 202 dB re 1 µPa	311	319	354

SPECIES OR GROUP	PTS CRITERIA (NMFS, 2016)	DISTANCE TO THRESHOLD EXCEEDANCE (M)		
		MINIMUM	MEAN	MAXIMUM
Bottlenose dolphin / white-beaked dolphin	Unweighted SPL $_{(0-p)}$ 230 dB re 1 µPa	4	4	4
Minke whale	Unweighted SPL $_{(0-p)}$ 219 dB re 1 µPa	19	19	19
Pinnipeds (harbour and grey seals)	Unweighted SPL $_{(0-p)}$ 218 dB re 1 µPa	21	21	21

Table 5-3: Predicted PTS impact ranges resulting from pile driving on marine mammals based on the consented design envelope (Genesis 2018)

SPECIES OR GROUP	PTS CRITERIA (NMFS, 2016)	DISTANCE TO THRESHOLD EXCEEDANCE (M)		
		MINIMUM	MEAN	MAXIMUM
Harbour porpoise	Weighted cumulative SEL 155 dB re 1 µPa	333	347	357
Bottlenose dolphin / White-beaked dolphin	Weighted cumulative SEL 185 dB re 1 µPa	0	0	0
Minke whale	Weighted cumulative SEL 183 dB re 1 µPa	2,229	2,900	3,375
Pinnipeds (harbour and grey seals)	Weighted cumulative SEL 185 dB re 1 µPa	3	3	4

114. The results indicate that there is a low risk of the onset of PTS to occur for any EPS species beyond 400 m with the exception of minke whale where it could occur up to approximately 3.0 km.

5.3 Use of ADD as mitigation

115. To reduce the reliance on visual searches, the mitigation for marine mammals presented in the Piling Strategy has been designed to avoid reliance on visual surveys by Marine Mammal Observers (MMOs). It is proposed that an ADD will be operated in order to displace marine mammals prior to the commencement of percussive piling. The aim of the ADD deployment will be to remove animals from an area where there is potential for injury or fatality to be caused by piling noise. Following advice received from SNH it is proposed that the use of the ADD will be limited to 5 - 10 minutes prior to the commencement of the 'soft-start' pile-driving (SNH 2020).

116. ADDs produce relatively high levels of sound in the water column with the aim of causing an avoidance behaviour in marine mammals and discouraging them from a particular area. The extent and duration of any displacement varies across devices and the behaviour of the individual species, with ADDs having less of an effect where marine mammals may be attracted to a site, e.g. seals and fish farms

(Coram *et al.* 2014). However, in areas where there is less of an attraction, the use of ADDs have been found to be effective at temporarily displacing marine mammals from an area (Table 5-4).

Table 5-4: Predicted range of effective deterrence by Acoustic Deterrent Devices.

SPECIES OR GROUP	DETERRENT RANGE	SOURCE
Harbour porpoise	Up to 7.5 km	Brandt *et al.* (2013)
Bottlenose dolphin	Unknown	Sparling *et al.* (2015)
Minke whale	Up to 4 km	McGarry *et al.* (2017)
Pinnipeds (harbour and grey seals)	>1,000 m	Gordon *et al.* (2015)

117. Published studies have been undertaken on the effectiveness of using an ADD to displace harbour porpoise (Brandt *et al.* 2012, 2013, Dähne *et al.* 2017). The studies have reported differing levels of effectiveness with one recording a harbour porpoise within 798 m of an active ADD and another showing that all harbour porpoise avoided the area within 1.9 km and for half the time between 2.1 and 2.4 km (Brandt *et al.* 2012, 2013). Both these studies reported a strong avoidance behaviour by harbour porpoise to the ADDs with one study recording a 96% reduction in the number of detections out to 7.5 km (Brandt *et al*. 2013, Coram *et al*. 2014). The studies concluded that there appeared to be effective deterrence at levels of 132 dB re 1 µPa (rms SPL) and no clear avoidance at levels below 119 dB re 1 µPa (rms SPL) (Brandt *et al*. 2012). Avoidance from the area lasted approximately six hours.

118. A study undertaken looking at the effects of pile-driving at the DanTysk wind farm in the German Bight reported a significant reduction in the number of harbour porpoise detected out to at least 12 km from the ADD with near total avoidance of the area within 3 km by (Dähne *et al.* 2017).

119. There are limited studies undertaken on the effectiveness of ADDs on dolphins (Sparling *et al*. 2015). However, they are recognised to be less sensitive to noise than other cetaceans and the deterrent radius from an ADD is likely to be smaller than that for other cetaceans. However, the area within which the onset of PTS is predicted to occur extends less than 1 km from the source and therefore an ADD is predicted to be an effective deterrence for dolphins.

120. Studies undertaken for minke whale indicate that the use of an ADD caused a change to a direct swimming direction away from the sound source and significant increase in the net speed of minke whales, minke whales were reported to respond within 4 km of the ADD (McGarry *et al*. 2017).

5.4 Geophysical survey equipment noise

121. Geophysical surveys will be required to be undertaken for a variety of purposes as part of the construction programme (See Section 3.5). Although the type of equipment that may be required to undertake the geophysical surveys is known, the specific items are not known at this stage.

122. Table 5-5 below presents the information on the potential noise sources required to be used for the geophysical survey.

Table 5-5: Operating frequency and sound source level of geophysical survey equipment.

REPRESENTATIVE GEOPHYSICAL EQUIPMENT	OPERATING FREQUENCY (KHZ)	SOURCE LEVEL REPORTED BY MANUFACTURER (DB)
Multibeam Echosounder		
EM2040 Dual Swath*	200 - 400 kHz	218
R2 Sonic 2024 MBES	200 – 450	229 (peak), 162 (rms)
Kongsberg EM2040C Dual Head	200 – 400	210 (peak), 204.5 (rms)
Reason Seabat 7125	400	220 (rms)
Side-scan Sonar		
EdgeTech 4200 dual frequency SSS*	300 or 900 kHz	115 or 230 (peak), 113 or 226 (rms)
Klein 3900	445 or 900	226 (peak), 220 (rms)
EdgeTech 4125-MP	400 or 900	
Sub-bottom profiler (Pingers, Sparkers, Boomers, Chirps) (only one to be used at any one time)		
Innomar SES 2000 medium*	2- 22 and 85-115 kHz	247 (peak)
Dual layer 800 tip Sparker*	200Hz – 4000Hz	201 – 222 (peak), 210 – 228 (peak to peak)
Teledyne Benthos Chirp III	2 – 7	217 (rms)
Geopulse sub-bottom profiler	1.5 – 18	223.5 (peak)
Innomar SES 2000	85 – 115	250 (peak), 243 (rms)
EdgeTech 3200 XS 216	2 – 16	208 – 213 (peak), 205 – 210 (rms)
GeoMarine Geo-source 400 tip	0.2 – 5	220 (peak, 205 (rms)
GeoSource 600 J, 800 J	0.05 – 5	221 – 223 (peak), 205 (rms)
Applied Acosutics S-Boom Boomer	0.1 – 5	209 (peak), 203 (rms)
Additional Equipment for Rock Placement - Very High Frequency Obstacle Sonar - for visual inspection (only one system used)		
Aris Explorer 3000	1,800 kHz to 3,000 kHz	200-206
Blueview P900*	900 kHZ	Not available
* utilised on project previous geophysical surveys for NnGOWL		

5.4.1 Multi-beam echosounder

123. Multi-beam echosounders are widely used in the marine environment and measure water depth by emitting rapid pulses of sound towards the seabed and measuring the sound reflected back. Emitted sound frequencies are typically between 12 – 400 kHz depending on water depth, with surveys in continental shelf applications operating at between 70 to 150 kHz, and in shallower waters of less than 200 m using multi-beam echosounders operating at between 200 and 400 kHz (Danson 2005, Hopkins 2007, Lurton and DeReutier 2011). Sound sources have been reported as ranging from 210-245 dB re 1µPa-m (Genesis 2011).

124. The water depths within the construction area are all less than 100 m. Consequently, the multi-beam echosounders that may be used will be emitting sound levels above 200 kHz therefore outwith the hearing frequency range of all marine mammals (Figure 5-1). It is therefore predicted that marine mammals will be unable to hear the sound arising an echosounder and there will be no impacts on any EPS from their use.

5.4.2 Side Scan Sonar

125. Side-scan sonar involves the use of an acoustic beam to obtain an accurate image over a narrow area of seabed to either side of the instrument. The frequencies used by side-scan sonar are relatively very high, typically between 100 and 900 kHz. In shallower waters, such as those found within the construction area, side-scan sonar operate at frequencies at the higher end of this spectrum, typically between 300 and 900 kHz and are therefore predominantly producing sound outwith the hearing frequency range of marine mammals. Marine mammals within the area will therefore be unable to hear sound arising from side-scan sonar and there will be no impacts on any European Protected Species.

5.4.3 Sub-Bottom Profiler

126. Sub-bottom profiling is used to determine the stratification of soils beneath the sea floor. Various types of instrument may be used, such as pingers, boomers, sparkers and chirpers, depending on the required resolution and seabed penetration. They produce sound source levels of between 196 and 225 dB re 1 µPa -1 m $_{(rms\ SPL)}$ and at frequencies ranging from between 0.5 and 300 kHz and are therefore audible to marine mammals (Figure 5-1) (BOEM 2016, King 2013, Danson 2005).

127. Chirpers are frequency modulated sub-bottom profilers capable of providing high penetration and high-resolution data. They have largely replaced the use of sparkers and boomers when undertaking many surveys. They produce sound levels of between 189 and 214 dB re 1 µPa – m (rms SPL) at frequencies of between 2 and 24 kHz. They cover a relatively broad range of frequencies that are detectable by marine mammals.

5.5 HDD at Landfall

128. Horizontal Directional Drilling will occur at landfall with the drilling being undertaken from land. Therefore, the majority of noise from the HDD drilling process will be generated onshore, by the drilling rig itself and by its nature is not considered likely to disturb marine European Protected Species. As drilling activity progresses beneath the seabed, there is a potential for underwater noise to be generated due to contact between the drill head and hard ground beneath the seabed. The majority of drilling activity will be undertaken at a depth of greater than 10 m under the seabed and it is not considered that this will be audible through this thickness of seabed. There is the potential for some noise to become audible as the drill nears the seabed surface.

129. Noise levels generated by HDD drilling are likely to be variable depending on ground and sea conditions and little empirical information is available on underwater noise levels generated from HDD drilling. Measurements of HDD noise in shallow riverine conditions reported sound levels of 129.5 dB re 1µPa directly above the underground drilling location and below that which will likely cause any significant level of disturbance (Nedwell et al. 2012).

130. Underwater noise modelling undertaken for an application to NOAA in relation to the Port Dolphin Energy LLC Deepwater port (2011), considered HDD drilling and estimated a maximum SEL of 154 dB at 250 Hz and predicted a disturbance impact radius of 250 m.

5.6 Cable installation

131. The inter-array and export cables will be trenched and buried by a cable laying vessel. There is potential for noise to arise during this activity. Little empirical data is available for noise emission levels resulting from cable burial works, due to the fact that the potential impacts of such operations are generally considered to be minimal.

132. Nedwell *et al.* (2003) reported noise measurements obtained during cable trenching at the North Hoyle offshore wind farm. The results showed that source level noise from the trenching equipment was 178 dB re 1µPa dB @ 1m. Similar results have been reported for cable trenching in the Bay of Biscay where the mean sound level was 188.5 dB re 1 µPa (Bald *et al*. 2015). Trenching associated with burying pipelines produces similar levels of sound with one study reporting mean source levels of less than 183.5 dB re 1 µPa (Johannson and Andersson 2012). The sound arising from cable jetting is reported to be predominantly between 1 kHz and 15 kHz (Hale 2018).

133. Although the level of noise from trenching will vary depending on the equipment used and the seabed conditions, in general, noise from the vessels required for trenching is likely to be louder than the trenching activity itself (Genesis 2011).

5.7 Rock placement

134. There are limited data on noise arising from rock placement activities. However, measurements of noise from rock placement have found that both the source levels and frequency spectrum from rock dumping are similar to those arising from the vessel undertaking the work and that rock placement does not contribute to the level of noise (Nedwell and Edwards 2004, McPherson *et al*. 2017).

135. Impacts to EPS resulting from the geophysical surveys and vessel presence associated with this activity are considered separately within the EPS Risk Assessment (see Section 6.4.2 and Section 6.4.7 respectively).

5.8 Vessel and Equipment Positioning

136. All vessels undertaking construction works will utilise USBL as a means of underwater acoustic positioning. The contractor undertaking the works is still to be selected and consequently, the precise details of the equipment to be used during the works is not yet available and will depend on the outcome of the contract tendering process currently being undertaken. However, the broad types of equipment that will be required are known and the assessment is based on a realistic worst-case scenario. Representative examples of the USBL equipment are presented in Table 5-6.

Table 5-6: Operating frequency and sound source level of USBL equipment.

GEOPHYSICAL EQUIPMENT	OPERATING FREQUENCY	MAXIMUM SOURCE LEVEL REPORTED BY MANUFACTURER (DB)
SUBSEA POSITIONING USBL (note only one of these devices will be used per vessel, although multiple vessels may be using a USBL at any one time).		
Sonardyne Ranger USBL	35 – 50 kHz	200 (peak), 188 (rms)
Sonardyne Ranger 2 USBL HPT 3000	19 – 34 kHz	194 (peak), 188 (rms)
Sonardyne Scout	30 – 35 kHz	193 (peak)
Easytrak Nexus 2 USBL	18 – 32 kHz	198 (peak), 192 (rms)

GEOPHYSICAL EQUIPMENT	OPERATING FREQUENCY	MAXIMUM SOURCE LEVEL REPORTED BY MANUFACTURER (DB)
Kongsberg HiPAP	21 – 30.5 kHz	207 (peak), 188 – 190 (rms)
Ix Blue GAPS	19 – 30 kHz	191 (rms)

137. Reported sound levels produced by USBL range from between 188 and 192 dB (rms) and 191 and 207 (peak) (Table 5-6). These sound levels are relatively low compared with other sources. For all but one USBL system the maximum sound levels produced are below those at which the onset of PTS is predicted to occur for all EPS species. The exception is the HiPAP USBL that can be operated at sound source levels of 207 dB $_{(0\text{-peak})}$. However, the sound source for this equipment can be reduced, depending on the type of survey being undertaken and it will not be operated at levels capable of causing the onset of PTS, i.e. it will only be used at levels below 202 dB re 1 µPa (Southall *et al*. 2019).

138. Consequently, there will be no risk of any hearing injury to EPS from the operation of USBL.

5.9 Vessel Activity

139. Vessels will be used throughout the construction period as described in Section 3.10.

140. The majority of construction activities will be undertaken by large, slow moving vessels such as heavy lift vessels, jack-up barges and cable laying vessels. Vessels undertaking construction activities will be largely static or slow moving during their operational activities. Vessel movements would be slow and predictable and therefore these vessels do not present a risk to EPS species.

141. Vessel noise is continuous and varies depending on the type of vessel being used. The primary sources of sound from vessels are propellers, propulsion and other machinery; the dominant noise source is from propeller cavitation (Ross 1976, Wales and Heitmeyer 2002, Arveson and Vendittis 2000). Source levels typically increase with increasing vessel size, with smaller vessels (< 50 m) having source levels 160-175 dB re 1µPa (rms SPL), medium size vessels (50-100 m) 165-180 dB re 1µPa (rms SPL) and larger vessels (> 100 m) 180-190 dB re 1µPa (rms SPL) (summarised by Richardson *et al*. 1995). Commercial vessels in transit have reported sound source levels of between 178.6 and 190.3 dB re 1 µPa -m (Genesis 2011, Johanson and Anderson 2012), whereas supply and maintenance vessels produce generally lower sound source levels of between 130 and 184 dB re 1 µPa (rms SPL), with frequencies of between 20 Hz and 10 kHz. However, sound levels depend on the operating status of the vessel with vessels equipped with dynamic positioning systems exhibiting increased sound levels in the spectrum from 3 Hz to 30 Hz (Nedwell and Edwards 2004, OSPAR 2009). Conventional tugs produce sound with a dominant frequency of 1,000 Hz and reported source levels ranging from between 160 and 187 dB re 1 µPa @1m and typically around 170 dB re 1 µPa @1m (Richardson *et al* . 1995, Genesis 2011).

142. Most of the acoustic energy from vessels is below 1 kHz, typically within the 50-300 Hz range, although cavitation from propellers produces sounds at frequencies of between 1 kHz and 125 kHz (Genesis 2011, Hermannsen *et al*. 2014). Consequently, vessel noise has historically thought to have a greater potential to impact marine mammals with relatively low frequency sensitivities e.g. seals and baleen whales rather than high frequency specialists, e.g. porpoise (Okeanos 2008). However, more recent studies indicate that high frequency sound from vessels of between 0.25 and 63 kHz and at mean sound levels of 123 dB re 1 µPa (rms SPL) can cause increased porpoising behaviour in harbour porpoise at distances greater than 1 km from the sound source (Dyndo *et al*. 2015).

6 EPS Risk Assessment

6.1 Introduction

143. Under Regulation 53(9) of the Habitats Regulations licences can only be issued where the proposed activity meets certain criteria. For the purposes of any likely application they are:

- There is a licensable purpose;
- There is no satisfactory alternative; and
- The action authorised will not be detrimental to the maintenance of the population of the species concerned at favourable conservation status in their natural range.

6.2 Test 1: Licensable Purpose

144. The Scottish Government can only issue licenses under Regulation 44(2) of the Regulations (as amended) for specific purposes. These purposes include:

- 44(2)(e) preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment; (Marine Scotland 2012).

145. When considering EPS licences under IROPI, SNH takes into account whether an activity or development is required to meet, or contribute to meeting a specific need, such as:

- maintaining the health, safety, education or environment (sustainable development, renewable or green energy, green transport) of Scotland's people;
- complying with national planning policies.
- supporting economic or social development (nationally important infrastructure development projects, employment, regeneration, mineral extraction, housing etc.).

146. The Project meets the criteria for the development to be considered as one of IROPI.

147. The development of the Project demonstrates a direct environmental benefit on a national and international scale and complies with international and national environmental policies. Furthermore, the life-span of the Project is predicted to be up to a 50-year period and therefore a long-term development that will contribute to ensuring the security of energy supply, with long-term environmental benefits. It is not a development for short-term economic interests.

148. The Project will have a direct national and international environmental benefit by significantly reducing carbon emissions to the atmosphere compared to other sources of non-renewable energy generation. By replacing non-renewable energy generation, e.g. coal generation, the development of the Project will reduce annual CO2 emissions. Over the operational period of the wind turbines, the Project will displace CO2 from other energy sources by up to 12.61 million tonnes coal equivalent.

149. Recognising the importance of reducing carbon emissions, the EU, UK and Scottish Government have all committed to reduce emissions and increase the use of renewable energy:

- In 2009 the EU introduced Directive 2009/28/EC on the *Promotion of the use of energy from renewable sources*, which set renewable energy targets for each member state. The Directive imposed on the UK a mandatory national target of deriving 15% of gross final energy consumption from renewable sources by 2020.

- The Climate Change (Scotland) Act 2009, which sets additional targets for emissions reductions in Scotland than the Climate Change Act: 80% reduction by 2050, with an additional interim target of 42% by 2020;
- The Climate Change Act 2008, which commits the UK to a net reduction in greenhouse gas emissions of 80% by 2050 and 34% by 2020.

150. The development complies with national policies and plans including:

- The National Renewable Energy Action Plan for the UK produced under Article 4 of the Renewable Energy Directive.
- The UK National Policy Statements (NPSs) on Energy, produced under Part 2 of the Planning Act 2008, which decision makers must have regard to when deciding an application for nationally significant infrastructure projects consented under that Act. As energy policy is a reserved matter for UK ministers, the Energy NPSs may be a relevant consideration in energy infrastructure decisions in Scotland. Of the 12 NPSs, EN-1 (overarching energy) sets out the policy for the delivery of major energy infrastructure and reflects the UK Low Carbon Transition Plan, and EN-3 (Renewable Energy) supports the development of renewable energy and offshore wind farms in particular.
- The National Planning Framework 2 (NPF2), produced under the Planning etc. (Scotland) Act 2006, sets out a strategy for Scotland's development up to 2030. One of the main elements of the strategy is to "*realise the potential of Scotland's renewable energy resources and facilitate the generation of power and heat from all clean, low carbon sources"* (Scottish Government 2009).
- The 2020 Routemap for Renewable Energy in Scotland, which sets further targets of renewable sources to meet the equivalent of 100% of Scotland's gross annual electricity demand by 2020 (Scottish Government 2011).
- Scotland's Low Carbon Economic Strategy (LCES) aims to secure economic growth and includes an approach to guiding Scotland into a low carbon economy. The strategy focuses on Scotland's targets for reducing GHG emissions, and recognises that, *"By 2030 almost all of our electricity will have to come from low carbon technologies such as renewables and fossil fuelled plants fitted with carbon capture and storage technology"* (The Scottish Government 2010).
- A sector specific marine plan, 'Blue Seas - Green Energy: A Sectoral Marine Plan for Offshore Wind in Scottish Territorial Waters' ('the Plan') (Marine Scotland 2011) was published in March 2011 (including a SEA, HRA and an Economic Impact Assessment), and confirmed that six sites for offshore wind developments were suitable for development. Within the Plan the Neart na Gaoithe site was shortlisted as one of these sites.

151. The development of the Project identifies a direct environmental benefit and complies with both international and national policies and plans and is therefore a project of Imperative Overriding Public Interest.

152. The proposed works are directly linked with the development of the project and therefore meets the requirements of the Regulations.

6.3 Test 2: No satisfactory alternative

153. Section 6.2 sets out the purpose of the Project and the need that the Project has the ability to meet. Any alternatives considered should be limited to those that have the capacity to meet this same need

and be similarly financially and logistically viable within the context of an offshore wind farm development.

154. The activities described in Section 3 are required to develop the Project.

155. Within the Project design envelope presented in the Application (NnGOWL 2018) there were a number of permutations for the development of the Project. Included within these permutations were different designs and installation methods that in turn can influence the levels of underwater noise entering the marine environment. Full consideration of Project design decisions and consideration of alternatives is provided in Chapter 3 of the EIA Report (NnGOWL 2018) and summarised below as relevant to the activities presented in Section 3 above.

6.3.1 Foundation Installation

6.3.1.1 Design

156. Both site and market conditions have an effect on the design selection of the wind turbine and OSP foundations. Water depth and underlying geology significantly influence the selection of specific foundation types. Economics and long-term maintenance requirements are also a powerful driver. The combination of a harsh and challenging environment and the relative difficulties associated with arranging access increases the cost of a single foundation relative to the overall cost of the wind farm and can have a significant effect on the overall financial viability of the development.

157. The physical conditions at the Wind Farm Area mean that monopile and tension leg platform foundations were discounted since the water is too deep and too shallow respectively for the use of these solutions. Insufficient sediment depth over a large part of the site means that suction caisson foundations were also ruled out on technical grounds.

158. Steel jackets with pile foundations are, therefore, considered to be the most feasible option for the Project on both a technical and economic basis.

6.3.1.2 Pile installation

159. NnGOWL has undertaken a number of geophysical and geotechnical surveys to determine seabed conditions. The survey data has been reviewed by NnGOWL engineers and contractors in order to identify the most suitable means of pile installation for the Project.

160. The majority of piles will be installed using the drill only method and only one location will require the drive-drill-drive methodology. Pile and casing installation using solely driven methods will not be undertaken. Noise levels from drilling will give rise to a substantially reduced source noise level when compared to pile driving. This approach represents a significant reduction in the amount of driving than was assessed in the EIA.

161. The drive-drill-drive installation method is required at one location for one or both of the following reasons. Firstly, in some locations, ground conditions mean that the pushing force required to jack the casing into the seabed is greater than the jacking capacity of the SST and SSVBM, which are limited to the weight of the SST. Secondly, at some locations the length of casings are required to be beyond the installation capability of the SSVBM and SST.

6.3.2 Use of ADDs as Piling Mitigation

162. The use of ADDs as part of the piling mitigation protocol is proposed in line with current good practice.

6.3.3 Geophysical Surveys

163. Geophysical surveys are required in order to map the seabed, measure water depth or characterising layers of sediment or rock below the seabed. They are essential when undertaking any offshore development work and projects cannot be developed without some geophysical work being undertaken. Although there may be different types of equipment that can be used, this is often constrained by the specific purpose the geophysical survey is being undertaken and the use of alternative equipment may not be effective. There are no alternative options to the use of the geophysical equipment required to undertake pre-construction and post-installation surveys.

6.3.4 HDD at Landfall

164. Installation of cables beneath the shoreline in the intertidal area is typically undertaken by either open cut trenching methods or using HDD techniques. At the Project landfall location at Thorntonloch, site investigation to date indicates that beneath shoreline sediments is hard rock suitable for drilling, but outwith the capabilities of the cutting tools that could be used in open-cut trenching.

165. HDD also brings additional benefits over open-cut methods; works do not need to be scheduled around tides and can be completed more rapidly, works are localised to a launch pit on private land above the beach thus minimising any disruption to the public, and the HDD can be installed in advance of cable installation thus decoupling works in a typically challenging intertidal zone.

6.3.5 Cable laying and burial

166. It is necessary for the export and inter-array cables to be buried where possible to mitigate impacts on physical processes, benthic habitats and other sea users.

167. The most appropriate method of cable installation has been selected. Cable burial will be conducted by a hybrid trenching tool that can be set to use water jetting and / or mechanical cutting to achieve required burial depths. The trenching tool can use jetting or mechanical cutting modes simultaneously to account for highly variable seabed conditions.

6.3.6 Rock Placement

168. Exposed bedrock within the Wind Farm Area at the two proposed OSP locations could inhibit the safe placement of the spud cans of the jack-up which will be used during the hook-up and commissioning of the platforms during construction. As a result, NnGOWL plan to place clean crushed gravel from an onshore quarry onto the seabed in the locations of each spud can, prior to arrival of the jack-up during construction, to prevent damage to the spud cans.

6.3.7 Vessel and Equipment Positioning

169. Acoustic signals are extensively used to support the positioning of vessels and equipment offshore. Acoustic positioning systems, such as USBL, enable underwater (rather than surface) positioning, which is required across a number of offshore sectors including renewables and oil and gas. Such systems also enable more reliable and repeatable positioning than alternatives, such as satellite-based positioning systems. On this basis, contracted vessels and equipment can be expected, in line with standard practice, to utilise acoustic positioning systems.

6.3.8 Construction Vessels

170. Survey and construction activities offshore are required to be undertaken by vessels that are fit for purpose. Construction (and survey) vessels that are suited to and equipped for each activity have been selected for use on the project.

6.4 Test 3: That the action authorised will not be detrimental to the maintenance of the species concerned at a favourable conservation status in their natural range

171. Regulation 44(3)(b) states that a licence cannot be issued unless the Scottish Government is satisfied that the action proposed "will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range" (SNH and JNCC 2014).

172. This section considers whether the proposed activities that could require licensing will be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range.

6.4.1 Installation of pin piles (including ADD use)

173. It is noted that the majority of piles will be installed using the drill only method and that noise levels from drilling will give rise to a substantially reduced source noise level when compared to pile driving.

174. The levels of noise reported from drilling activities are below those at which the onset of PTS is predicted to occur for all EPS and therefore it is predicted that noise arising from drilling activities will not will not be detrimental to the maintenance of the population at a favourable conservation status within their natural range for any European Protected Species.

175. Based on revised noise modelling it is predicted that the noise levels arising from pile-driving will not exceed levels at which the onset of PTS is predicted to occur for bottlenose or white-beaked dolphins and will be limited to no more than 357 m for harbour porpoise (Table 5-3) (Genesis 2018). With the physical presence and associated noise from vessels in the area causing localised areas of disturbance before and during any piling activities it is predicted that there is a very low risk of any harbour porpoise being present in the area within which the onset of PTS is predicted to arise from pile-driving. Furthermore, planned mitigation such as the use of ADD will reduce the risk further (See Section 7: Proposed Mitigation).

176. There is potential for noise from pile-driving to cause the onset of PTS to minke whales up to a maximum of 3.3 km (Table 5-3) and cover an area of approximately 176 km^2. Based on a minke whale density of 0.039 ind/km^2 an estimated 7 minke whales may be at risk of PTS from pile-driving; this is 0.06% of the Management Unit population. Agreed mitigation in place prior to undertaking any piling, including the use of an ADD will ensure that no minke whale are present in the area within which the onset of PTS is predicted to arise.

177. The areas of estimated disturbance (based on TTS threshold) for EPS are presented in Table 6-1. It is estimated that up to 0.28% of the harbour porpoise management unit population and 0.6% of the minke whale population could be disturbed. The disturbance from pile-driving will be of short duration with piling being undertaken at only one turbine location and each lasting up to 12 hrs.

178. On the basis that there is very low risk of any EPS receiving sound levels capable of causing the onset of PTS and there will only be a localised short-term disturbance to a small proportion of the EPS populations it is concluded that the impacts from pile-driving will not be detrimental to the maintenance of the population at a favourable conservation status within their natural range for any European Protected Species.

Table 6-1: Estimated total number of European Protected Species that could be disturbed by proposed pile-driving activities and the proportion of the Management Unit population affected

SPECIES OR GROUP	DENSITY (IND/KM^2)	ESTIMATED AREA OF DISTURBANCE	NO. OF INDIVIDUAL DISTURBED	% OF MANAGEMENT UNIT POPULATION
Harbour porpoise	0.599	1,572	942	0.28
White-beaked dolphin	0.24	0	0	0
Bottlenose dolphin	0.07	0	0	0
Minke whale	0.039	1,838	72	0.6

6.4.2 Geophysical Surveys

179. The frequencies at which both side-scan sonar and multi-beam echosounders will be operated at are above the hearing frequencies of all EPS and therefore there will be no impact on these species from these types of geophysical survey.

180. The use of sub-bottom profilers will produce sound audible to EPS and therefore could cause a level of disturbance.

181. Noise modelling undertaken for BEIS as part of a Review of Consents Habitats Regulations Appraisal (HRA) was based on the maximum source levels and bandwidths obtained from a range of sub-bottom profilers. The results indicated that for harbour porpoise the onset of Permanent Threshold Shift (PTS) could arise from between 17 m and 23 m from source and potential behavioural impacts within 2.4 km and 2.5 km (BEIS 2018). This was a worst-case scenario and the use of a Chirper with a peak SPL of 267 dB re 1 µPa-m is not expected to be required for this survey.

182. Similar noise modelling undertaken for pipeline inspection surveys based on a hull mounted pinger (the Neptune T335 pinger sub-bottom profiler) with a sound source of 220 dB re 1 µPa-m (peak), indicated that noise levels could cause the onset of PTS in minke whales within 5 m of the sound source and harbour porpoise within 32 m. The thresholds at which the onset of PTS in dolphins could occur were not exceeded. Disturbance to marine mammals was predicted to occur out to 1.5 km (Shell 2017).

183. The physical presence of vessels and their associated noise significantly reduces the risk of any marine mammals being within the very localised area where the onset of PTS could arise. There is potential for a relatively localised area of disturbance to occur no further than 2.5 km from the survey and more probably only within 1.5 km. Therefore, assuming a spherical radius of disturbance the estimated area of disturbance at any one location will be between 7.0 km^2 and 19.63 km^2.

184. The estimated number of European Protected Species that may be disturbed by the use of a sub-bottom profiler is presented in Table 6-2.

Table 6-2: Estimated total number of European Protected Species that could be disturbed by the use of a sub-bottom profiler and proportion of Management Unit population affected.

SPECIES OR GROUP	DENSITY (IND/KM^2)	NO. OF INDIVIDUAL DISTURBED (2.5 KM RADIUS)	% OF MANAGEMENT UNIT POPULATION	NO. OF INDIVIDUAL DISTURBED (1.5 KM RADIUS)	% OF MANAGEMENT UNIT POPULATION
Harbour porpoise	0.599	192	0.06	140	0.04
White-beaked dolphin	0.24	77	0.21	56	0.15
Bottlenose dolphin	0.07	15	7.69	9	4.61
Minke whale	0.039	13	0.11	9	0.07

185. The results indicate that for all species, with the exception of bottlenose dolphin, the number of individuals that may be disturbed is relatively low and will impact on less than 0.21% of the Management Unit populations.

186. For bottlenose dolphin the estimated number of individuals that could be disturbed is less than 15 individuals. However, due to the small Coastal East Scotland Management Unit population of 195 individuals, the proportion of the population potentially disturbed is estimated to be between 4.6% and 7.7%, depending on the type of sub-bottom profiler used. However, this is considered to be very precautionary as bottlenose dolphins have not been recorded within the wind farm area and therefore the use of a sub-bottom profiler in waters further offshore will not impact on any bottlenose dolphins.

187. Any displacement will cause the bottlenose dolphins to move away from the survey during the period it is present, although the dolphins are predicted to remain coastal. Displaced bottlenose dolphins will be able to forage and communicate when outside the zone of effect. There is a theoretical potential for increased intra-specific competition during the period the survey is within the coastal waters but as bottlenose dolphins occur widely along the coast any that are displaced will be able to relocate elsewhere.

188. The sub-bottom profiler will be used over a period four months (April to July) and will be mobile. The area across which disturbance occurs will be no further than 2.5 km from the survey vessels and once the vessel moves away from the area noise levels will reduce to below which disturbance is predicted to occur. Therefore, any disturbance impacts will be temporary with evidence from other noise producing activities showing that cetaceans return relatively quickly to an area following displacement (e.g. Thompson *et al.* 2010, 2013; Pirotta *et al.* 2014).

189. It is therefore concluded that although there may be localised short term disturbance to bottlenose dolphins during the period the sub-bottom profiler is operating, the impacts will be temporary and will not be detrimental to the maintenance of the population at a favourable conservation status within their natural range for any European Protected Species.

6.4.3 HDD at Landfall

190. The level of noise in from direct drilling in the marine environment is relatively low (see Section 5.2) and it is predicted that the level of noise arising from land based drilling will be lower than that caused from drilling in the marine environment.

191. Drilling noise, when audible, would be continuous rather than pulse noise and generated during the final section of the drill only. At this point, it is also expected to be partially masked by vessel engine noises of vessels supporting the cable installation activity. On the basis that any displacement would be highly localised and short term, it is concluded that there is no risk to EPS species for HDD drilling activity.

192. The densities of EPS in nearshore coastal waters along the cable route are unknown but will likely differ from those recorded during the three years of baseline offshore surveys and presented in Table 4-1, Table 4-2 and Table 4-3. However, the very localised area of no more than 250 m across which disturbance is predicted to arise, is so small that it is not be possible to impact on anything other than a very small and insignificant proportion of the species' populations.

193. Horizontal directional drilling is predicted to have a lower level of noise impact in the marine environment than offshore drilling. It is concluded that the HDD drilling activities undertaken during construction will also not have an impact that is detrimental to the maintenance of the population at a favourable conservation status within their natural range for any European Protected Species.

6.4.4 Cable Laying and Burial

194. Although the level of noise from trenching will vary depending on the equipment used and the seabed conditions, in general, noise from the vessels required for trenching is likely to be louder than the trenching activity itself (Genesis 2011).

195. It is concluded that the cable burial activities undertaken during construction will not have an impact that is detrimental to the maintenance of the population at a favourable conservation status within their natural range for any European Protected Species.

6.4.5 Rock Placement

196. Measurements of noise from rock placement have found that both the source levels and frequency spectrum from rock dumping are similar to those arising from the vessel undertaking the work and that rock placement does not contribute to the level of noise (Nedwell and Edwards 2004, McPherson *et al*. 2017).

197. It is therefore concluded that the cable burial activities undertaken during construction will not have an impact that is detrimental to the maintenance of the population at a favourable conservation status within their natural range for any European Protected Species.

6.4.6 Use of USBLs in Positioning

198. There is limited published information on the potential impact USBL may have on marine mammals. Assessments based on NMFS (National Marine Fisheries Service) disturbance criteria indicate that there is no risk of physical injury (Level A Harassment) to any marine mammals and that disturbance (Level B Harassment) will only occur to within 6 m of the USBL equipment (NOAA 2018)

199. Monitoring reports for the installation of a cable between Caithness and Moray, during which USBL was operated, reported bottlenose dolphins between 100 m and 1,200 m from the sound source and minke whale between 80 m and 2,000 m. Indicating that marine mammals were not significantly displaced beyond that which might be expected from the presence a vessel, during the time USBL was

in operation. The report does not record the behaviour of the marine mammals observed during the period USBL equipment was operating and therefore it is not known whether there was disturbance that could have caused changes in behaviour. However, there were no sightings of any marine mammals within the range at which physical injury was predicted to occur (Natural Power 2018).

200. Reported sound levels produced by USBL range from between 188 and 192 dB (rms) and 191 and 207 (peak) (Table 5-6). The sound source for this equipment can be reduced, depending on the type of survey being undertaken and mitigation in place will ensure that all USBL equipment will be operated at levels below those capable of causing the onset of PTS, i.e. it will only be used at levels below 202 dB re 1 µPa (Southall *et al*. 2019). Consequently, there will be no risk of any hearing injury to EPS from the operation of USBL.

201. There will be limited levels of disturbance when USBL equipment is operating, the impacts will be localised and temporary and will not have an impact that is detrimental to the maintenance of the population at a favourable conservation status within their natural range for any European Protected Species.

6.4.7 Vessel Activity during Construction

202. As described in Section 3.4 vessels will be present on site throughout the construction period. In order to reduce potential disturbance to EPS species from vessel movements, vessels will navigate using defined routes as outlined in the NnGOWL NSVMP. Noise from vessels will be below that at which the onset of PTS is predicted to occur but is capable of causing disturbance. Evidence suggests that the area of disturbance will be relatively localised.

203. Studies on the impacts vessel have on harbour porpoise have shown that changes in harbour porpoise behaviour due to vessel noise occur when noise levels between 113 to 133 dB re 1 µPa (weighted), which can be equivalent to a vessel 1,000 m away (Dyndo *et al*. 2015). Studies undertaken in Denmark recorded harbour porpoise no closer than 60 m from seventeen recorded ship interactions (Hermannsen *et al*. 2014). Similarly, studies on harbour porpoise within the black sea reported between 40% and 80% of harbour porpoises responded to vessel less than 50 m away and this decreased with distance when at 400 m less than 10% showed any response to vessels (Bas 2017).

204. The number of vessels on site during construction will vary and multiple vessels will be present at any time; this will increase the likely area of disturbance. It is not possible to predict how many vessels may be present or where they will be located. However, there is potential for some overlap in the areas of disturbance where vessels are working in relatively close proximity to each other. Any displacement caused by a vessel will be temporary and EPS will be able to return to the area once the vessel has departed.

205. It is therefore concluded that although there may be localised short term disturbance to EPS during the period vessels are present, the impacts will be temporary and will not be detrimental to the maintenance of the population at a favourable conservation status within their natural range for any European Protected Species.

7 Proposed Mitigation Strategy

7.1 Introduction

206. Marine Scotland guidance on EPS states that 'Mitigation measures should be put in place whenever there is concern that an activity is likely to cause an offence and should be proportionate to the risk of injury or disturbance' (Marine Scotland 2014). This section outlines the proposed mitigation for each aspect of construction outlined in Section 3, where disturbance is predicted.

7.2 Installation of pin piles (including ADD use)

207. Drilling activities during pile installation are considered unlikely to produce noise levels that could result in PTS or TTS to European Protected Species as detailed in Section 6.4.1. Therefore, no specific mitigation is proposed in relation to drilling operations.

208. For pile driving, a mitigation zone is identified which ensures that no animals are within a range which may cause injury or fatality when piling starts. For each marine mammal species, the appropriate mitigation zone is determined as the impact range associated with either the unweighted SPL or the cumulative SEL, whichever is greater, for PTS.

209. During pile driving it is proposed that the following steps are implemented to minimise the risk of injury to marine mammals within PTS range:

- Optimised hammer energies;
- Deployment of Acoustic Deterrent Devices (ADDs); and;
- Incorporation of a soft-start.

7.2.1 Optimised Hammer Energies

210. The minimum practical hammer energy will be used for each pile to minimise the underwater noise.

7.2.2 Acoustic Deterrent Devices

211. It is proposed that an ADD will be used to displace marine mammals prior to the commencement of pile driving. The aim of the ADD will be to remove animals from an area where there is potential for injury or fatality to be caused by pile driving noise.

212. An ADD device will be selected based on sound levels and frequencies which are appropriate to the hearing capabilities of the key marine mammal species present within the vicinity of the Wind Farm Area to stimulate a disturbance response and cause the animals to leave the mitigation impact zones.

213. The duration of ADD use is aimed at balancing the key objective of dispersing animals from the mitigation zone against risks of habituation to the ADD source or significantly increasing disturbance effects. The ADDs will be deployed from the piling vessel for a period of 5 – 10 minutes prior to pile driving, to allow marine mammals to be displaced from the mitigation zone. The mitigation zone is determined by the length of time that it takes for a fleeing marine mammal to vacate the maximum distance at which the onset of auditory injury could occur when pile driving at maximum hammer energy using instantaneous PTS ranges as advised by SNH (SNH, 2020). In this case, the maximum predicted distance is 354 m for harbour porpoise which, if swimming at a speed of 1.5 m/s (Williams 2009) will take just under 4 minutes to swim beyond the range at which the onset of PTS is predicted to occur. For all other marine mammals, the time it will take to swim beyond the range of PTS is lower than this. Deployment of the ADD for 5 – 10 minutes is sufficient to displace harbour porpoise, and all other marine mammals, from the mitigation zone prior to piling at full power.

214. The ADD operator will be in direct communications with the offshore construction manager responsible for managing offshore piling operations. Communications will be maintained throughout ADD deployment and commencement of piling to ensure ADD has been effectively deployed for the required duration.

7.2.3 Soft Start

215. At commencement of each drive (including recommencement following stoppage or interruption), the hammer energy will be limited to 360 kJ.

216. The 30-minute soft start mitigation would commence after the ADD deployment has been completed. The soft-start would commence with a low blow rate of 20 or less strikes per minute and as low a hammer energy as is practicable but not exceeding 360 kJ.

217. Following completion of the soft-start the hammer energy and blow rate will be incrementally ramped up until the optimum blow rate is achieved. At no time will the hammer energy exceed 1,635 kJ.

7.2.4 Protocol for Planned and Unplanned Breaks

218. Each casing at the one turbine location where the drive-drill-drive method may be used, there will be a planned break in impact driving of approximately 14 hours at each pile casing location during which drilling will be completed. Prior to recommencement of impact driving the ADD will be deployed and a soft start completed.

219. For unplanned breaks in pile-driving mitigation will be dependent on the duration of the break. In the event of breaks in piling of less than 10 minutes no additional mitigation would be required (i.e. pile driving may continue from the hammer energy and frequency last used).

220. For breaks in piling of greater than 10 minutes but less than six hours the following procedures are proposed:

- Initiate piling with approximately 5 - 6 single blows at low energy; and
- Continue to ramp up hammer energy to the levels required to maintain pile movement at optimised rate

221. If the break is predicted to be greater than six hours the ADD will be activated for 5 - 10 minutes prior to the recommencement of piling activities, with a full 30-minute soft-start followed by a ramp-up in hammer energy.

7.3 Geophysical Surveys

222. It is predicted that marine mammals will be unable to hear the sound arising from the echosounder and side-scan sonar and there will be no impacts on any European Protected Species from using this equipment.

223. There is potential for a very localised area in which auditory injury could arise when using a sub-bottom profiler with potential for disturbance to occur out to approximately 2 km. Mitigation measures to reduce the risk of disturbance include ensuring that the SBP is operated at the lowest potential sound levels and over the shortest period of time. Any future surveys will be undertaken within as localised area as possible which will reduce the potential extent and duration of any possible disturbance. If practical, the sub-bottom profiler will be started at a lower level and ramped up over a period of time until operating at levels suitable for its purpose. This will allow any marine mammals within the potential range at which disturbance could occur to swim away.

224. The use of a Marine Mammal Observer (MMO) or Passive Acoustic Monitoring (PAM) is not considered to be necessary as there is very low, if any risk, of injury occurring due to the very low number of cetaceans recorded in the area and the very localised extent noise capable of causing the onset of PTS is predicted to occur, which as a worst-case is predicted to be within 30 m of the sound source. Furthermore, the use of a soft start and the physical presence of the vessel will further reduce the risk of any physical injury to virtually zero.

7.4 Use of USBLs in Positioning

225. At all times the USBL will be operated below 190 db (peak) and therefore below levels at which sound could cause permanent auditory injury in all EPS.

226. Mitigation measures to reduce the risk of disturbance include ensuring that the USBL is operated at the lowest potential sound levels and over the shortest period of time. Where USBLs are used in surveys, the surveys will always be undertaken within as localised area as possible. This will reduce the potential extent and duration of any possible disturbance. If practical, the equipment will be started at a lower level and ramped up over a period of time until operating at levels suitable for its purpose. This will allow any marine mammals within the potential range at which disturbance could occur to swim away.

7.5 Vessel Activity during Construction

227. Indicative transit routes to site from key construction and operation ports have been defined. These defined routes will be used wherever possible by Project vessels, limiting the extent of impacts.

8 Cumulative Impacts

228. Within the Firth of Forth and Tay region there are a number of consented wind farms (Inch Cape and Seagreen) that could theoretically cause a cumulative impact. Whilst it is known from information presented within the project Environmental Statements that there is potential for project related activates capable of causing disturbance to occur during the proposed NnGOWL construction period, the precise timing of these activities is not known

229. Other activities that have been identified as having the potential for a cumulative impact between May 2020 and March 2023 are presented in Table 8-1. These include noise arising from construction at the Moray East wind farm, Aberdeen Harbour Expansion and construction related activities at NnG.

Table 8-1: Projects with potential for causing cumulative impacts on EPS

Licensed activities	Completion date	Sound sources	Estimated impact
Moray East Offshore Wind Farm Construction	Ending June 2020	Pile-driving completed Jacket and turbine installation, cable laying	Mitigation in place will ensure no risk of permanent auditory injury. Potential for cumulative disturbance impacts.
NnGOWL UXO clearance	March 2020 – July 2020	Explosive detonation	Mitigation in place will ensure no risk of permanent auditory injury. Potential for cumulative disturbance impacts between May and July 2020
NnGOWL Seabed Preparation	November 2019 – June 2021 (9-month discontinuous duration during this period)	Up to five USBL	Very localised, if any.
Aberdeen Harbour Expansion Project	Ending after May 2020	Drilling, Dredging, Rock-blasting, ADD	Drilling noise may have a very localised impact within 100 m from activities. Dredging noise may have a localised area of impact with the onset of PTS within tens of metres and displacement within *c.*500 m Rock blasting potential for wider area of impact. Double bubble curtain in place may significantly reduce the area of PTS to within the harbour works area. Potential for wider area of disturbance. ADD area of displacement potentially up to *c.*7.5 km.
Potential activities			
Seagreen Offshore Wind Farm – Construction	Unknown	Installation of foundations,	Suction bucket foundations and therefore limited, if any, pile-driving.

Licensed activities	Completion date	Sound sources	Estimated impact
		Array cable Installation, Wind turbine installation, UXO clearance, Geophysical surveys	UXO clearance likely but unknown when or how much UXO will be located. Geophysical surveys using typical equipment will be undertaken. Not known when or where.
Inch Cape Offshore Wind Farm	Unknown	Installation of foundations, Array cable Installation, Wind turbine installation, UXO clearance, Geophysical surveys	Piled foundations. UXO clearance likely but unknown when or how much UXO will be located. Geophysical surveys using typical equipment will be undertaken. Not known when or where.
Moray West Offshore Wind Farm	Unknown		

230. There is potential for cumulative disturbance impacts to arise with construction activates from other offshore wind farms, although when these will be undertaken are unknown.

231. The Seagreen Offshore Wind farm has a Contract for Difference (CfD) and it is therefore likely that there will be some wind farm related works undertaken during the NnG construction period. Offshore construction is planned to commence in Q1 2021 with the installation of the turbine foundations and export cable in Q2 and Q3 2021. Installation is to be completed by Q3/Q4 2023. However, the exact timing and nature of the actives are unknown. Turbine foundations for the planned Seagreen development will be suction buckets and therefore there will be no pile-driving during the installation of these foundations. Other activities will be similar to those that have been or are being undertaken at NnG. These include clearance of UXO and geophysical surveys using side-scan sonar, multi-beam echosounders and sub-bottom profilers. As previously discussed, such equipment are either inaudible to EPS or, in the case of sub-bottom profilers, have a very localised area of impact. Similarly, USBL will be widely used pre, during and post-construction. USBL also has a very localised area of effect.

232. Based on the assumption that mitigation will be in place, which is similar to that being undertaken at NnG, no EPS will be at risk of injury from activities undertaken by Seagreen. There will be a level of disturbance which could be cumulative if undertaken at the same time as NnG construction activities. However, due to the localised and temporary nature of the disturbance from the planned activities and the relatively low numbers of EPS predicted to be disturbed the cumulative impacts are predicted to be very small compared with Management Unit populations. The potential exception is disturbance from UXO clearance which may occur over a wider area depending on the size of UXO identified at Seagreen. The timing of UXO clearance at Seagreen is not known but likely to be around Q1 2021 and therefore after the UXO clearance at NnG and possible over the same period as the drilling of the wind turbine foundations is being undertaken or possible cable laying activities. Consequently, cumulative disturbance impacts will be minimised.

233. The Inch Cape offshore wind farm does not have a CfD and is therefore unlikely to start any construction activities over the same period as NnG is being constructed. There is significant uncertainty over the project schedule. UXO clearance could be undertaken sometime between Q2 2021 and Q2 2022 and the installation of wind turbine foundations and the wind turbines between Q3 2021 and 2023. There is no information as to when any geophysical surveys may be undertaken. There is potential for some activities relating to Inch Cape to be undertaken at the same time as both NnG and Seagreen are under construction. There is considerable uncertainty if or when such activities will be undertaken and they will all be subject to EPS licences at the time which would include cumulative impact assessments based on information for which there will be a much greater degree of certainty. Activities that could be being undertaken that could cause a cumulative impact include the installation of the turbines and cables, including trenching and rock dumping. Noise generated from these activities is primarily from vessels undertaking the activities. Vessel noise will be localised and not overlap with activities at Inch Cape and therefore there will be no overlapping cumulative impacts with a localised area of disturbance at NnG impacting on a relatively small number of EPS up until the end of construction by NnG in Q3 2022.

234. Pile-driving being undertaken at the Moray East Offshore Wind Farm will be completed prior to the start of any construction works and therefore cumulative impacts will be limited, primarily to localised construction vessel noise.

235. The Moray West Offshore Wind Farm does not have a CfD and there is no published information on likely construction dates. Although there is potential for activities to be undertaken during the period construction is being undertaken at NnG, it is not known what or when such activities will take place and therefore it is not possible to undertake a cumulative impact assessment. However, it is noted that any future activities being undertaken by Moray West Offshore Wind Farm that require an EPS licence will have to assess the potential cumulative effects which will have a high degree of confidence in the conclusions.

236. The NnGOWL Seabed Preparation works will be ongoing at the time of the start of construction period. However, the only equipment being used during this survey that has potential to impact on marine mammals is Ultra Short Baseline (USBL) which are operated at levels below which the onset of PTS is predicted to occur and predicted to have a very localised area of disturbance.

237. There is potential for cumulative impacts to arise from the construction of Aberdeen Harbour (The Aberdeen Harbour Expansion Project (AHEP)). Activities capable of causing cumulative impact include dredging, drilling and rock blasting. The potential impacts from dredging and drilling are predicted to be very localised and be largely within the area of works. The impacts from rock-blasting will, if it occurs, have a wider area of impact. However, currently rock-blasting has been very limited in its nature and the future use of it for AHEP may also be limited. Mitigation measures in place include the use of a double bubble curtain and an ADD which ensure that there is a very low risk of any cetaceans being at risk of the onset of PTS. In the event that rock-blasting does occur any disturbance impacts will be temporary and due to the presence of a double bubble curtain predicted to be localised.

9 Conclusion

238. It is recognised that there are a range of activities associated with the construction of the Project that are capable of causing either auditory injury or disturbance to EPS and therefore an EPS licence is required.

239. There is potential for pile-driving to cause the onset of PTS over a very localised area, however, ADD use will reduce the potential for injury. During pile driving it is proposed that the following steps are implemented to minimise the risk of injury to marine mammals within PTS range:

- Optimised hammer energies;
- Deployment of Acoustic Deterrent Devices (ADDs); and;
- Incorporation of a soft-start.

240. Additionally, the presence of construction vessels in the wind farm area will reduce the risk of any EPS being within range at which the onset of PTS is predicted to occur. With the above agreed mitigation measures, it will be ensured that no EPS will suffer auditory injury.

241. Only one foundation location is predicted to require pile-driving, as the majority will be installed using a drill-only method.

242. All other activities planned to be undertaken during construction will not cause auditory injury but the following could cause localised and temporary areas of disturbance;

- Geophysical surveys
- Vessel and equipment positioning; and,
- Vessel activity.

243. The levels of sound reported from pile drilling and HDD are below that which would be predicted to cause either PTS or TTS and although audible to EPS, studies indicate no adverse behavioural response to drilling noise. Similarly, it is concluded that there is no significant risk to EPS individuals or populations from the activity of cable laying and burial and rock placement.

244. The construction of the Project will not impact on the favourable conservation status of any European Protected Species. A relatively small number of cetaceans may be disturbed by a range of activities but any disturbance impacts will be temporary with behaviour returning to normal once the activity is ceased.

245. There is potential for cumulative impacts to arise from a number of different sources, although there is significant uncertainty when these may arise. Based on current and likely future activities and the predicted level of impact, along with the potential mitigation that will be in place, the level of cumulative disturbance is predicted to be relatively small. There will be a cumulative disturbance impact that will occur over a period of time. However, the impacts arising from disturbance from each activity will be temporary and there will be no impact on the favourable conservation status of any European Protected Species.

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