



The Sizewell C Project

6.3 Volume 2 Main Development Site, Chapter 22 Marine Ecology and Fisheries Appendix 22N of the Environmental Statement: Marine Mammal Mitigation Protocol - Clean Version

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EXECUTIVE SUMMARY

Level 1 control documents will either be certified under the DCO at grant or annexed to the DoO. All are secured and legally enforceable. Some Level 1 documents are compliance documents and must be complied with when certain activities are carried out. Other Level 1 documents are strategies or draft plans which set the boundaries for a subsequent Level 2 document which is required to be approved by a body or governance group. The obligations in the DCO and DoO set out the status of each Level 1 document.

This Draft Marine Mammal Mitigation Protocol is a Level 1 document which concerns the construction of the Beach Landing Facilities (BLF) as part of the Sizewell C Project.

Under Condition 40(2) of the Deemed Marine Licence in Schedule 20 of the **DCO**, prior to the commencement of impact piling associated with the BLF, a Marine Mammal Mitigation Protocol (MMMP) must be submitted to and approved by the Marine Management Organisation (MMO). The MMMP must be in general accordance with this draft MMMP.

Where further documents or details require approval, this document states which body or governance group is responsible for the approval and/or must be consulted. Any approvals by East Suffolk Council, Suffolk County Council or the Marine Management Organisation will be carried out in accordance with the procedure in Schedule 23 of the DCO. The DoO establishes the governance groups and sets out how these governance groups will run and, where appropriate, how decisions (including approvals) should be made. Any updates to these further documents or details must be approved by the same body or governance group and through the same consultation and procedure as the original document or details.

Where separate Level 1 or Level 2 control documents include measures that are relevant to the measures within this document, those measures have not been duplicated in this document, but cross-references have been included for context. Where separate legislation, consents, permits and licences are described in this document they are set out in the **Schedule of Other Consents, Licences and Agreements** (Doc Ref. 5.11).

For the purposes of this document the term ‘SZC Co.’ refers to NNB Nuclear Generation (SZC) Limited (or any other undertaker as defined by the DCO), its appointed representatives and the appointed construction contractors.

1 INTRODUCTION

1.1 Project background

1.1.1 SZC Co. proposes to construct and operate a new nuclear power station immediately to the north of the existing operational and decommissioned stations (Sizewell B and Sizewell A, respectively) at Sizewell on the Suffolk coast (Figure 1.1).

1.1.2 A draft Marine Mammal Mitigation Protocol (MMMP) was submitted as part of the original DCO submission Appendix 22N [\[APP-331\]](#) and is in fulfilment of the Deemed Marine Licence (Condition 40(2)(b)) [\[REP2-015\]](#) and Code of Construction Practice [\[APP-615\]](#).

1.1.3 Since DCO submission of the Application, further design work has been carried out which has identified that there may be potential for more material to be brought to the site by sea than is currently provided for in the original Application. As described in the ES Addendum [\[AS-181\]](#), this will be achieved by:

- enhancing the design of the Beach Landing Facility (BLF); and
- providing a new temporary Marine Bulk Import Facility (MBIF).

1.1.4 The BLF and MBIF will be used to receive large deliveries into Sizewell C by sea. The BLF will support construction of the power station by enabling delivery of abnormal indivisible loads (AILs) by sea. The primary role of the MBIF will be to receive aggregate deliveries and building materials from self-unloading vessels.

1.1.5 The BLF will be longer (approximately 100m in total length) to better align the barge deck with the platform, making deliveries safer and more efficient. It will require approximately 28 permanent piles in total.

1.1.6 The MBIF will be up to approximately 505m in length. Approximately 114 piles will be required to construct the MBIF, of which approximately 12 will be located above Mean High Water Springs (MHWS).

1.1.7 Two piles will typically be driven every three days (for each BLF) to an embedment depth of approximately 20m, with hammering typically lasting approximately one hour per pile. Piling is assumed to occur simultaneously.

1.2 Purpose of this document

1.2.1 This document outlines the monitoring and mitigation requirements for minimising the impacts on marine mammals during the construction of the BLF and MBIF. It aims to ensure, as far as practicable, that marine mammals occurring around the proposed development site are not exposed to potentially damaging levels of underwater noise during piling operations, with its primary focus on avoiding injurious impacts during piling.

1.2.2 This draft MMMP is based on the statutory advice on minimising the risk of injury to marine mammals from piling noise provided by the JNCC (2010). The protocol:

- Identifies the area known as the mitigation zone (MZ);
- Outlines the mitigation measures that will be implemented to limit potential impacts on marine mammals;
- Describes the communication plan in place to implement the mitigation measures quickly and effectively;
- Sets out the roles of the Marine Mammal Mitigation Team (MMMT) and the Designated Person (DP) in relation to piling activity (i.e., their authority in terms of pile driving activity).

1.2.3 This draft MMMP outlines the approach for mitigation to reduce the risk of permanent auditory injury to marine mammals during piling. The final MMMP will be developed in the pre-construction period and based upon best available information, latest guidance and detailed project design. The final MMMP will be developed in consultation with the Marine Management Organisation and relevant Statutory Nature Conservation Bodies (SNCBs) and, as outlined in Condition 40(2)(b) of the DCO/DML [\[REP2-015\]](#), will have to be approved by the Marine Management Organisation before piling can commence.

1.2.4 The protocol presented in the final MMMP pursuant to DML Condition 40, must be followed for all piling operations during the piling activities for construction of the BLF and MBIF in the marine environment. SZC Co. responsible for ensuring the final MMMP is implemented.

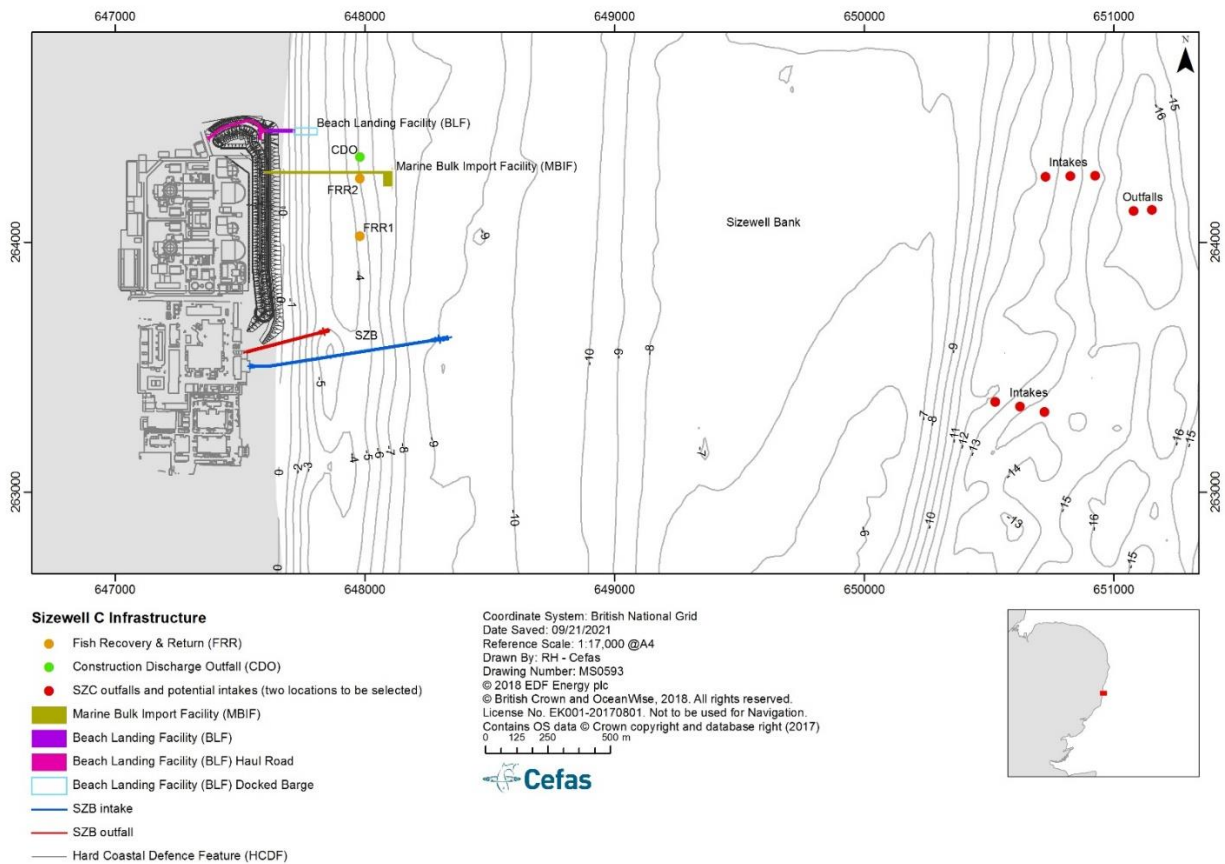


Figure 1.1: Schematic of the proposed location of development infrastructure in the marine environment with indicated locations of the BLF and MBIF. Background to pile driving and marine mammal mitigation.

1.3 Background to pile driving and marine mammal mitigation

1.3.1 Pile driving activities are performed to establish foundation support for different structures in the marine environment. Piles are driven into the seabed by means of a hydraulic hammer. The sounds from pile driving enters the water column directly because the impact of the hammer strike will create waves in the pile wall, which combine with the surrounding fluid (water) (Popper and Hastings, 2009). Furthermore, the pulse propagating down the pile may combine to the substrate at the bottom, causing waves to propagate outward through the seabed sediment (Popper and Hastings, 2009). Acoustic energy can radiate back into the water column from the seabed at some distance away from the pile (Erbe, 2012). The propagation of pile driving noise varies according to the seabed type (Hildebrand, 2009), pile characteristics (size, shape, length and material), the size and energy of the hammer, water depth, bathymetry, temperature and salinity (Erbe, 2012). Pile driving activities are of particular concern as they generate loud,

impulsive sounds, at low frequencies and high source levels (Hildebrand, 2009). Pile-driving operations have been identified as producing sufficiently high noise levels, capable of causing physical injury to marine mammals (Nedwell *et al.*, 2007).

1.3.2 The Joint Nature Conservation Committee (JNCC) ‘*Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise*’ (2010) provides guidance on mitigation measures required during pile-driving operations. As per the protocol (JNCC, 2010), the best practice for mitigating the impacts of anthropogenic sound on marine mammals includes the following mitigation options:

- Establishment of an appropriate mitigation zone around the sound source (standard is 500m), encompassing the area within which mitigation measures are applicable.
- The implementation of a soft start/ramp up procedure to build up the sound source slowly over time and permit marine mammals to leave the area prior to maximum exposure.
- The use of dedicated personnel to undertake visual and/or acoustic monitoring in order to detect marine mammals and implement a suite of real-time mitigation measures.

1.3.3 Additional measures may also be considered including interrupting noise-generating activities if marine mammals are sighted within a designated mitigation zone during the operation (JNCC, 2010), or at the planning stage by imposing constraints on when and where noise emissions are permitted due to known sensitivities (e.g., a fish spawning area during a particular period, or bird breeding season).

1.3.4 Recently, noise abatement technologies have been given more consideration. Noise abatement can be achieved by making the noise sources quieter, such as by modifying or replacing technology (e.g., alternative piling foundations or technologies) or by operational interventions (e.g., bubble curtains around pile driving operations). Available noise abatement technologies have different constraints related to water depth and oceanographic conditions (Merchant and Robinson, 2020).

1.3.5 The marine mammal mitigation measures proposed for pile-driving activities for the proposed development follow the JNCC (2010) piling protocol and latest guidelines on the abatement of underwater noise pollution from pile-driving (Merchant and Robinson, 2020).

1.4 Piling during construction

- 1.4.1 Impact piling represents the primary construction impact for marine mammals for the Sizewell C project. Construction of the BLF and MBIF requires pile driving¹. The installation and mitigation measures summarised and described in the Construction Method Statement (Appendix 3D of Volume 2 Chapter 3) and detailed within this MMMP aim to minimise potential effects.
- 1.4.2 The BLF will be located on the coast at the northern end of the sea defences (Figure 1.2). It will consist of 24 piles (12 below MHWS) and four fenders and mooring dolphins seaward of the terminus of the BLF. The total length of the BLF will be approximately 100m. Piles will be approximately 1m in diameter and embedded to a depth of approximately 29m into the seabed. Mooring dolphins and the fender will be approximately 2.5m in diameter and embedded approximately 22m into the seabed.
- 1.4.3 The MBIF will be constructed approximately 165m south of the BLF (Figure 1.2). The MBIF will consist of a trestle pier, fitted with a covered aggregate conveyor, with an unloading platform at the seaward terminus. The MBIF will be in place during the construction phase before being decommissioned. The MBIF will be approximately 505m in length and extend approximately 440m seaward of MHWS. The trestle pier will require 68 piles to be installed below MHWS. Piles will be approximately 1.2m in diameter and embedded to a depth of approximately 19m. The unloading platform will consist of 30 piles. Four mooring dolphins with a diameter of approximately 2.5m will be installed at the seaward end of the MBIF.

¹ The MBIF will be dismantled after the construction phase. The full superstructure will be dismantled from seaward working back toward land. Piles will be removed by a combination of very short duration impact piling to loosen the pile, followed by vibropiling. In a similar fashion to installation, two piles will be removed per day followed by two days to dismantle the span. Piles and dolphins that are not possible to be removed by vibropiling will be cut off below the seabed. This MMMP is designed to fulfil the construction phase associated with conditions in the Deemed Marine Licence (Condition 40(2)(b) [REP2-015] and Code of Construction Practice [APP-615], thus it does not cover the mitigation during the decommissioning phase.

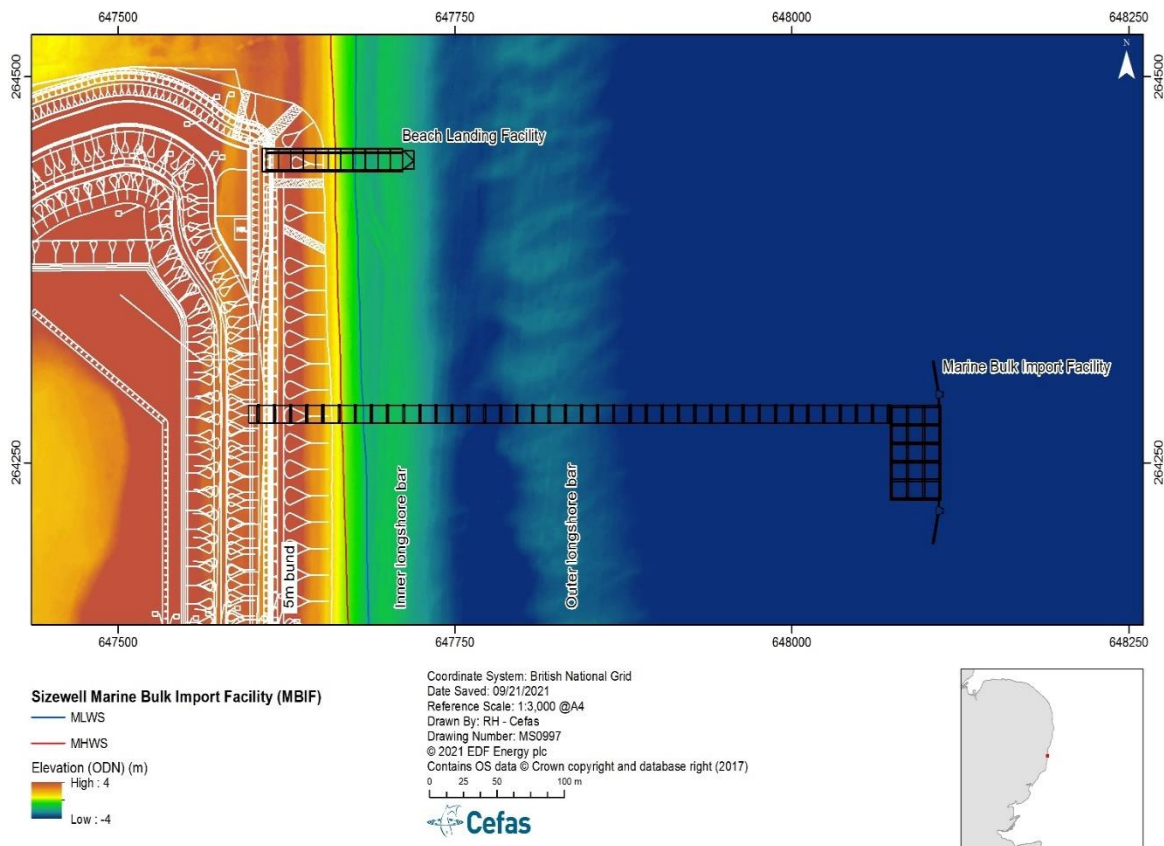


Figure 1.2: The location of the Beach Landing Facility (BLF) and Marine Bulk Import Facility (MBIF) showing the pile locations relative to local bathymetry.

1.4.4 Impact piling to install piles is anticipated to require 120kJ hammer energies. Installation of mooring dolphins is anticipated to require 280kJ hammer energies. Where technically practicable, noise reduction systems are proposed in the Construction Method Statement (Appendix 3D of Volume 2 Chapter 3). The noise reduction as a result of changes to the hammer employed and will be implemented through the use of measures such as a hydrohammer that has hydraulic plungers filled with water designed to dampen the impact and reduce the source noise of impact piling. For the purposes of this MMMP the application of a hydrohammer is included as part of the suite of piling mitigation measures that also includes marine mammal observers, soft start procedures and seasonal piling restrictions, detailed in Section **Error! Reference source not found.**

1.4.5 Construction of the BLF will require the use of land based/shallow water plant and/or jack-up barges to install the piles. Up to two piles will be installed per day followed by laying of the platform.

- 1.4.6 In the case of the MBIF, a Cantitravel system will be used (where the piles are installed from landward and the crane/plant advances seaward across the newly installed piles and platform). Up to two piles may be installed per day for the trestle and three piles per day may be installed during the installation of the unloading platform. A maximum of two mooring dolphins per day will be installed by a jack-up barge both for the BLF and MBIF.
- 1.4.7 Piling parameters are provided in Table 1.1 and Table 1.2.
- 1.4.8 Installation of the BLF is anticipated to last six months. Installation of the MBIF is anticipated to last nine months. Installation is assumed to start in August in year 1 for both the BLF and MBIF and be completed by April of year 2 (i.e., 2023) of the construction phase. No piling will occur in the months of May to August inclusive to minimise the potential for effects on designated breeding birds. Assuming no temporal overlap of piling activities, a total of 54 days piling will occur during this period. If piling for the BLF and MBIF occurred simultaneously, a total of 48 days of piling will be required. No consecutive piling at each BLF will occur when the mooring dolphins are installed.

Table 1.1 Piling parameters for the BLF.

Parameter	Piles	Mooring dolphins
Number (below MHWS).	12	4
Pile diameter.	1m	2.5m
Modelled depth of deepest pile (depth includes +1.4m chart datum to encompass a range of tidal conditions).	5.1m	5.1m
Hammer energy.	120kJ	280kJ
Strike rate.	44 blows / minute	44 blows / minute
Piling duration.	45 minutes (+ 20-minute ramp-up)	45 minutes (+ 20-minute ramp-up)
Acoustic conversion efficiency.	0.5%	1%
Maximum piles installed in 24-hour period.	2	2
Minimum piling interval (worst-case).	15 minutes	15 minutes

Table 1.2 Piling parameters for the MBIF.

Parameter	Piles	Mooring dolphins
Number (seaward of MHWS).	98 (30 unloading platform piles) (68 trestle piles).	4
Pile diameter.	1.2m	2.5m
Modelled water depth of deepest pile. (depth includes +1.4m chart datum to encompass a range of tidal conditions).	8.5m at the unloading platform at the seaward end. 5.3m within the outer longshore sand bar (trestle pier).	8.5m
Hammer energy.	120kJ	280kJ
Strike rate.	44 blows / minute.	44 blows / minute.
Piling duration.	45 minutes (+ 20-minute ramp-up).	45 minutes (+ 20-minute ramp-up).
Acoustic conversion efficiency.	0.5%	1%
Maximum piles installed in 24-hour period.	2 for trestle - (34 days of piling). 3 for the unloading platform (10 days of piling).	2 (2 days of piling).
Minimum piling interval (worst-case).	15 minutes.	15 minutes.

2 MARINE MAMMALS IN THE AREA

2.1.1 BEEMS Technical report TR324, Appendix 22E of the ES [\[APP-317\]](#) characterised the marine mammals in the area. Three species of marine mammal are known to occur in the Great Sizewell Bay (GSB). These include one cetacean species: harbour porpoise (*Phocoena phocoena*) and two pinniped species: harbour seal (also known as common seal) (*Phoca vitulina*) and grey seal (*Halichoerus grypus*). Other species of cetaceans are present in the southern North Sea, although, these species are infrequently observed within the GSB (BEEMS Technical report TR324, Appendix 22E of the ES [\[APP-317\]](#) BEEMS 2019a).

2.1.2 Effects on marine mammal receptors (including underwater noise) are considered in the Environmental Statement (ES) in Section 22.9 [\[APP-317\]](#) and in the cumulative effects assessment in Appendix 4C [\[APP-579\]](#). Effects on designated sites with marine mammal features are considered in the shadow Habitats Regulations Assessment [\[APP-145\]](#). Updated assessments for the revised marine freight management strategy are provided in Section 2.17 of the ES Addendum [\[AS-181\]](#) and detailed modelling results are provided in BEEMS Technical Report TR538 (BEEMS, 2021b) [\[REP5-124\]](#).

2.2 Harbour porpoise

2.2.1 The harbour porpoise is the only cetacean species regularly present in the GSB with the majority of acoustic detections occurring during winter months (i.e., between October and March). Their presence is more pronounced in offshore waters (10-20km from the coast) with lower detection rates in inshore waters (1-2km from the coast) (BEEMS Technical Report TR271 BEEMS, 2014).

2.2.2 The area of open sea adjacent to the eastern boundary of the proposed development is located within the Southern North Sea Special Area of Conservation (SAC) designated for the purpose of aiding the management of the Annex II² species harbour porpoise. The designated area is of high importance to harbour porpoise in both the summer and winter months. The conservation objectives of the site are to ensure that site integrity is maintained, and that it makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for harbour porpoise in UK water (JNCC & NE, 2019). In the context of natural change, this will be achieved by ensuring that:

² Annex II species require designation of SACs under the Habitat Directive (92/43/ECC).

- harbour porpoise is a viable component of the site;
- there is no significant disturbance of the species; and
- the condition of supporting habitats and processes, and the availability of prey is maintained.

2.2.3 Due to harbour porpoise sensitivity to anthropogenic noise, special attention has been given to assessing the significance of noise disturbance against the conservation objectives of the harbour porpoise SACs (JNCC, 2020). The noise disturbance within an SAC from a plan/project, individually or in combination, is considered to be significant if it excludes harbour porpoises from more than:

- 20% of the relevant area³ of the site in any given day; or
- an average of 10% of the relevant area of the site over a season.

2.2.4 The guidance therefore recommends that ‘significant disturbance’⁴ should be interpreted as a reduction of the range of the species within the site or a reduction in the access to available habitat within the site, not changes in species abundance in the site. This is due to the fact that harbour porpoises are highly mobile and wide-ranging thus density and abundance both within and outside the sites vary considerably by season and year (JNCC, 2020).

2.3 Harbour seal

2.3.1 The harbour seal is found around the UK coast but is more widespread around the west coast than in the North Sea. The nearest sites of relevance to the proposed development area are The Wash and North Norfolk Coast Special Area of Conservation (SAC) (harbour seal is an Annex II species and the primary reason for selection of this site) to the north and the Thames Estuary to the south. Tagging studies have revealed that harbour seals do transit along the coastline between the Thames and north Norfolk (Sharples *et al.*, 2012; Barker *et al.*, 2014; Russell *et al.*, 2017) suggesting a certain level of at-sea usage of the area close to the proposed development area. Generally, habitat use is considered to be low to moderate in the proposed development area with low haul out usage (SCOS, 2019).

³ The relevant area is defined as that part of the SAC that was designated on the basis of higher persistent densities for that season (summer defined as April to September inclusive, winter as October to March inclusive).

⁴ The results of underwater noise modelling and Cumulative Ecology Assessment (CEA) show that there is no significant disturbance from this project alone or in-combination with other plans/projects (Appendix 4C of [APP-579]).

2.4 Grey seal

- 2.4.1 Previous surveys conducted in the wider area suggest that grey seals are present reasonably regularly around the proposed development area (Kowalik *et al*, 2008; Galloper Wind Farm Limited, 2011; Fugro EMU, 2015). However, they do not utilise the area heavily and appear present mostly during winter and spring (Fugro EMU, 2015). The nearest SAC to the proposed development that includes grey seal as a qualifying feature is the Humber Estuary, circa 220km to the north.

3 ASSESSMENT OF POTENTIAL IMPACTS AND UNDERWATER NOISE MODELLING

3.1.1 Underwater noise modelling was undertaken to determine the potential effects of piling on marine mammals and fish (BEEMS Technical Report TR312 BEEMS, 2019b; ES Addendum BEEMS, 2021a [\[AS-181\]](#); BEEMS Technical Report TR538 BEEMS, 2021b [\[REP5-124\]](#)). For each noise generating activity, the underwater noise effects assessment presents:

- Instantaneous auditory effects – To account for exposure to a single strike. Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) thresholds are formulated using the peak sound pressure level (SPL_{peak}) and presented in linear distance.
- Cumulative (24-hour) auditory effects – To account for accumulated exposure, over the duration of the activity within a 24-hour period. PTS and TTS thresholds are formulated using the weighted cumulative sound exposure level (SEL_{cum}) and presented in area (linear distance is also provided for context).

3.1.2 For activities with the potential to occur simultaneously (i.e., piling for both the BLF and MBIF simultaneously and associated vessel traffic) the underwater noise effects assessment presents:

- Combined effects - PTS and TTS thresholds which are formulated using the weighted cumulative sound exposure level (SEL_{cum}) and presented as an area of effect (linear distance cannot be provided as there are two source locations).

3.1.3 The modelling considered the indicative piling specifications provided (as outlined in Section 1.4). Modelling was conducted with and without the use of a hydrohammer to illustrate the potential effectiveness of the mitigation measure being proposed. The results presented herein reflect the application of a hydrohammer to mitigate noise exposure (Table 3.1). Using the proposed hydrohammer reduces all the piling effect zones for marine mammals by between approximately 30 and 80% (BEEMS Technical Report TR538 [\[REP5-124\]](#); BEEMS, 2021b). Results presented in BEEMS Technical Report TR538 [\[REP5-124\]](#) includes acoustic contours displayed in GIS with a higher spatial resolution than directly generated from the model. The higher spatial resolution and subtle differences in the shape of the coastline result in minor differences in calculated area in BEEMS Technical Report TR538 [\[REP5-124\]](#); however, these have no bearing on the outcome of the assessment and the raw model outputs reported in the

ES Addendum [\[AS-181\]](#) and below in Tables 3.1 and 3.2 are typically larger, therefore marginally more precautionary.

- 3.1.4 The low energy impact piling is predicted to result in no instantaneous TTS and permanent hearing damage (PTS) for harbour porpoise or seals outside the standard 500m mitigation zone at the onset of piling in any of the modelled scenarios (BEEMS Technical Report TR538 BEEMS, 2021b [\[REP5-124\]](#)). As such instantaneous impacts from piling are considered minimal. Therefore, compliance with standard mitigation procedures is predicted to be effective in negating the risk of instantaneous auditory damage in marine mammals.
- 3.1.5 Cumulative (24-hour) exposure assessments incorporated fleeing behaviours, which assume that marine mammals will flee from the source location at the onset of piling. Cumulative sound exposure was predicted for pile driving two consecutive piles within 24-hours using 120kJ and 280kJ hammer energy for piles and mooring dolphins, respectively. No cumulative (24h) auditory effect zones were predicted for seal species. For harbour porpoise no PTS was predicted and the largest TTS effect zones (associated with the mooring dolphins) were predicted to occur within 5,230ha for the BLF and 3,734ha for the MBIF (BEEMS Technical Report TR538 BEEMS, 2021b [\[REP5-124\]](#)).
- 3.1.6 An additional scenario was modelled whereby piling occurs at both the BLF and MBIF simultaneously, the results of the fleeing model show that there will be no PTS for harbour porpoise or seals. The largest TTS effect zones were predicted to occur within 128ha for harbour porpoise using a noise reduction system on the hammer (i.e., a hydrohammer) (Table 3.2). Simultaneous piling will only occur with piles (not mooring dolphins). Therefore, the auditory effect zones in the simultaneous piling scenario are smaller than in the case of the mooring dolphins for the individual BLF scenarios which require a larger hammer energy. There is no PTS predicted in the cumulative assessment for marine mammals in response to piling.
- 3.1.7 SZC Co. conducted an assessment of potential impacts of underwater noise during construction of the BLF and MBIF to marine mammals as part of the Environmental Statement (ES) (Chapter 22, Section 22.9 Marine Mammals [\[APP-317\]](#)) and Environmental Statement (ES) Addendum ([\[AS-181\]](#) BEEMS, 2021a). Considering the predicted impact ranges of the underwater noise modelling, it was concluded that the impact of increased underwater noise due to the piling activities will have a minor negative effect on marine mammals. Effects are therefore not significant and are predicted to be short-lived and return to baseline conditions after piling activity ceases.

Table 3.1 Marine mammal auditory effect zone for piling activities associated with the BLF and MBIF with a noise reduction system on the hammer (i.e., use of hydrohammer).

Piling Type		Threshold	Instantaneous		Fleeing Cumulative	
			Harbour porpoise	Phocid seals	Harbour porpoise	Phocid seals
BLF	Pile	PTS	11m	2m	0ha (<25m).	0ha (<25m).
		TTS	24m	4m	95ha (1,051m).	0ha (<25m).
	Mooring dolphin	PTS	33m	5m	0ha (25m).	0ha (<25m).
		TTS	55m	10m	1,878ha (4,589m).	0ha (<25m).
MBIF	Unloading platform pile	PTS	9m	2m	0ha (25m).	0ha (25m).
		TTS	20m	4m	90ha (774m).	0ha (25m).
	Mooring dolphin	PTS	31m	5m	0ha (25m).	0ha (25m).
		TTS	68m	8m	1,435ha (4,203m).	0ha (25m).

Table 3.2 Marine mammal auditory effect zone for piling activities associated with the BLF and MBIF occurring simultaneously. Effect zones are based on fleeing animals using a noise reduction system on the hammer (i.e., a hydrohammer).

Piling Type	Threshold	Cumulative (24 hour) fleeing	
		Harbour porpoise	Phocid seals
BLF piles (2 piles) and MBIF piles (2 piles) within the longshore bar.	PTS	0ha	0ha
	TTS	128ha	0ha

4 MARINE MAMMAL MONITORING

4.1.1 Both visual and acoustic monitoring methods are generally considered as standard mitigation tools for piling projects.

4.1.2 The efficacy of both visual and acoustic monitoring methods varies depending on the species being monitored. Visual detection of marine mammals can vary with species depending on their size, surfacing behaviour, group size and weather conditions. Species such as harbour porpoise are particularly difficult to detect visually in poorer weather conditions due to their small size and often elusive surfacing behaviour (Palka, 1996). However, harbour porpoise can be detected acoustically using passive acoustic monitoring system (PAMS) but due to the ultrasonic nature of their clicks and rapid attenuation in water, the maximum likely range of their detection is 300m in good acoustic propagation conditions and minimal background noise (Goodson and Sturtivan, 1996). Harbour and grey seals are unlikely to be detected acoustically. Therefore, it has been considered that these two monitoring techniques complement each other and enhance likelihood of detections when used in synergy.

4.1.3 For this project, however, visual monitoring is deemed as a more practical and effective monitoring method in the relatively sheltered waters with low wave heights⁵ inshore of the Sizewell-Dunwich Bank especially given the precautionary nature of the assessment, the limited instantaneous impact ranges and the logistical difficulties in deployment of an effective PAMS at the site. It has been agreed during the consultation process with Natural England that acoustic monitoring is not a practicable option for the construction of the BLF and MBIF due to the very shallow waters and thus inability to deploy the PAMS effectively.

4.2 Summary of mitigation measures

4.2.1 The following mitigation measures will be in place, as described in the Construction Method Statement (Appendix 3D of Volume 2 Chapter 3):

- Marine mammal observation – a visual inspection for local marine mammals prior to and during the piling.
- Use of a noise reduction system on the hammer, where practicable (i.e., a hydrohammer). A hydrohammer has hydraulic plungers filled with water designed to dampen the impact and reduce the source noise of impact piling.

⁵ For the decade 2008–2018, wave heights greater than 1.5m occurred 7.87% of the time (BEEMS, 2020).

- Soft start procedure (ramp-up).
- No pile driving between May and August (inclusive).

5 ROLE AND RESPONSIBILITIES

5.1 Marine Mammal Mitigation Team (MMMT)

5.1.1 The Marine Mammal Mitigation Team (MMMT) will consist of Marine Mammal Observers (referred to herein as ‘Observers’ to avoid confusion with the Marine Management Organisation). Observers will ensure that monitoring commences in good time to conduct a minimum of 30 minutes pre-piling monitoring and continue monitoring throughout the piling process for the BLF and MBIF in order to avoid unnecessary operational delays.

5.1.2 The maximum duration of each observer’s shift will be 12 hours in any 24-hour period, including time needed for reporting requirements.

5.1.3 The MMT will give briefings on the marine mammal mitigation requirements to crew members at the start-up meeting and provide continuous advice throughout the project and tool-box talks, which are required by Parts B and C of the Code of Construction Practice [\[APP-615\]](#) ([Doc Ref. 8.11\(E\)](#)) (secured pursuant to Requirement 2).

5.2 Visual monitoring

5.2.1 Visual methods using trained⁶ and experienced Observers are likely to be most effective during daylight hours, good visibility and calm (Beaufort Sea state <4) weather conditions. Therefore, visual monitoring for piling activities for both the BLF and MBIF will be conducted during daylight hours in favourable weather conditions⁷ by dedicated⁸ Observers. The Observers will be observing from a suitable vantage point⁹ allowing a clear and unobstructed view of the mitigation zone (MZ).

5.2.2 The Observers will conduct diligent observations focusing on the area around the pile scanning with the naked eye and using binoculars to focus on points of interest where required. The Observers will have field experience of detecting and identifying marine mammals in UK Continental Shelf (UKCS) waters. The Observers will be equipped with a range-finder stick for measuring the distance as well as with binoculars, digital camera and field guides to aid species identification. Additionally, the Observer will be

⁶ A trained marine mammal observer (Observer herein) is defined as one who has attended a JNCC-approved marine mammal observer course.

⁷ Weather conditions allowing a clear view of minimum 500m around the pile are considered as ‘favourable’.

⁸ A dedicated Observer is defined as one whose only role on board is to conduct visual watches for marine mammals.

⁹ The exact location of the Observer will be established once piling platform is confirmed.

provided with a VHF radio to enable clear communication with the designated person (DP).

5.2.3 The JNCC protocol provides standardised data recording forms for ‘Operations’, ‘Effort’ and ‘Sightings’¹⁰, and these will be used to record data on marine mammal monitoring carried out, the time that pile-driving operations start and cease, and any sightings observed.

5.3 Designated person

5.3.1 A designated person (DP) will be assigned who will be situated on the piling vessel and will be responsible for liaising with the MMT. The DP will have authority, based on the advice of the MMT, to delay/stop piling if it is deemed necessary in accordance with the requirements of the MMMP. The contractor responsible for piling activity will be made aware of the jurisdiction of the DP during the start-up meeting.

5.3.2 The DP will be briefed at the beginning of the project on the mitigation protocol to ensure the requirements are clear.

5.3.3 Communications between the MMT and DP will be conducted via VHF radios. The radios will be tested prior to the commencement of the survey as clear communication is essential.

¹⁰ Recording forms can be found at <http://jncc.defra.gov.uk/page-1534>

6 MITIGATION PRINCIPLES

6.1.1 The mitigation principles outlined below and described in the Construction Method Statement (Appendix 3D of Volume 2 Chapter 3) and detailed aim to minimise potential effects on marine mammals from impact piling.

6.2 Mitigation zone

6.2.1 The mitigation zone (MZ) refers to the radius around the pile-driving source where primary visual monitoring effort should be focused. This area is also the area in which mitigation procedures will be implemented if marine mammals are observed within.

6.2.2 The results of the underwater noise modelling indicate that the instantaneous impacts from piling are considered minimal (BEEMS Technical Report TR312 BEEMS, 2019b; ES Addendum BEEMS, 2021a [[IAS-181](#)]; BEEMS Technical Report TR538 BEEMS, 2021b [[REP5-124](#)]) and well within the standard MZ prescribed within the JNCC piling protocol (JNCC, 2010). Thus, the MZ for this project is established to be a precautionary 500m from the centre of the pile (Figure 6.1).

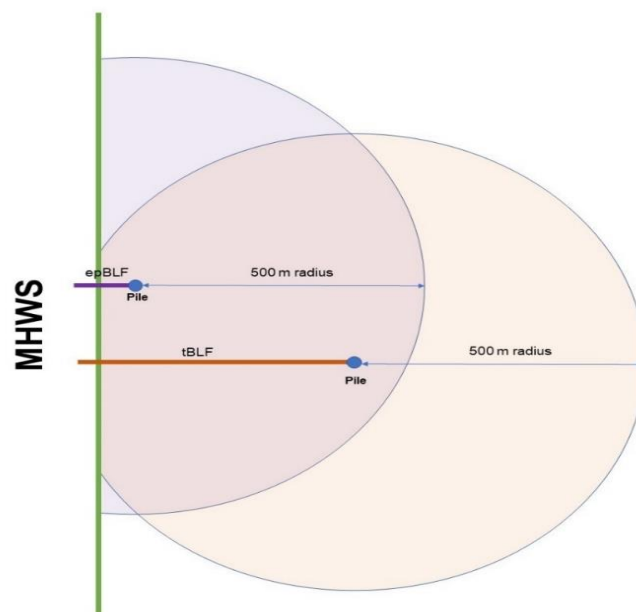


Figure 6.1 Schematic illustration of the mitigation zones for the BLF and MBIF in relation to the MHWS (please note, the pile positions were located at the furthest point from MHWS i.e., radius has been applied from the terminus of the BLF and MBIF).

6.3 Pre-piling monitoring

6.3.1 The MMTT will be notified at least one hour prior to the commencement of piling operations. Visual monitoring will be conducted for at least 30 minutes in advance of piling. At the completion of pre-piling monitoring, if no marine mammals are observed within the MZ, the MMTT will inform the DP that piling (with a soft start) can commence.

6.4 Delay procedures

6.4.1 Should marine mammal/s be observed within the MZ during the pre-piling monitoring period, the MMTT will immediately alert the DP who will then ensure that a delay of the piling occurs.

6.4.2 The piling (with a soft start) will commence only if: a) the animal(s) have left the MZ and the Observers are fully confident that they are outside of the MZ; or b) at least 20 minutes have passed since the last sighting within the MZ.

6.5 Soft start

6.5.1 Soft start is a gradual increase of hammer energy at the onset of piling. The purpose of soft start approach is to allow animals to move away from the noise source before full power is reached thus reducing the likelihood of exposing the animals to injurious sound levels.

6.5.2 If operationally practicable, a full 20-minute soft start (in line with JNCC protocol, 2010) will be undertaken for all piling events during the construction of the BLF and MBIF. However, it must be noted that the planned hammer energies during this project are expected to be 120kJ for piles and 280kJ for mooring dolphins. Such energy is lower than usual energy levels for piling of offshore windfarms reaching up to 4000kJ. It is best practice to commence soft start with 10% of the maximum hammer energy, which in this case will be 12kJ and 28kJ, respectively. If such low energy is not operationally practicable or if a gradual increase of energy throughout the full duration of soft start is not possible, then an alternative soft start method will be applied whereby there is a linear ramp-up in hammer strike rate from 1 blow per minute to full strike rate, during the first 20 minutes of piling (slow start).

6.5.3 The exact methodology will be confirmed by the piling contractor when final technical and operational capabilities are considered.

6.5.4 Each soft start or slow start will be carried out in a consistent manner and timings will be logged by the MMTT. A hammer energy report will be

produced by a piling contractor and provided to the MMMT post-piling for inclusion in the mitigation report (outlined in Section **Error! Reference source not found.**).

6.6 Marine mammals within mitigation zone during soft start

6.6.1 Marine mammal monitoring will continue throughout the soft start procedure. If a marine mammal is detected/observed within the MZ during the soft start, then the Observer will inform the DP and the power and frequency will not be further increased until: a) the animal(s) have left the MZ and the Observer is fully confident that they are outside of the MZ; or b) at least 20 minutes have passed since the last sighting within the MZ.

6.7 Breaks in piling

6.7.1 The DP will inform the MMMT immediately if breaks in pile-driving operations occur. Following a pause in pile-driving of less than 10 minutes, operations may resume immediately at required power if no marine mammals have been observed within the MZ during the time of no piling activity. However, if any marine mammals are observed during the break in piling, then piling operations may only resume following the agreed soft start procedure if: a) the animal(s) have left the MZ and the Observer is fully confident that they are outside of the MZ; or b) at least 20 minutes have passed since the last sighting within the MZ.

6.7.2 As per JNCC protocol (JNCC, 2010) pauses in pile-driving operations of more than 10 minutes in duration require full pre-piling monitoring period of 30 minutes followed by a full soft start procedure. However, if continuous monitoring has been undertaken for the previous 30 minutes, and no marine mammals have been seen within the MZ, the soft start may resume immediately as long as MMMT has given 'All clear'. If marine mammals have been observed, then the delay and soft start procedures described above will be implemented.

6.7.3 As such, the Observer will remain on watch during the entire duration of the piling operations.

6.8 Poor visibility

6.8.1 JNCC guidelines recommends that piling should not commence during periods of darkness or poor visibility (such as fog or sea state associated with Beaufort wind force 4). Therefore, piling will not occur during times of reduced visibility affecting effective observation of the entire 500m MZ.

6.9 Hydrohammer

6.9.1 A noise reduction system will be used on the hammer, where practicable (i.e., hydrohammer). This can be considered as reducing the amount of noise pollution (noise abatement), through mitigation measures (Merchant and Robinson, 2020). The hydrohammer is positioned between the piling hammer and the sleeve; two hydraulic plungers filled with water are designed to dampen the impact and reduce the source noise associated with impact piling. Hydrohammers can reduce the sound exposure levels (SEL) by 3 to 6dB and peak sound pressure levels (SPL) by 9 to 12dB.

6.10 Temporal exclusions

6.10.1 To mitigate the potential for impacts on breeding birds, no piling will occur in May to July inclusive. This period of the year also coincides with the spawning of some of the marine mammal prey species (e.g., European sprat, whiting, seabass, sand gobies, anchovies) thus this measure will mitigate the potential for indirect effects thorough avoidance of disturbance to prey species. Further to this, it is considered that implementation of the measures such as soft start (Section 6.4) could effectively mitigate the impacts of underwater noise on fish in the area (further information is provided within the underwater noise modelling report BEEMS Technical Report TR538 and ES addendum) ([\[AS-181\]](#) BEEMS, 2021b [\[REP5-124\]](#)).

7 COMMUNICATION PROTOCOL

7.1.1 The communication protocol (as outlined in Figure 7.1) will be introduced at a start-up meeting with the DP, Observers, and construction team representatives in attendance, to ensure that everyone understands the communication channels and their specific roles and responsibilities.

7.1.2 Quick and effective communications are crucial to the success of the mitigation programme. Key aspects are:

- To convey information quickly and clearly, mitigation-related communications will be between the DP and the MMMT.
- The DP and MMMT will be confident at utilising VHF radios.
- Appropriate working channels for communications will be determined prior to commencing the first pile-driving operation.
- The DP will have a clear and direct communication with the construction team.
- The DP will notify the MMMT of planned times for piling activities.
- The DP will notify the MMMT prior to commencement of piling (soft start) and request the 'All Clear' to commence operations.
- The MMMT will maintain communications with the DP throughout visual monitoring, alerting them to any marine mammal sightings.
- Once piling has commenced, the DP will notify the MMMT of any breaks in operations.
- Hammer logs (including information on the time of start of operations, time taken to reach full power, duration of the soft start, duration of piling, number of blows, energy of each blow and number of blows per minute) will be provided to the MMMT at the end of the piling operations.

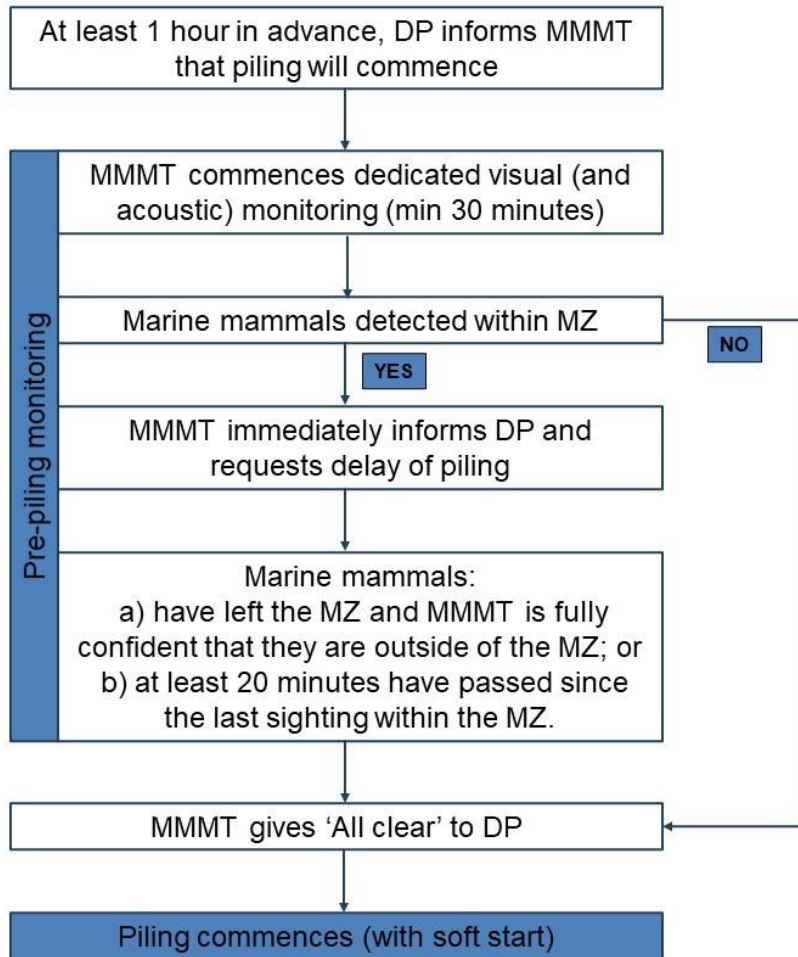


Figure 7.1 Communication and monitoring plan.

8 REPORTING

- 8.1.1 The JNCC data recording forms will be completed throughout the survey, recording details of the visual monitoring carried out, any marine mammal sightings and pile-driving operations.
- 8.1.2 The data collected will be presented within monthly interim reports and a final report upon completion of pile-driving operations. This report will detail methods, monitoring effort, weather conditions, marine mammal sightings, pile-driving events, compliance with soft-start procedures, communications, mitigation measures taken and any recommendations. The completed JNCC survey forms will be included as Appendices. The final report will be submitted within an agreed period to the client, relevant Statutory Nature Conservation Bodies (SNCBs) and the Marine Management Organisation.

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