Environmental Impact Assessment Report
Volume 4: Outline Piling Strategy

MarramWind Offshore Wind Farm

December 2025

MarramWind

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1. Introduction

1.1 Overview

1.1.1.1 This Outline Piling Strategy has been produced along with the Environmental Impact Assessment (EIA) Report for the MarramWind Offshore Wind Farm Project (hereafter referred to as 'the Project').

1.1.1.2 The Project has both offshore and onshore infrastructure components. However, this Outline Piling Strategy relates solely to piling activities in the marine environment and therefore this document is focused on the offshore components of the Project and does not provide any information regarding the Project's onshore components.

1.1.1.3 The Outline Piling Strategy outlines the approach and detail around piling activities associated with the mooring and anchoring system, offshore substation platforms / reactive compensation platforms (RCPs) and subsea foundations, where applicable, ensuring environmental compliance and minimising impacts on marine receptors.

1.1.1.4 The Outline Piling Strategy is related to the mitigation measure M-105 of **Volume 3, Appendix 5.2: Commitments Register**.

1.2 Project background

1.2.1.1 MarramWind Limited is wholly owned by ScottishPower Renewables UK Limited (SPR).

1.2.1.2 MarramWind Offshore Wind Farm is a proposed floating wind farm located in the North Sea, with a grid connection capacity of up to 3 gigawatts (GW). The location of the Project is determined by the Option Area Agreement (OAA), which is the spatial boundary of the Northeast 7 (NE7) Plan Option within which the electricity generating infrastructure will be located. The NE7 Plan Option is located north-east of Rattray Head on the Aberdeenshire coast in north-east Scotland, approximately 75 kilometres (km) at its nearest point to shore and 110km at its furthest point. An Option to Lease Agreement (OLA) for the Project within the NE7 Plan Option was signed in April 2022.

1.2.1.3 A summary of the Project is provided in **Volume 1, Chapter 1: Introduction** and a comprehensive description of the Project is provided in **Volume 1, Chapter 4: Project Description.**

1.2.1.4 In March 2024, National Grid Electricity System Operator Limited published the Beyond 2030 report, which presented the ScotWind elements of the Holistic Network Design Follow Up Exercise. This report confirmed that the full 3GW connection for the Project will be connected to the Scottish and Southern Electricity Networks (SSEN) Netherton Hub at Longside, to the west of Peterhead.

1.2.1.5 The Project's offshore infrastructure, located seaward of Mean High Water Springs (MHWS), may include the following:

- wind turbine generators (WTGs), including floating units (platforms and station keeping system);
- array cables;
- subsea distribution centres;
- subsea substations;
- offshore substations;

- RCPs (if required); and
- offshore export cables to connect the wind farm area to the landfall(s).

1.2.1.6 The EIA Report accompanies applications for offshore consents, licences and permissions for the Project to Marine Directorate - Licensing Operations Team (MD-LOT) under s.36 of the Electricity Act 1989, the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009, for the offshore infrastructure seaward of MHWS.

1.2.1.7 The EIA Report also accompanies an application to Aberdeenshire Council for Planning Permission in Principle consent under The Town and Country Planning (Scotland) Act 1997, for the onshore infrastructure landward Mean Low Water Springs (MLWS).

1.2.1.8 There are four sets of EIA regulations applicable to the Project: the Electricity Works (EIA) (Scotland) Regulations 2017 for offshore generating stations requiring s.36 consent; the Marine Works (EIA) (Scotland) Regulations 2017 and the Marine Works (EIA) Regulations 2007 for marine licence applications within Scottish territorial waters (0-12 nautical miles) and offshore waters (12-200 nautical miles) respectively; and the Town and Country Planning (EIA) (Scotland) Regulations 2017 for planning applications submitted to Aberdeenshire Council for onshore infrastructure located landward of MLWS.

1.3 Purpose of the Outline Piling Strategy

1.3.1.1 The Outline Piling Strategy will form the basis of the Final Piling Strategy. The Final Piling Strategy will be finalised and approved post-consent and approved as part of condition discharge prior to construction by Scottish Ministers in accordance with s.36 and associated marine licences.

1.3.1.2 The broad objectives of the Outline Piling Strategy are as follows:

- To provide key information on the piling activities, such as anticipated timing, location duration and maximum hammer energy to be used associated with the installation of key components for the offshore infrastructure, namely:
  - anchors (driven piles where necessary only);
  - offshore substation foundations within the Option Agreement Area (OAA); and
  - RCP(s) that may be within the offshore export cable corridor, typically between 40–60% of the total length from an offshore substation within the OAA to the onshore substations.
- to provide information on the mitigation measures which will be applied during the piling process and any monitoring proposed in relation to underwater noise from piling;
- to provide assurance to regulators that adequate mechanisms are in place to implement any relevant conditions; and
- to provide a framework for compliance auditing and inspection to enable the Applicant to be assured that the necessary levels of environmental performance are being met.

1.3.1.3 This document will be further developed post consent, once the final design and construction methods are confirmed. This Outline Piling Strategy should also be read in conjunction **Volume 4: Outline Marine Mammal Mitigation Protocol**.

1.3.1.4 The Final Piling Strategy shall state the legislative requirements; current standards of practice and best practice measures that define the standard of construction practice adhered to by the Contractors. However, adhering to the Final Piling Strategy does not

absolve the Applicant, or its third-party Contractors or Subcontractors from complying with legislation and bylaws relevant to their construction activities.

1.4 Implementation of the Final Piling Strategy

1.4.1.1 The Final Piling Strategy will be submitted for approval to the Scottish Ministers / Licensing Authority and other stakeholders in relation to monitoring compliance with the specific requirements of the relevant consent conditions.

1.4.1.2 During construction activities the Final Piling Strategy will be monitored by MarramWind Construction Manager (or equivalent), Environmental Manager (or equivalent) and MD-LOT.

1.5 Other related implementation plans

1.5.1.1 The Outline Piling Strategy and Final Piling Strategy will be developed with consideration of the content and requirements of other relevant Implementation Plans. These are set out in **Table 1.1** below with details of the linkages.

Table 1.1 Other related implementation plans to the Outline Piling Strategy / Final Piling Strategy

Implementation plan	Linkage with Piling Strategy
Outline Construction Method Statement	The **Construction Method Statement** will include: details of the commence dates, duration and phasing of key elements of construction, working areas, the construction procedures and good working practices; details of the roles and responsibilities; and details of how the construction related mitigation step proposed are to be delivered. **Volume 4: Outline Construction Method Statement** has been submitted with the application.
Marine Mammal Mitigation Protocol	The **Marine Mammal Mitigation Protocol** outlines environmental procedures for avoiding or minimising harm to marine mammals during piling activities. The Outline Piling Strategy references **Volume 4: Outline Marine Mammal Mitigation Protocol**, which has been submitted with the Application.
Project Environmental Monitoring Programme	The **Project Environmental Monitoring Programme** will set out the Applicant's commitments to monitoring the potential effects of the Project on key receptors and provide detail on how that monitoring will be delivered across all stages of the Project (pre-construction, construction, operation and maintenance and decommissioning). **Volume 4: Outline Project Environmental Monitoring Programme** has been submitted with the Application.

2. Project Envelope for Piling

2.1 Overview

2.1.1.1 As per **paragraph 1.2.1.5** the Project is a floating offshore wind farm. The Project will utilise floating units, on which the WTGs will be mounted that will be anchored to the seabed using a dedicated “station keeping system”. The station keeping system consists primarily of mooring lines and seabed anchors, that may involve driven piles, suction caissons or drag embedment anchors. This document addresses the driven piles only.

2.1.1.2 In addition, offshore substations will be installed to collect and transmit the electricity generated from the WTGs, via the array cables. The offshore substations, including any RCPs required will typically consist of a foundation and topsides. In addition, subsea substations are being considered. Securing of the foundation / subsea structure may involve driven piles or suction caissons. This document will address the driven piles only.

2.1.1.3 The Project design envelope is described in **Volume 1, Chapter 4: Project description** and the noise propagation from driven piles is considered within **Volume 3, Appendix 8.1: Underwater Noise Modelling Assessment**.

2.2 Project design envelope refinement

2.2.1.1 A characterisation geophysical survey and a characterisation geotechnical survey have been undertaken across the full site with seabed cone penetrometer tests. The survey for deeper bore holes is still to be undertaken and will be undertaken post consent, but pre-construction.

2.2.1.2 As the design progresses the characterisation survey data alongside additional geotechnical surveys to be undertaken, will be used to inform and refine the Project parameters. One of the factors that is taken into account during the final WTG layout is the seabed conditions, with a view to site anchors out with areas that necessitate driven piling, where possible. It is therefore considered that the analysis undertaken to date is conservative, but difficult to refine at this time without further surveys/anchor design. The refinement for anchors will be undertaken during Concept Engineering and Front End Engineering Design (FEED) phases of the Project.

2.2.1.3 For the substations themselves, the deep bore hole survey has not been undertaken, as noted above, however based on knowledge of the Central North Sea it is expected that driven piles are likely to be required. The maximum number of driven piles per platform will also be refined, noting that the maximum number of 12 per foundation is more applicable for a larger high voltage direct current offshore substation, so it is probable that the total number of driven piles could reduce (and be more akin to 4 to 8 per foundation for the high voltage alternating current substation). The design refinement will occur during the FEED and detailed design phases of the Project.

2.2.1.4 As the Project is to be built out in phases, the Piling Strategy will be updated at each project phase as the design and more detailed site survey data become available relevant to that phase. As part of this refinement, more detail will be provided on items such as type of hammer, e.g. impact hammer or vibro hammer, maximum hammer energy, duration of piling and any necessary mitigation methods.

3. Pile Installation Methodology and Pile Noise Mitigation

3.1 Overview of piling installation methodology

3.1.1.1 The driven pile anchors and the driven piles for the offshore substation and RCP jacket foundations will typically be installed from a large construction vessel/anchor handling vessel. The same vessel will typically perform the piling operations, maintaining station using dynamic positioning.

3.1.1.2 Pre-installation activities will either be conducted from a survey vessel, with remotely operated vehicle, or from the construction vessel. It is not anticipated that any seabed preparation will be required, as any debris, boulder, and unexploded ordinance clearance will have been conducted as part of the pre-construction activities.

3.1.1.3 It is expected that the driven piles will be driven into the seabed.

3.1.1.4 For the anchors, a single driven pile is expected to be utilised where a pile is necessary. However, it may be that several smaller driven piles are installed instead of one single larger driven pile. This will be determined during the anchor FEED / detailed design stages.

3.1.1.5 Where driven piles are necessary for the offshore substation or RCP jacket foundations there are two methods that can be used to install the piles, namely pre-installation of piles using a pile installation frame (PIF), or post-installation of piles through the jacket legs.

3.1.1.6 The most common and therefore expected method for installation is that the foundation is installed first and temporarily secured on the seabed. The piles are then driven through the sleeves (also called pile guides) in the jacket legs.

3.1.1.7 Alternatively, a PIF is temporarily placed on the seabed. The piles are driven through the frame into the seabed before the jacket is installed. The jacket is then lowered over the pre-installed piles and grouted connections are made between the jacket legs and the piles. This method is often used where greater precision is required.

3.1.1.8 After pile driving, grouting or mechanical connections are used to secure the piles to the jacket. The structure is levelled, and secure and topside installation can proceed.

3.1.1.9 When a pile is over boarded and placed in position the pile will settle into the surface sediments. The piles will be driven into the seabed to the desired depth using a suitable hammer.

3.1.1.10 Where applicable, the PIF will be recovered once measurements have confirmed all piles have been driven to the required depth.

3.2 Mitigation of piling noise

3.2.1 Overview

3.2.1.1 The project will review the piling noise and apply mitigation measures if necessary. The primary aim of the mitigation is as follows:

- reducing the risk of instantaneous mortality and injury to marine mammals to negligible levels; and
- reduce the exposure to and / or the effects of underwater noise on fish species.

3.2.1.2 An Outline Marine Mammal Mitigation Protocol (MMMP) has been developed as part of the EIA. Full details of the Outline MMMP can be found in **Volume 4: Outline Marine Mammal Mitigation Protocol.** This Section briefly outlines the piling mitigation measures which are provided in **Volume 3, Appendix 5.2: Commitments Register of the EIA Report.**

3.2.2 Pre-piling search

3.2.2.1 Prior to commencing piling marine mammal observers will conduct a pre-piling search of the mitigation zone for a minimum of 30 minutes. The size of the mitigation zone will be determined by predictions from underwater noise modelling, in agreement with the regulatory authority, but will be a minimum radius of 500m from the piling location in accordance with Joint Nature Conservation Committee (JNCC) (JNCC, 2010).

3.2.2.2 Passive Acoustic Monitoring may also be used to supplement or replace visual observations when visibility is poor (e.g. in darkness or, inclement weather, or at higher sea states) and where used will be in accordance with JNCC guidance (JNCC, 2023) to minimise the risk of injury to marine mammals from offshore activities. See **Volume 4: Outline Marine Mammal Mitigation Protocol**.

3.2.2.3 In the event of a marine mammal detection within the mitigation zone during the pre-piling search, the 'soft-start' (see **Section 3.2.3**) will be delayed for a minimum of 20 minutes after the last visual or acoustic detection to ensure any marine mammals have left the area before commencement of piling.

3.2.3 Soft-start

3.2.3.1 A 'soft-start' process will be undertaken before ramping up to the required hammer energy to maintain a steady rate of penetration while minimising damage to the hammer or pile.

3.2.3.2 A pile hammer soft-start is a procedure to mitigate the potential for injury or fatality to fish and marine mammals in the immediate vicinity of the pile. The process has the effect of producing lower noise levels and more intermittent pulses at the start, with the intention of allowing marine mammals time to move away from the noise source and may also deter hearing-sensitive fish species from the impact zone, before hammer energies reach levels that could cause injury.

3.2.3.3 During the mitigation soft-start the piling must remain below 500 kilojoule (kJ) for a minimum of 20 minutes, in accordance with the JNCC mitigation guidelines (JNCC, 2010).

3.2.4 Ramp-up to full power

3.2.4.1 A low energy value will be used to commence piling and will be adjusted in stages to maintain a steady rate of pile penetration.

3.2.4.2 Where necessary, the hammer energy will gradually increase to a maximum of 3,500kJ.

3.2.4.3 The table below demonstrates a "worst-case" ramp-up used for the impact piling modelling.

Table 3.1 Summary of the soft start and ramp up used for the impact piling modelling

Impact piling	9% (320kJ)	14% (490kJ)	18% (630kJ)	38% (1330kJ)	62% (2170kJ)	76% (2660kJ)	81% (2835kJ)	100% (3500kJ)

No. of strikes	180	180	180	150	180	150	2331	150
Duration	30 minutes	6 minutes	6 minutes	5 minutes	6 minutes	5 minutes	~78 minutes	5 minutes
Strike rate (bl/min)	6	30	30	30	30	30	30	30
3,501 strikes over 2 hours 20minutes 42 seconds per pile. 7,002 strikes over 4 hours 41 minutes 24 seconds for two sequentially installed piles.								

3.2.4.4 The final details will be determined during the FEED / detailed design phases of the Project. **Table 3.1** will be updated in the Final Piling Strategy with the refined values.

3.2.4.5 While the maximum hammer energy will be 3,500kJ, at each location pile installation will be completed at the lowest practicable hammer energy for the relevant phase of the work, in order to minimise pile and hammer fatigue and minimise the impact zones of injury to marine mammals and fish.

3.2.4.6 Piling will be undertaken until pile refusal, or the target penetration depth is reached.

3.2.4.7 If premature pile refusal occurs, the internal pile plug may be drilled out and a short drill-ahead undertaken. The purpose of this drilling is to reduce installation resistance so that piling can recommence. If refusal occurs once again, the same drill-out and drill-ahead process may need to be repeated until the target penetration is reached.

3.3 Piling assumptions for EIA modelling

3.3.1.1 The piling locations will be determined during the FEED phase of the Project when the anchor layout is finalised, and the substation locations are confirmed.

3.3.1.2 For the purposes of the EIA the worst-case scenarios have been modelled taking into account different water depths and proximity to other wind farms.

3.3.1.3 It is also assumed as a worst case that two piling activities could be undertaken at the same time, namely piling of a substation and piling of an anchor. In addition, a scenario has been considered whereby there is one piling operation within the Red Line Boundary, but additional piling being undertaken at a neighbouring wind farm. The aim of this is to understand the cumulative effect and take any findings into account.

3.3.1.4 For further details on modelling, refer to **Volume 3, Appendix 8.1**.

4. References

Joint Nature Conservation Committee (JNCC), (2010). *Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise*. JNCC, Aberdeen. [online] Available at: https://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf . [Accessed on: 05 August 2025].

Joint Nature Conservation Committee (JNCC), (2023). *JNCC guidance for the use of Passive Acoustic Monitoring in UK waters for minimising the risk of injury to marine mammals from offshore activities. JNCC, Peterborough*. [online] Available at: https://data.jncc.gov.uk/data/fb7d345b-ec24-4c60-aba2-894e50375e33/jncc-pam-guidance-in-uk-waters.pdf . [Accessed on: 05 August 2025].

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5. Glossary of Terms and Abbreviations

5.1 Abbreviations

Acronym	Definition
EIA	Environmental Impact Assessment
FEED	Front End Engineering Design
GW	Gigawatts
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
JNCC	Joint Nature Conservation Committee
kJ	kilojoule
MD-LOT	Marine Directorate – Licensing Operations Team
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMMP	Marine Mammal Mitigation Protocol
OAA	Option Agreement Area
PIF	Pile Installation Frame
RCP	Reactive Compensation Platform
s.36	Section 36
SPR	ScottishPower Renewables UK Limited
WTG	Wind Turbine Generator

5.2 Glossary of terms

Term	Definition
Cone penetrometer	A tool for testing shear strength and other physical properties of soils and sediments.
Crown Estate Scotland	The public corporation of the Scottish government that is responsible for the management of land and property in Scotland, as owned by the monarch "*in right of the Crown*".
Dynamic positioning	A computer-operated vessel positioning system that uses a set of thrusters to maintain position against oceanographic conditions such as waves and currents. Dynamic positioning is typically used in deeper waters where anchoring is less suitable.
Front End Engineering Design	An early design stage of a capital project that specifies technical requirements and investment costs prior to the detailed engineering design stage.
Marine Directorate-Licensing Operations Teams	Formerly known as Marine Scotland- Licensing operations Team, MD-LOT is the regulator for determining marine licence applications on behalf of the Scottish Ministers in the Scotland inshore region (between 0 and 12 nautical miles) under the marine (Scotland) Act 2010, and in the Scottish offshore region (between 12 and 200 nautical miles) under Marine and Coastal Access Act 2009.
Marine licence	Licence required for certain activities in the marine environment and granted under either the Marine and Coastal Access Act 2009 or the Marine (Scotland) Act 2010.
MarramWind Limited ('the Applicant')	A company wholly owned by ScottishPower Renewables UK Limited (SPR).
Offshore	Pertaining to the seaward side of the MLWS, and typically in reference to locations some distance from the coast.
Offshore Wind Farm	An offshore wind farm is a group of wind turbines generators in the same location (offshore) in the sea, which are used to produce electricity.
Onshore	Pertaining to the landward side of MHWS.

Term	Definition
Passive Acoustic Monitoring	A technique involving the deployment of hydrophone (underwater microphones) to listen for a record marine mammal (or other) vocalisations.
Planning Permission in Principle	Planning Permission in Principle is a type of planning application that allows a proposal to be assessed without requiring detailed plans of the layout, design, or finish of any buildings. It is typically used for larger developments, such as residential projects, where the specifics can be determined later.
Soft-start	Also known as ramp up, whereby pile driving commences at a low energy level and gradually increases over a specified time period to reach the maximum energy level required. The objective is to allow time for noise-sensitive species to move out of the area and consequently recue the risk of auditory injury or other distress.
Scottish Ministers	The devolved government of Scotland.

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