Rampion 2 Wind Farm
Category 7:
Other Documents

In Principle Sensitive Features Mitigation Plan (~~clean~~tracked)

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E	09/07/2024	Updates at Deadline 5	GoBe	RED	RED
F	06/12/2024	Updates following Request for Additional information	GoBe	RED	RED

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Executive Summary

This In Principle Sensitive Features Mitigation Plan (hereafter referred to as the Plan) sets out the approach for the Rampion 2 Offshore Windfarm (hereafter referred to as Rampion 2) to deliver potential mitigation measures to ensure the avoidance of significant effects on sensitive features.

The approach and measures provided within this Plan are in relation to Rampion 2 only and are in response to the conclusions of the Environmental Impact Assessment (EIA). The EIA concluded that, subject to the final design of Rampion 2, further mitigation measures may be necessary in relation to the potential effects of the construction phase of the project, in order to ensure there will be no significant effects on sensitive features within the export cable corridor area or on designated features of the relevant Marine Conservation Zones (MCZ), specifically the Kingmere MCZ, the Beachy Head East and West MCZs and Selsey Bill and the Hounds MCZ.

This Plan has been produced to outline the principles and methodologies, building on the discussions undertaken under the Evidence Plan Process for Rampion 2, that will underpin the final pre-construction Sensitive Features Mitigation Plan. The Final Plan will be submitted to the Marine Management Organisation (MMO) for approval, in consultation with Natural England, during the post-consent/pre-construction phase, based on the final design of Rampion 2. At the time of writing, the mitigation measures are yet to be confirmed and, as such, this plan is considered 'in principle' until an optimised design for construction, and therefore clarity on the maximum parameters to be employed at the Proposed Development, is known. Submission of the Final Plan for agreement is secured within Condition 11 of Schedules 11 and 12 of the Rampion 2 draft Development Consent Order (DCO).

June 2024 Update: To ensure the efficacy of the proposed mitigation measures for underwater noise from piling operations, detailed in this Plan, additional work has been undertaken to provide a comparison of the environmental conditions at the Proposed Development with other projects where Noise Abatement Systems (NAS) have been deployed successfully this is provided in: **Information to support efficacy of noise mitigation / abatement techniques with respect to site conditions at Rampion 2 Offshore Windfarm [REP4-067]**. This report was produced by the Institute of Technical and Applied Physics (ITAP) who have considerable experience monitoring noise abatement measures in Germany. The outputs of this report, in particular the predicted decibel reduction that is likely to be achieved by different noise abatement measures, have been incorporated into this Plan. The outputs of the ITAP report have been used to inform the modelling of the performance of the noise abatement technologies, in the environmental conditions specific to the Proposed Development. This process ensures confidence in the efficacy of these technologies, to provide the required mitigation for noise sensitive qualifying features of the MCZs.

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1. Introduction

1.1 Purpose of this document

1.1.1 The primary aim of this Plan is to set out the approaches and process for Rampion 2 Offshore Windfarm (hereafter referred to as 'Rampion 2') to agree all works and mitigation measures associated with:

- offshore export cable installation (including seabed preparation works and cable protection); and
- piling operations in the offshore array area.

1.1.2 This Plan reflects the commitment from Rampion Extension Development Limited (RED) (the Applicant) to undertake required measures to reduce the potential for any significant disturbance on sensitive features. The Plan sets out the necessary mitigation that will be secured through the Development Consent Order (DCO), whilst allowing scope for refinement of the precise mitigation measures to be adopted once the final design and construction methods for Rampion 2 have been confirmed. This will enable the most appropriate project related measures to be confirmed, based on best knowledge, evidence and proven technology available at the time of construction.

1.1.3 The need to provide scope for refinement arises, in part, due to the range of complex interdependencies common to all offshore wind farms in the early (pre-consent) development stages. These include the selection of specific infrastructure, equipment, and collection and analysis of more detailed site engineering data, which means that design work continues up until the immediate pre-construction period. As a result, it is not possible to provide final detailed method statements for construction prior to consent and, as a result, the specific detail of required mitigation also cannot be finalised at this stage. In addition, and as discussed through the Evidence Plan Process (EPP) via Expert Topic Group (ETG) meetings, further contemporary data acquisition is required to provide confirmation on the location of certain sensitive receptors at the pre-construction stage. Key outstanding areas of uncertainty that will be addressed post-consent therefore comprise:

- The precise extent and location of sensitive features within the offshore export cable corridor. This will be informed by pre-construction surveys which will be undertaken prior to cable installation and which will, in turn, inform route design.
- The precise extent and location of geotechnical constraints. This will be informed by pre-construction geotechnical surveys prior to cable route design.
- The detailed methodologies for foundation and export cable installation, as informed by pre-construction surveys.
- The specifics of the technology available (and procured) at the time of construction.

1.1.4 It is important to note that the approach and measures listed in this Plan relate solely to Rampion 2 and address assessment outcomes from the Environmental Impact Assessment (EIA) based on the maximum design scenarios (worst-case parameters) for the Proposed Development. The assessment of maximum design scenarios concluded that further mitigation measures may be necessary to avoid significant effects on specific sensitive receptors. As the assessment outcomes are predicated on worst-case parameters, which may not be brought forward in the final design, the measures presented herein are 'in-principle'. As such, this Plan should be considered as 'in principle' until completion of the pre-construction surveys and an optimised design for construction is known.

1.1.5 The Plan will be refined and developed on the basis of the additional pre-construction data, and as the Rampion 2 project design is optimised and finalised. This will ensure the in-principle provisions set out within this Plan are appropriate and relevant to the final design, and subsequently that the mitigation measures that will be implemented are effective in avoiding significant effects as a result of Rampion 2 on sensitive features within the export cable corridor area or on designated features of the relevant MCZs, which comprise:

- Kingmere MCZ;
- Beachy Head East MCZ;
- Beachy Head West MCZ and
- Selsey Bill and the Hounds MCZ.

1.1.6 The Final Plan will be submitted pre-construction for agreement with the MMO in consultation with Natural England. Relevant information arising from the Final Plan will also be presented, as appropriate, in the following:

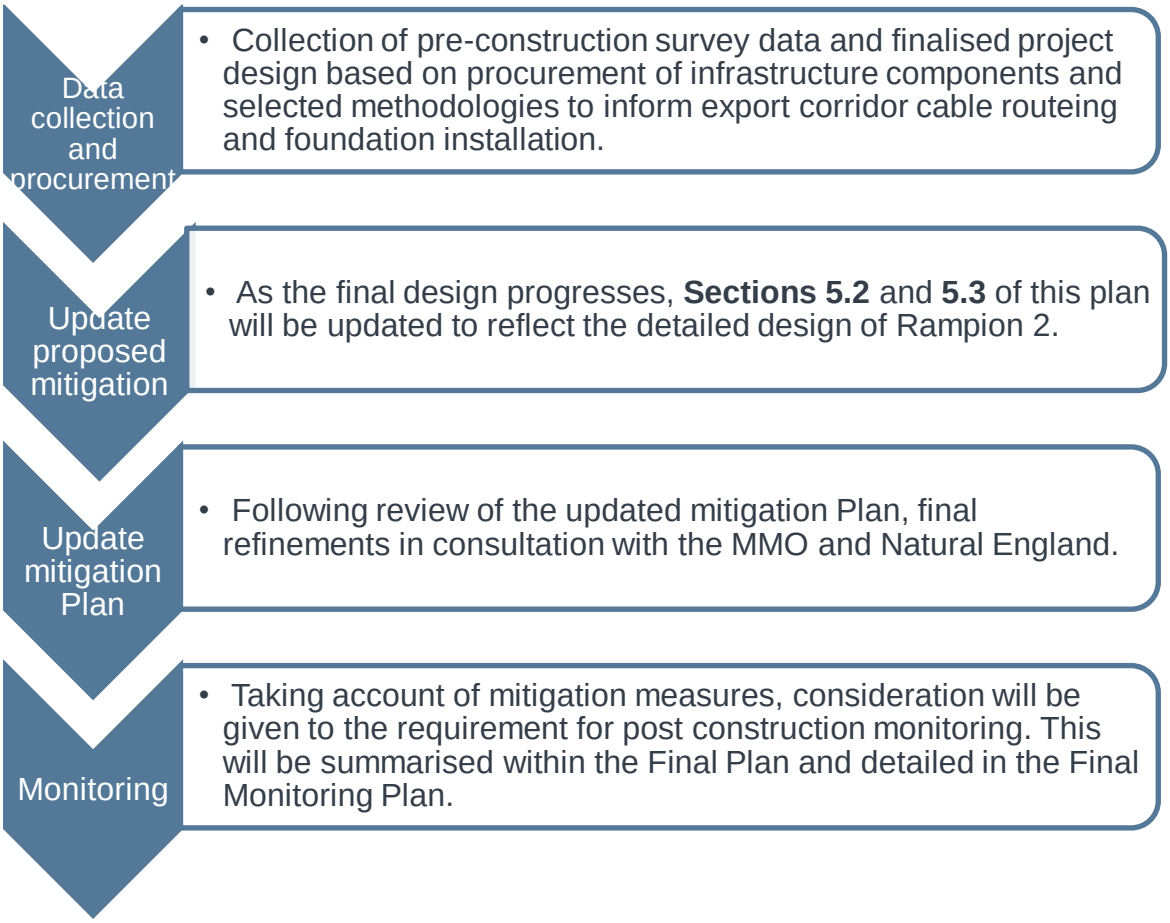
- Scour Protection and Cable Protection Plan, an **Outline Scour Protection and Cable Protection Plan [REP3-039]** (updated at Deadline 5) has been submitted with this DCO Application;
- Cable Specification and Installation Plan; and
- Offshore In Principle Monitoring Plan, an **Offshore In Principle Monitoring Plan [REP3-055]** (updated at Deadline 5) has been submitted with this DCO Application.

1.1.7 Due to the long lead in times for the development of offshore wind farms it is not possible to provide final detailed method statements for construction prior to consent and, as a result, the detail of any required mitigation also cannot be agreed at this stage. Key outstanding areas of uncertainty that will be addressed post-consent through the Plan include:

- The precise extent and location of sensitive features within the offshore export cable corridor. This will be informed by pre-construction surveys which will be undertaken prior to cable installation; and
- The detailed methodology for wind turbine generators (WTGs) and export cable installation will be informed by pre-construction surveys. The installation methodologies will be dependent on the technology available at time of construction, and what is procured.

1.1.8 The process that will be undertaken in finalising the Plan is outlined in the flowchart below:

Flowchart 1 Mitigation Plan Process



1.2 Document structure

1.2.1 This Plan is structured as follows:

- **Section 1**: Introduction;
- **Section 2**: Sensitive features;
- **Section 3**: Consultation summary;
- **Section 4**: Effects requiring mitigation;
- **Section 5**: Proposed mitigation measures;
- **Section 6**: Overview of mitigation commitments; and
- **Section 7**: Monitoring.

1.2.2 This Plan should be read in conjunction with the following chapters of the **Environmental Statement, Volume 2** (**ES**), which contain relevant detail which have been drawn upon and referred to throughout this document:

- **Chapter 4: The Proposed Development, Volume 2** of the ES **[APP-045]**;

- **Chapter 6: Coastal processes, Volume 2** of the ES **[APP-047]**;
- **Chapter 8: Fish and shellfish ecology, Volume 2** of the ES **[APP-049]** (updated at Deadline 5);
- **Chapter 9: Benthic, subtidal and intertidal ecology, Volume 2** of the ES **[APP-050]** (updated at Deadline 5);
- **Draft Marine Conservation Zone Assessment** **[APP-040]**; and
- **Appendix 11.3: Underwater noise assessment technical report, Volume 4** of the ES **[APP-149]**.

1.3 Project background

1.3.1 Rampion Extension Development Limited (hereafter referred to as 'RED') (the Applicant) is developing the Rampion 2 Offshore Wind Farm Project (Rampion 2) located adjacent to the existing Rampion Offshore Wind Farm Project ('Rampion 1') in the English Channel.

1.3.2 Rampion 2 will be located between 13km and 26km from the Sussex Coast in the English Channel and the offshore array area will occupy an area of approximately 160km^2.

1.3.3 The key offshore elements of the Proposed Development will be as follows:

- up to 90 offshore wind turbine generators (WTGs) and associated foundations;
- blade tip of the WTGs will be up to 325m above Lowest Astronomical Tide (LAT) and will have a 22m minimum air gap above Mean High Water Springs (MHWS);
- inter-array cables connecting the WTGs to up to three offshore substations;
- up to two offshore interconnector export cables between the offshore substations;
- up to four offshore export cables each in its own trench, will be buried under the seabed within the final cable corridor; and
- the export cable circuits will be High Voltage Alternating Current (HVAC), with a voltage of up to 275kV.

1.3.4 The key onshore elements of the Proposed Development will be as follows:

- a single landfall site near Climping, Arun District, connecting offshore and onshore cables using Horizontal Directional Drilling (HDD) installation techniques;
- buried onshore cables in a single corridor for the maximum route length of up to 38.8km using:
  - trenching and backfilling installation techniques; and
  - trenchless and open cut crossings.

- a new onshore substation, proposed near Cowfold, Horsham District, which will connect to an extension to the existing National Grid Bolney substation, Mid Sussex, via buried onshore cables; and
- extension to and additional infrastructure at the existing National Grid Bolney substation, Mid Sussex District to connect Rampion 2 to the national grid electrical network.

1.3.5 A full description of the Proposed Development is provided in **Chapter 4: The Proposed Development, Volume 2** of the ES **[APP-045]**.

1.3.6 The proposed project area has been reduced from EIA scoping in response to a number of constraints. The evolution of the Rampion 2 proposed DCO Order Limits is detailed in **Chapter 3: Alternatives, Volume 2** of the ES **[APP-044]**.

1.3.7 This Plan relates to construction activities within the offshore export cable corridor and the offshore array area.

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2. Sensitive features

2.1 Kingmere MCZ

2.1.1 The Kingmere MCZ is located in the English Channel, between 5km and 10km off the West Sussex coast to the South of Littlehampton and Worthing. It covers an area of around 47km^2. Although the initial site selection for Rampion 2, including the offshore export cable corridor Area, has ensured avoidance of any direct overlap with the Kingmere MCZ, the site is in proximity to the proposed development area (see **Figure 2.1,** located in this document, page 21) and therefore subject to potential indirect effects from construction activities.

2.1.2 Within the Kingmere MCZ, the seabed features include rock habitats and outcrops of chalk reef systems. Much of the moderate energy infralittoral rock habitat is covered by a thin veneer of mixed sediments. This creates a complex mosaic of habitats, some of which are noted as being of particularly importance to black seabream during spawning (nesting). The Kingmere MCZ is designated for the following marine features:

- Black seabream (*Spondyliosoma cantharus*);
- Moderate energy infralittoral rock and thin mixed sediment; and
- Subtidal chalk.

2.1.3 The conservation objectives (Natural England, 2022) are designed to describe the ecological ambitions for each feature within each MCZ, thereby providing a framework for the identification of appropriate management measures to achieve favourable condition or the features. Therefore, conservation objectives inform stakeholders of the potential implications of a MCZ designation.

2.1.4 The conservation objectives for the Kingmere MCZ are detailed in **Table 2-1** below. Further information on black seabream and geogenic reef habitats outside of the Kingmere MCZ is presented in **Sections 2.5** and **2.6** below.

Table 2-1 Kingmere MCZ features and associated Conservation Objectives

Feature	Conservation Objectives
Infralittoral rock and thin mixed sediment	To ensure that the protected habitats are: • maintained in favourable condition if they are already in favourable condition; or • brought into favourable condition if they are not already in favourable condition. For each protected habitat feature, favourable condition means that, within a zone both: a) its extent is stable or increasing; and b) its structure and function, its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that it remains in a condition which is healthy and does not deteriorate.
Subtidal chalk	As above for infralittoral rock and thin mixed sediment.
Black seabream	• In relation to black seabream spawning habitat to ▸ maintain the habitat in favourable condition if already in favourable condition; or ▸ bring into favourable condition if not already in favourable condition. • To ensure the black seabream population occurring in the MCZ be free of the disturbance of a kind likely to significantly affect the survival of its members or their ability to aggregate, nest, or lay, fertilise or guard eggs during breeding. For the spawning habitat of black seabream within the MCZ, favourable condition means that the habitat is of sufficient quality and quantity to enable individuals of this species using the habitat to survive, aggregate, nest, lay, fertilise or guard eggs during breeding.

2.2 Beachy Head West MCZ

2.2.1 The Beachy Head West MCZ runs parallel to the East Sussex coastline, extending from Brighton to the Beachy Head cliffs near Eastbourne, and protects a total area of approximately 24km^2. The MCZ lies to the northeast of the Rampion 2 offshore export cable corridor (see **Figure 2.1,** located in this document page 21).

2.2.2 The Beachy Head West MCZ protects a multitude of habitat types and their associated species. The extensive intertidal wave cut chalk platforms and subtidal

chalk ridges present are considered to be among the best examples of chalk habitat in the southeast. The MCZ includes an extensive intertidal wave cut chalk platform and subtidal chalk ridges, of which the surface is pitted with holes. These holes are created by burrowing molluscs (piddocks) and, once empty, can be inhabited by and provide shelter to animals such as crabs and anemones. Blue mussel (*Mytilus edulis*) beds and native oysters (*Ostrea edulis*) are found densely packed on the chalk ridges creating a mosaic of habitats.

2.2.3 A feature of the MCZ is the rare and cryptic short-snouted seahorse (*Hippocampus hippocampus*), which is known to be present along this area of coastline. Short snouted seahorses are found in shallow waters, often in estuaries or associated with seagrass meadows, particularly in the summer. During the winter months it is believed that short-snouted seahorses migrate out of the nearshore areas and into deeper and calmer waters in the English Channel.

Table 2-2 Beachy Head West MCZ short-snouted seahorse feature description and associated conservation objectives

Feature	Feature description	Conservation objective(s)	Condition of features
Short snouted seahorse (*H. hippocampus*)	Short-snouted seahorse is one of only two species found in UK waters. They are usually brownish in colour, smooth and lack the fleshy "mane" seen in some other seahorse species. Seahorses have excellent eyesight and hunt for their food by sight. They feed on a variety of small crustaceans, such as shrimp, but do not have teeth so instead suck food up through their snouts. Seahorses require protection as they are particularly vulnerable to threats which cause damage to their habitat. Short snouted seahorses are found in shallow waters, often in estuaries or associated with seagrass meadows, particularly in the summer. During the winter months it	To ensure that the protected species are: 1) maintained in favourable condition if they are already in favourable condition; or 2) brought into favourable condition if they are not already in favourable condition. For each species of marine fauna, favourable condition means that the population within the MCZ is supported in numbers which enable it to thrive, by maintaining (a) the quality and quantity of its habitat; and (b) the number, age and sex ratio of its population. Any temporary reduction of numbers of a species is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery.	No current Marine Condition Assessment.

Feature	Feature description	Conservation objective(s)	Condition of features
	is believed that short-snouted seahorses migrate out of the nearshore areas and into deeper and calmer waters in the English Channel.	Any alteration to a feature brought about entirely by natural processes is to be disregarded when determining whether a protected feature is in favourable condition.	

2.3 Beachy Head East MCZ

2.3.1 Beachy Head East MCZ is an inshore site that covers an area of 195km^2 and is located along the coast near Eastbourne in East Sussex, in the Eastern Channel region. The MCZ lies to the northeast of the Rampion 2 offshore export cable corridor (see **Figure 2.1**, located in this document page 21).

2.3.2 Beachy Head East has a sandstone and chalk reef system which provides a home for a wide range of species. Between Beachy Head point and Holywell, a chalk reef extends from the subtidal area up to the coast and white cliffs forming sheltered rockpools at low tide. The soft chalk is pitted by holes created by rock-boring piddocks. Once empty, these holes can also house crabs, sponges, anemones, and worms. Chalk extending above the high-water mark supports rich littoral chalk communities, dominated by seaweeds.

2.3.3 Short-snouted seahorses (*H. hippocampus)* and Ross worm (*S. spinulosa*) reefs are also found within this site. Ross worms build tubes from sand and shell fragments. Large colonies can form reefs, stabilising the seabed, providing shelter for other creatures and boosting the number and types of species in the area.

Table 2-3 Beachy Head East MCZ short-snouted seahorse feature description and associated conservation objectives

Feature	Feature description	Conservation objective(s)	Condition of features
Short snouted seahorse (*H. hippocampus*)	As above in **Table 2-2**.	Maintain in favourable condition. For each species of marine fauna, favourable condition means that the population within a zone is supported in numbers which enable it to thrive, by maintaining: 1. The quality and quantity of its habitat 2. The number, age and sex ratio of its population	No current Marine Condition Assessment.

2.4 Selsey Bill and the Hounds MCZ

2.4.1 Selsey Bill and the Hounds MCZ covers an area of approximately 16km^2 and is located by the town of Selsey in West Sussex on the south coast of England. The landward boundary is at Mean Low Water and the site adjoins the Bracklesham Bay Site of Special Scientific Interest. The MCZ lies within the Eastern Channel region of English waters, to the east of the Rampion 2 offshore export cable corridor (see **Figure 2.1**, located in this document page 21).

2.4.2 Selsey Bill and the Hounds MCZ is well known for its high biodiversity and species richness, supported by a variety of different habitats ranging from rocky habitats to soft sandy sediments. The site provides additional protection for a series of geological interest features that are exposed on, and underlie, the foreshore within Bracklesham Bay. These rock features, known locally as “The Hounds”, consist of outcrops of limestone and clay exposures and are representative of a coherent rock system stretching across the MCZ from the northwest corner to the southeast. These rock features provide a range of habitats that support a wide variety of species, with deeper or vertical rock faces dominated by animals such as anemones, sponges, and sea squirts. The rare and cryptic short-snouted seahorse (*H. hippocampus*) is known to be present along this area of coastline.

Table 2-4 Selsey Bill and the Hounds MCZ short-snouted seahorse feature description and associated conservation objectives

Feature	Feature description	Conservation objective(s)	Condition of features
Short snouted seahorse (*H. hippocampus*)	As above in **Table 2-2**.	Maintain in favourable condition. For each species of marine fauna, favourable condition means that the population within a zone is supported in numbers which enable it to thrive, by maintaining: 1. The quality and quantity of its habitat. 2. The number, age and sex ratio of its population.	No current Marine Condition Assessment.

2.5 Black seabream

2.5.1 Black seabream (*S. cantharus*) are recognised as a significant interest to commercial and recreational fishers with spawning grounds within the region that are considered important within regional Marine Plan Policies (South Inshore and

South Offshore Marine Plan (MMO, 2018)). As noted in **Section 2.1** above, Kingmere MCZ was designated in part to protect areas of spawning importance in the region for this species, although areas outside of the designated site also provide suitable habitat and support active spawning of black seabream. Kingmere MCZ lies to the north (inshore) of the offshore array area off the coast of Worthing, and adjacent to the offshore export cable corridor area (see **Figure 2.1**, located in this document page 21).

2.5.2 Black seabream are known to nest in areas around the south coast of the UK with extensive nesting grounds off the West Sussex coast to the Isle of Wight and Dorset (Collins and Mallinson, 2012; EMU Limited, 2009; Southern Inshore Fisheries and Conservation Authority (IFCA), 2014). Targeted studies identified black seabream nest areas off the coast of Littlehampton to Bogner Regis (EMU Limited, 2009), to Shoreham harbour in the east and to the north of Kingmere MCZ (EMU Limited, 2012).

2.5.3 It is reported that the black seabream stock within the English Channel area overwinters in water depths of between 50 to 100m, prior to migrating inshore to breed between May and June in suitable habitats (Vause and Clark, 2011). The specified breeding season, and therefore sensitive period for black seabream in this area, was considered (up to 2020) as being between April and June, however this has since been updated (in 2021) to reflect an extended breeding season between March and July (Natural England, 2021).

2.5.4 Black seabream nests have been recorded within the offshore export cable corridor Area through targeted repeat aggregate industry surveys (EMU Ltd, 2009; Fugro EMU Ltd, 2013; 2014), as well as the Rampion 2 specific geophysical and benthic surveys undertaken in 2020 and 2021. Recognising that the wider area in the vicinity of the Kingmere MCZ is known to support black seabream spawning (nesting), there is a focus for the mitigation on the MCZ itself as it is within this site that specific protection is afforded to the species during the spawning season.

2.5.5 Pre- construction fish surveys were carried out for Rampion 1 offshore windfarm in September/October 2015 and May 2016, with post-construction monitoring of fish undertaken in November 2019 and May 2020. Otter and epibenthic scientific beam trawls were used to provide an assessment of any long-term changes in the fish and shellfish communities of the Rampion 1 offshore windfarm. Results from the surveys indicated significant changes in the abundance of a range of fish and shellfish species between pre- and post-construction surveys, seasons, and treatment areas, notably including an increase in black seabream abundance post-construction[1]. However these changes were also reflected in data from the reference stations, suggesting the differences recorded were likely attributable to natural variation rather than effects from the development of Rampion 1.

2.6 NERC Biodiversity Action Plan (BAP) reef habitat

2.6.1 Outcrops of bedrock forming reef features, some of which comprise chalk substrata, are known to occur through the inshore portion of the benthic subtidal

[1] It should be noted that Rampion 1 had a piling restriction during April – June and the export cable corridor was not located in an area of known black seabream nesting.

ecology study area and across the wider region. These features were identified through the site-specific geophysical and ecological surveys and supported by a predictive habitat mapping process undertaken for Rampion 2 as being characterised by two principal biotopes *'Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock (A3.215)' and 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)' (**Chapter 9: Benthic, subtidal and intertidal ecology, Volume 2** of the ES **[APP-050]** (updated at Deadline 5) and **Figure 9.4, Chapter 9: Benthic, subtidal and intertidal ecology, Volume 3** of the ES **[REP2-010]**.

2.6.2 The site-specific benthic survey of Rampion 2 also verified the presence of outcropping rock, peat and clay exposures, and chalk areas, observed across the western areas of the offshore array area and nearshore areas of the offshore export cable corridor (**Figure 4, Section 6.1.1** of **Appendix 9.3: Offshore wind farm subtidal benthic characterisation survey report, Volume 4** of the ES **[APP-137]**. Both bedrock, peat and clay, and chalk reef habitats are listed as UK BAP and comprise habitats identified as requiring conservation action under the UK BAP, being listed under Section 41 of the Natural Environment Research Council (NERC) Act (2006).

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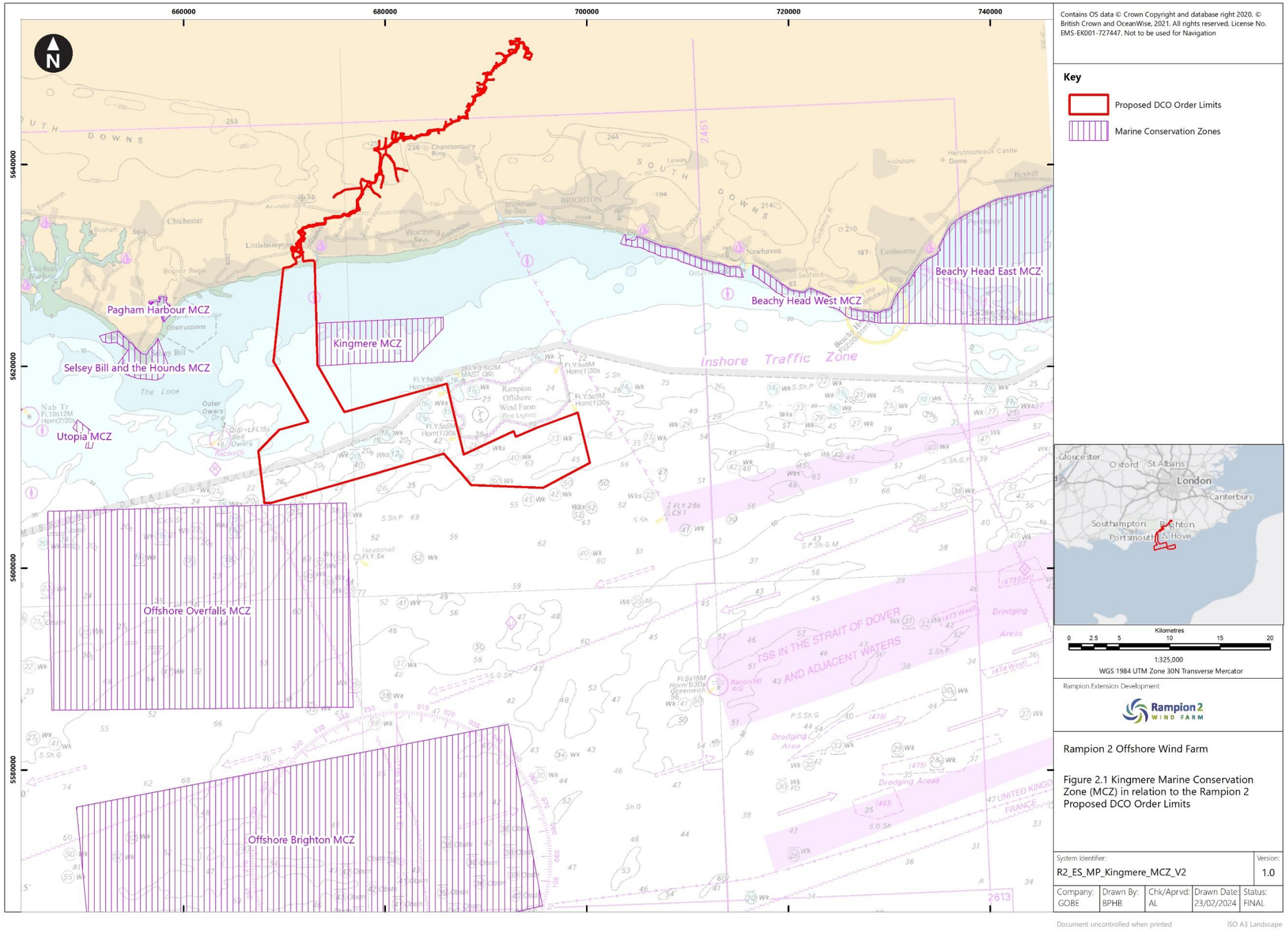
Figure 2.1 Marine Conservation Zones (MCZs) in relation to the Rampion 2 proposed DCO Order Limits



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3. Consultation summary

3.1.1 The Applicant has engaged with Natural England, Sussex Inshore Fisheries and Conservation Authority (Sussex IFCA), and the MMO (and their advisors, Centre for Environment, Fisheries and Aquaculture Science (Cefas)) from the earliest stages of the EIA process. This has included focused discussions relating to the following topics, to seek agreement on potential mitigation measures:

- Known presence of black seabream nesting locations, and potential impacts from underwater noise on breeding black seabream and breeding seahorse; and
- Known presence of NERC (BAP) reef habitats (specifically chalk reef, peat and clay exposures, and *S. spinulosa* reef), and the potential for direct and indirect impacts from export cable installation works.

3.2 Pre-Application consultation

3.2.1 A summary of the relevant consultation undertaken in the pre-Application phase is provided in **Table 3-1** below.

3.2.2 Following the pre-Application consultation, the Plan was drafted by RED (the Applicant), detailing the proposed mitigation measures to be implemented for the Rampion 2 development and submitted as part of the DCO Application. Through the Examination process, the Plan has since been revised, to reflect commitments made by the Applicant to mitigate against the potential impacts of the Proposed Development on sensitive features.

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Table 3-1 Summary of pre-application consultation

Theme	Date of consultation	ETG Stakeholder consultation response summary	Applicant response summary
Pre-application consultation on impacts from construction noise on spawning/nesting black seabream.			
Underwater noise mitigation measures for breeding black seabream	Physical Processes (Water Quality), Benthic Ecology & Fish Ecology ETG meeting, 3 November 2021	Initial concerns were raised at Scoping, regarding the potential for impacts from underwater noise arising from the construction of the Proposed Development. An ETG meeting was held on the 3 November 2021 with the MMO, Cefas, Natural England, Environment Agency and the Sussex Wildlife Trust where stakeholders requested further information on the proposed mitigation measures to reduce the potential for impact on nesting black seabream within and adjacent to the offshore array area.	The Applicant subsequently issued a technical note, **Underwater Noise Mitigation for Sensitive Features** (**Appendix D, Evidence Plan (Part 9 of 11)** **[APP-251]**), detailing the proposed underwater noise mitigation for sensitive features. This technical note provided a mitigation commitment to utilise at least one offshore piling noise abatement technology to reduce noise at the Kingmere MCZ to a level where the risk of impact was low enough to avoid the potential for significant effects on breeding black seabream during the spawning (nesting) season (March to July).
	Targeted Meeting – Underwater Noise Mitigation, 24 February 2022	On 24 February 2022, a targeted ETG meeting was held with the MMO, Cefas, Natural England, the Environment Agency, the Sussex Wildlife Trust and the Sussex Inshore Fisheries & Conservation Authority (Sussex IFCA). Discussions were held regarding the establishment of a suitable behavioural response threshold for black seabream. Cefas suggested a more conservative approach should be taken by the Applicant in relation to underwater noise and supported proposed mitigation across the entire site rather than zoning to address uncertainty. A recommendation was also made to make the proposed mitigation clearer in the Technical Note.	In response, the Applicant issued a further technical note, **Rampion 2 Technical Note: Additional underwater noise modelling** of **Appendix D, Evidence Plan (Part 9 of 11)** **[APP-251]**, summarising the results of underwater noise modelling for noise mitigation for black seabream and the proposal to use a disturbance threshold of 147 decibels (dB) SEL_{ss} (Radford *et al.*, 2016), based on a low response reaction in seabass. Following the meeting, the Applicant commissioned a dedicated survey of ambient noise levels to provide contemporary data on noise levels at the Kingmere MCZ site and within surrounding areas whereby much of the black seabream nesting activity is focused. This survey was undertaken over 15 days in July 2022.
	Advice note/ response received from Natural England and MMO, both dated 20 May 2022	An advice note was submitted to RED from Natural England in response to the two previously submitted technical notes. Natural England expressed their concerns about the potential disturbance of breeding black seabream from the piling of the turbine foundations, in the absence of mitigation. Natural England expressed their view that a piling restriction during the entirety of the breeding season is the only approach that provides certainty that black seabream will not be subject to behavioural disturbance. Natural England also raised concerns about the behavioural noise thresholds for breeding black seabream as proposed by RED. This was also echoed by the MMO, reiterating the potential use of 135 dB as a suitable threshold that was previously discussed and whilst supportive of the use of noise abatement for piling, raised concerns over the efficacy of the measures. The MMO, whilst accepting seabass as a potentially suitable proxy for black seabream based on physiological similarity, noted that lifecycle and breeding differences in seabass in comparison to black seabream which introduced uncertainty in establishing a threshold for the	A further technical note, **Piling Noise and Black Bream: Further Information and Response Paper** of **Appendix D, Evidence Plan (Part 10 of 11)** **[APP-252]** was therefore issued to Natural England and the MMO in March 2023, providing responses to the following key issues raised: • Approaches to dealing with uncertainty and the application of precaution in the assessment; • Approach to improving the rigour of the baseline soundscape data; • Additional context from Rampion 1 construction; and • Additional empirical evidence to support the efficacy of mitigation techniques. Following the targeted meeting, the Applicant commissioned a second in-situ noise monitoring survey, targeted at collecting data across the March to July black seabream spawning/nesting period in 2023.

Theme	Date of consultation	ETG Stakeholder consultation response summary	Applicant response summary
Pre-application consultation on impacts from construction noise on spawning/nesting black seabream.			
		species, and the difficulties in setting a quantitative threshold generally. Further requests for modelling at lower levels than 147 dB were made. The MMO noted that a seasonal restriction on piling (March to July) was required to confidently reduce the risk of impact as a result of the uncertainties with assessing behaviour and applying behavioural thresholds.	
	Targeted Meeting – Underwater Noise Black seabream Survey Queries Meeting, 12 September 2022	On 12 September 2022 a targeted meeting was held with Natural England, the MMO, Sussex IFCA and Cefas, to continue discussions on the establishment of a black seabream threshold and response upon which to design appropriate mitigation. The MMO and Natural England raised concerns regarding the lack of definitive species-specific data on the behavioural responses of black seabream to noise during the spawning period and when the males are engaged in nest-guarding/nest maintenance activity. It was identified that in order to design a mitigation strategy for potentially significant effects on sensitive receptors, a level of noise below which the risk of an effect arising to black seabream is reduced to an acceptable level needed to be established. The results of the site-specific ambient noise survey (undertake in July 2022) were also discussed (the results are presented in **Appendix 8.3: Underwater noise study for sea bream disturbance, Volume 4** of the ES **[REP2-011].** As informed by the study, a revised noise level of 141dB was proposed in the meeting as being at the precautionary end of the scale of potential response levels and was proposed by the Applicant as representing a protective disturbance threshold. The MMO confirmed that it was comfortable with the use of the 141dB SEL_{ss} noise level to inform the impact assessment but advised that discussions with Natural England would be required regarding mitigation. Natural England and the MMO noted that whilst the ambient noise monitoring was considered potentially useful, there were issues regarding the robustness of the data obtained, being collected over a relatively short period, late in the spawning season (15 days in July 2022).	
	Advice note /response from Natural England (2 November 2022) and MMO (3 November 2022)	An advice note was submitted to RED from Natural England on 2 November 2022, providing advice on a technical note provided by RED for review; **Appendix 8.3: Underwater noise study for sea bream disturbance, Volume 4** of the ES **[APP-134],** which detailed the results of the site-specific underwater noise study undertaken in July 2022. Natural England welcomed the additional information provided in the technical note, but	The Applicant highlighted that a piling restriction through the entirety of the March to July period would have significant issues for the practical development of Rampion 2. In order to address concerns, the Applicant made a commitment to utilising at least one offshore piling noise mitigation technology during the breeding season of black seabream (March to July), to deliver noise attenuation in order to maintain noise immission (received) levels

Theme	Date of consultation	ETG Stakeholder consultation response summary	Applicant response summary
Pre-application consultation on impacts from construction noise on spawning/nesting black seabream.			
		maintained their position that there is insufficient evidence to substantiate the proposed thresholds for behavioural disturbance to black seabream whilst in their reproductive phase. Specifically, Natural England stated that whilst the suggested thresholds for behavioural disturbance of proxy species represented physical similarity, they do not represent the reproductive behaviours which define the black seabream. The MMO noted the use of the proxy species proposed might be suitable, however it also expressed reservations, *inter alia*, due to differences in breeding habit and audiogram assumptions and following further consideration could not support the proposed 141 dB threshold and that a more precautionary approach was merited. Natural England confirmed that a piling restriction during the entirety of the breeding season is the only approach that provides sufficient certainty that long term exposure to underwater piling will not cause significant behavioural disturbance or physiological effects, and that the conservation objectives of the Kingmere MCZ will not be hindered. The MMO welcomed the work undertaken by RED, however considered that insufficient evidence, including on mitigation, had been provided to agree the removal of the seasonal restriction and noted its commitment to working with RED and Natural England to review and discuss any further information provided.	at the MCZs below the proposed noise threshold, to reduce predicted impacts on sensitive receptors to a non-significant level. As outlined in **Section 5.3** this commitment has now been updated so that noise mitigation technology will be in place for the entirety of the piling operations, with additional measures put in place during the breeding season.
Zoning strategy for mitigation	Targeted meeting - Underwater Noise and Impacts on Fish Receptors, 30 March 2023	Within the targeted meeting held on the 30 March 2023, the Applicant proposed a zoning exercise is undertaken to recognise a spatial aspect (i.e., where piling works can be undertaken) to a mitigation plan in relation to the March-July black bream nesting period. The Applicant stressed the importance of July during the construction period, due to reliable weather conditions, and proposed that a zoned approach to mitigation within the array area from March-July inclusively is undertaken. Natural England stated that an agreement has not been made on the 141dB threshold, the Applicant reiterated that when discussing the 141dB threshold, this is a stress response and using this as a target is worst-case scenario. The Applicant confirmed that feedback will be taken from the meeting, and progress additional modelling, a zonation plan, and a temporal plan for Rampion 2, which will be presented prior to examination for discussion.	The Applicant has undertaken a zoning exercise to inform seasonal and spatial piling restrictions across the offshore array area, whereby at least one offshore piling noise mitigation technology during the breeding season of black seabream can be utilised, to deliver noise attenuation with the aim to reduce predicted impacts to sensitive receptors at relevant MCZ. These are detailed in **Section 5.3** of this Plan. As outlined in **Section 5.3** this commitment has now been updated so that noise mitigation technology will be in place for the entirety of the piling operations, with additional measures put in place during the breeding season.
Pre-application consultation on the avoidance of direct impacts on bream nesting habitats, sensitive chalk reefs and chalk habitats, rock reef habitats and biogenic reef habitats			
Direct impacts on sensitive features	Physical Processes, Water Quality, Benthic Ecology and Fish	Concerns were raised over the potential for direct impacts to sensitive features within the offshore export cable corridor arising from the proposed construction works. This includes	A cable routeing exercise of the offshore export cable corridor was undertaken to mitigate as far as possible the impact on sensitive features (black bream nesting sites and NERC benthic habitats),

Theme	Date of consultation	ETG Stakeholder consultation response summary	Applicant response summary
Pre-application consultation on impacts from construction noise on spawning/nesting black seabream.			
	Ecology ETG meeting, 24 March 2021	sensitive chalk reefs and chalk habitats, rock reef habitats and biogenic reef habitats. Stakeholders highlighted that direct impacts have the potential to include long-term or permanent habitat loss (of chalk, chalk and rock reef, and black seabream nesting habitats) as a result of the installation of secondary protection where cable burial is not possible, or permanent habitat loss for geogenic reef features subject to direct impacts from cable trenching. In the view of Natural England, the MMO, Sussex IFCA and Sussex Wildlife Trust, the issue around the ability to avoid such features is compounded for black seabream nesting areas by uncertainty over where nesting occurs outside the focused aggregate industry survey boxes, or the locations identified from the Rampion 2 surveys	whilst also maintaining the requirement to progress the shortest installable routes. The routing exercise is detailed in **Section 5.2** of this Plan. A technical note, **Rampion 2 Technical Note: Cable Corridor area mitigation for sensitive features** of **Appendix D, Evidence Plan (Part 9 of 11)** **[APP-251]** was issued to stakeholders in January 2022 providing further information, specifically detailing the proposed approach to offshore export cable installation which would be based on further engineering design work, continuing evaluation of ecological data and assessment of practical mitigation options. This note also detailed the outputs of the initial cable routeing exercise and mitigation of impacts, which was submitted to Natural England, the MMO and their statutory advisors Cefas, and the Sussex IFCA. A seasonal restriction on export cable installation works was also proposed during the key breeding season for black seabream.
	Targeted Meeting – Offshore Cable Corridor Issues (including black seabream nesting and reef features), 15 February 2022	The Applicant proposed mitigation options for cable laying in the offshore export cable corridor in relation to black seabream nesting and reef features, as detailed in the technical note. The MMO, Natural England and Cefas welcomed the proposed seasonal restriction on cable installation works for black seabream, and formal agreement was noted.	The Applicant has proposed several mitigation measures, including a seasonal restriction on works within the offshore export cable corridor from March to July to avoid any effects from installation works on breeding black seabream within or outside of the Kingmere MCZ. These measures are detailed in full in **Section 5.2** of this Plan. The measures detailed in this Plan include the commitment to undertake pre-construction surveys to confirm locations of habitats/species “of principal importance pursuant to Section 41 of the NERC Act 2006” to feed into the detailed routeing design for the export cables. The cable routeing design measure will be applied to avoid direct disturbance to these sensitive habitats/species where practicable and determine the appropriate offshore export cable installation methods to minimise the area of physical disturbance to chalk habitat, stony reef and *Sabellaria spinulosa* reef (if recorded) where interaction is unavoidable. The final offshore export cable routeing plan will be provided prior to construction.
	Advice note / response received from Natural England (20 May 2022) and MMO (18 May 2022)	An advice note was submitted to RED from Natural England on 20 May 2022. Natural England expressed their support for a commitment to adhere ‘to a seasonal restriction to ensure cable installation activities within the export cable area are undertaken outside the black seabream breeding period (March-July)’. Natural England however expressed that consideration needs to be given to the recoverability of suitable breeding habitats after the works. Natural England also recognised RED’s intention to microsite around known nesting sites to avoid direct impacts to the features. Natural England stated however, that in the event that known bream nesting areas cannot be avoided, then consideration would need to be given to whether rock directly impacted by trenching could recover to suitable nesting habitat. The MMO also confirmed agreement with the cable routeing design and seasonal restriction mitigation presented although there were some minor points of clarification raised, including with respect to nest variability (inter-annual), predictive mapping assumptions, and recognising limitations in the marine aggregate datasets.	

Theme	Date of consultation	ETG Stakeholder consultation response summary	Applicant response summary
Pre-application consultation on impacts from construction noise on spawning/nesting black seabream.			
Pre-application consultation on indirect impacts on bream nesting habitats, sensitive chalk reefs and chalk habitats, peat and clay exposures, rock reef habitats and biogenic reef habitats			
Indirect impacts on nesting black seabream from increased SSC and deposition	Targeted Meeting – Offshore Cable Corridor Issues (including black seabream nesting and reef features), 15 February 2022	Stakeholders raised concerns over the potential for indirect impacts including suspended sediment concentrations (SSC) and subsequent sediment deposition to sensitive features within the offshore export cable corridor Area, arising from the proposed construction works. Of principal concern was the potential for impacts relating to sediment deposition on black seabream nesting areas during the breeding season arising from seabed disturbance during cable installation activities.	A technical note, **Rampion 2 Technical Note: Cable Corridor area mitigation for sensitive features** (**Appendix D, Evidence Plan (Part 9 of 11)** **[APP-251]** was issued to stakeholders in January 2022 providing further information, specifically in respect of proposed approaches to Offshore Export Cable installation based on further engineering design work, continuing evaluation of ecological data and assessment of practical mitigation options. This note proposed approaches and methodologies to be employed to provide mitigation of impacts to inform a discussion on the proposed measures with Natural England, the MMO and their statutory advisors Cefas, and the Sussex IFCA. These measures are detailed in full in **Section 5.2** of this Plan.
Indirect impacts on black seabream nesting habitats from secondary effects	Targeted Meeting – Offshore Cable Corridor Issues (including black seabream nesting and reef features), 15 February 2022	Secondary effects arising from SSC plumes and subsequent sediment deposition were also raised as a concern by stakeholders for the Kingmere MCZ, particularly in relation to black seabream nesting areas and spawning success during the breeding season and also over the longer term if sediment deposition changed the nature of seabed habitats previously suitable for nesting.	Information on sediment plume distances and modelling are provided in **Chapter 6: Coastal processes, Volume 2** of the ES **[APP-047]** and **Appendix 6.3: Coastal processes technical report: Impact assessment, Volume 4** of the ES **[APP-131]**. An assessment of potential for indirect impacts on black seabream nesting sites was undertaken in **Chapter 8: Fish and shellfish ecology, Volume 2** **[APP-049]**. The Applicant has proposed several mitigation measures, including a seasonal restriction on works within the offshore export cable corridor from March to July to avoid any effects from installation works on breeding black seabream within or outside of the Kingmere MCZ. These measures are detailed in full in **Section 6** of this Plan.
	Advice note received from Natural England, 20 May 2022	An advice note was submitted to RED from Natural England on 20 May 2022. Natural England expressed their support for a commitment to adhere 'to a seasonal restriction to ensure cable installation activities within the export cable area are undertaken outside the black seabream breeding period (March-July)'. Natural England however, stated that indirect impacts such as increased sediment deposition in nesting areas, which has the potential to persist after the works will also need to be considered. Natural England requested illustrative sediment plume modelling in relation to known nesting sites and also Kingmere MCZ, to understand the impacts on potential bream nesting areas. Natural England also expressed their support for the adoption of cable installation methodologies that minimise the footprint of impact and the amount of SSC/deposition. They stated however that consideration should be given in the first instance to the methodology available at the time of construction that minimises this as far as possible.	

3.3 Post-consent consultation

3.3.1 There will be an on-going requirement to engage with Natural England and the MMO throughout the detailed design stage of the project, including in the planning and review of pre-construction surveys in the offshore export cable corridor, as well as during development of the final project design, construction plans and mitigation measures.

3.4 Schedule for agreement

3.4.1 It is not possible at this stage to determine exact dates for agreement and refinement of the Plan. However, the key milestones have been outlined in **Table 3-2** to indicate the anticipated development of the Plan between consent and construction.

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Table 3-2 Indicative milestones for refinement and agreement of the Plan

Indicative Stage	When	Action for Rampion 2	Relevant Authority/Consultee	Status
Indicative milestones for refinement and agreement of the In Principle Sensitive Features Mitigation Plan	Prior to examination	The Rampion 2 Plan to be provided to the relevant authorities.	MMO and Natural England	Currently in progress (during Examination)
Consent determination	Expected 2024	Review of In Principle Sensitive Features Mitigation Plan, identify any areas for revisions/updates.	Internal	To be completed
Front End Engineering Design (FEED)	Pre-construction	Refining the project design during the pre-construction period. Results from pre-construction surveys will be used to inform this. Updates to the project design that could impact the conclusions of the assessment may be subject to further assessment if deemed appropriate in consultation with the relevant authority. Any updated project design will also require consideration in the Sensitive Features Mitigation Plan.	Internal	To be completed
Submission and review of the Sensitive Features	Pre-construction	The Sensitive Features Mitigation Plan will be updated to capture all relevant assessments and mitigation measures.	MMO and Natural England	To be completed

Indicative Stage	When	Action for Rampion 2	Relevant Authority/Consultee	Status
Mitigation Plan and any associated documentation				
Final Design	Pre-construction	Confirm the project design and installation techniques during the pre-construction period. Based on the final project design, including any required updated underwater noise modelling, an updated assessment will be undertaken, if necessary.	Internal	To be completed
Final Sensitive Features Mitigation Plan Sign off	The dMLs set out certain timescales in advance of commencement of the licensed activities, by when the Sensitive Features Mitigation Plan must be submitted to the MMO for approval	The Sensitive Features Mitigation Plan will be updated and finalised. The Final Sensitive Features Mitigation Plan will be submitted to the MMO for approval at a timescale in accordance with the dMLs prior to the commencement of construction works.	MMO for sign off	To be completed
Construction monitoring and reporting	Construction	Monitoring/management reports will be submitted to the MMO.	MMO	To be completed

4. Effects requiring mitigation

4.1 Overview

4.1.1 The following section provides an overview of the relevant impact sources and sensitive receptors for the mitigation Plan. The measures that have been identified, set out below in **Section 5**, are based on maximum design scenarios as informed by the project design envelope, described in **Chapter 4: The Proposed Development, Volume 2** of the ES **[APP-045]**, with the associated topic-specific maximum design scenarios and potential effects on sensitive features detailed in full within the following chapters:

- **Chapter 8: Fish and shellfish ecology, Volume 2** of the ES **[APP-049]** (updated at Deadline 5); and
- **Chapter 9: Benthic, subtidal and intertidal ecology, Volume 2** of the ES **[APP-050]** (updated at Deadline 5).

4.2 Export cable installation activities

4.2.1 As set out in **Chapter 8: Fish and shellfish ecology, Volume 2** of the ES **[APP-049]** (updated at Deadline 5), and **Chapter 9: Benthic, subtidal and intertidal ecology, Volume 2** of the ES **[APP-050]** (updated at Deadline 5), the Rampion 2 EIA identified that export cable installation impacts from Rampion 2 could result in significant effects on sensitive receptors in the absence of further mitigation:

- Direct disturbance resulting from the installation of the export cable;
- Habitat disturbance in the offshore export cable corridor from construction activities; and
- Increased SSC and sediment deposition resulting from the installation of the export cable.

4.2.2 The relevant sensitive receptors for these impacts comprised bedrock and chalk reef habitats (being listed under Section 41 of the NERC Act 2006), and breeding black seabream, principally as a qualifying feature of the Kingmere MCZ. The Applicant has committed to undertaking a pre-construction survey, secured in Condition 11 of Schedules 11 and 12 of the draft DCO, which will inform the final cable design. The survey will be conducted to determine the location and extent of any NERC habitats and provide additional data on the presence of black seabream nesting locations along the export cable corridor, within which the proposed export cable installation works are proposed. Throughout export cable installation activities, there will be no anchoring of vessels within the MCZ or other designated site boundaries. Cable routeing design methodologies, and other relevant mitigation measures to be applied, are set out in **Section 5**.

4.3 Foundation installation activities (piling)

4.3.1 The assessment presented in **Chapter 8: Fish and shellfish ecology, Volume 2** of the ES **[APP-049]** (updated at Deadline 5), identified that the installation of foundations at Rampion 2 by percussive piling, and assuming the maximum design scenario, had the potential to result in significant effects in the absence of further mitigation. Potential significant effects arising from behavioural/disturbance levels of noise from piling works were identified for:

- Breeding black bream as a qualifying feature of the Kingmere MCZ; and
- Breeding seahorse as qualifying features of the Beachy Head East MCZ, the Beachy Head West MCZ, and the Selsey Bill and the Hounds MCZ.

4.3.2 The approach to applying noise abatement technologies for piling, and subsequent development of a spatial and temporal zoning plan for the Rampion 2 array area, is set out in **Section 5**. The zoning plan will delimit areas of the offshore array area where piling can be undertaken, either with or without the application of noise abatement measures, to meet noise immission mitigation target values during sensitive periods for sensitive receptors, i.e., black seabream at Kingmere MCZ during the spawning/nesting season, and seahorse during the summer breeding season, when resident at the relevant MCZs.

5. Proposed mitigation measures

5.1 Overview

5.1.1 This section of the Plan outlines the measures currently available or likely to be available within the development timeframe for Rampion 2, which may be applicable to construction activities at the Proposed Development, pending final post-consent project design.

5.1.2 The approach to developing the mitigations for export cable installation and piling are presented separately, with each adhering to relevant Commitments made by the Applicant, as set out in the ES and **Commitments Register** **[REP4-057]** (updated at Deadline 5), as follows:

Export cable installation

- C-269 - Cable routeing design will be developed to ensure micrositing where possible to identify the shortest feasible path avoiding subtidal chalk and reef features, peat and clay exposures and areas considered to potentially support black seabream nesting.
- C-270 - As part of the routeing design, a working separation distance (buffer) will be maintained wherever possible from sensitive features, notably black seabream nesting areas, as informed by the outputs of the physical processes assessment, to limit the potential for impacts to arise (direct or indirect).
- C-271 - The offshore export cable routeing design will target areas of the seabed that enable maximising the potential for cables to be buried, thus providing for seabed habitat recovery in sediment areas and reducing the need for secondary protection and consequently minimising any potential for longer-term residual effects.
- C-272- Adoption of specialist offshore export cable laying and installation techniques will minimise the direct and indirect (secondary) seabed disturbance footprint to reduce impacts, which will provide mitigation of impacts to all seabed habitats, but particularly chalk and reef areas, peat and clay exposures, as well as potential (unknown) black seabream nesting locations, where avoidance is not possible. The Applicant will seek to utilise the most appropriate technology available at the time of construction and operation, if required, to reduce the direct footprint impact from cutting machinery, where practicable.
- C-273 - A seasonal restriction will be put in place to ensure Offshore Export Cable Corridor activities (including: construction and installation, preparatory works during cable installation, UXO clearance, preventive or scheduled maintenance, inspections and decommissioning) are undertaken outside the black seabream breeding period (1st March- 31st July inclusive) to avoid any effects from installation works on black seabream nesting within or outside of the Kingmere MCZ. This does not apply to emergency work required to maintain the operation, safety and integrity of the infrastructure.

- C-305 –Excavated chalk will be used to infill cable trenches produced by mechanical cutters, where practicable.

Foundation installation (piling)

- C-265 Double big bubble curtains will be deployed as the minimum single offshore piling noise mitigation technology to deliver underwater noise attenuation for all foundation installations throughout the construction of the Proposed Development where percussive hammers are used in order to reduce predicted impacts to:
  - sensitive receptors at relevant Marine Conservation Zone (MCZ) sites and reduce the risk of significant residual effects on the designated features of these sites;
  - spawning herring; and
  - marine mammals.
- C-280 Commitment that no piling will occur in the piling exclusion zones during the seabream breeding period (March-July) which will be defined by the modelling in the Final Sensitive Features Mitigation Plan.
- C-281 Commitment to no piling within the western part of the Rampion 2 offshore array closest to the Kingmere MCZ during the majority of the black seabream breeding period (March-June); and sequenced piling in the western part of the Offshore Array Area during July in accordance with the zoning plan to be set out in the Final Sensitive Features Mitigation Plan, to reduce the risk of significant effects from installation works on breeding black seabream within or outside of the Kingmere MCZ.
- C-274 Commitment to commence piling at locations furthest from the Kingmere MCZ during the black seabream breeding period (March-July), to reduce effects from installation works on breeding black seabream within or outside of the Kingmere MCZ.

5.2 Mitigation measures for export cable installation within the offshore export cable corridor

5.2.1 The export cable installation mitigation plan presented below sets out the approaches and methodologies proposed to be employed to provide mitigation of impacts identified in the ES that could lead to potentially significant effects. The Plan draws upon engagement undertaken throughout the pre-application phase, including statutory consultation and through the Evidence Plan ETG meetings, supported by information and examples of the types of equipment that may be used. The importance of the latter aspect is to demonstrate that such methods and techniques are deliverable for the proposed works within the offshore export cable corridor area and can therefore be relied upon to deliver the mitigation of potentially significant impacts that may arise in the absence of such.

5.2.2 The principles underpinning the export cable installation mitigation comprise the following:

- Route design and micrositing:
  - This aims to deliver avoidance of known sensitive features within the offshore export cable corridor area as far as practicable, as well as maximising the potential to achieve cable burial, thus providing for seabed habitat recovery in sediment areas and reducing the need for secondary protection, consequently minimising any potential for longer-term residual effects.
- Use of specialist cable laying and installation techniques:
  - This aims to minimise the direct and indirect (secondary) seabed disturbance footprint to reduce impacts, which will provide mitigation of impacts to all seabed habitats, but particularly seabed chalk and *S. spinulosa* reef, peat and clay exposures as well as potential (unknown) black seabream nesting locations, where avoidance is not possible.
- Seasonal restriction for cable installation works:
  - This will ensure offshore export cable corridor installation activities are undertaken outside the black seabream breeding period (March-July) to avoid any effects from installation works on active black bream nesting.

5.2.3 Further detail on each of these principles is set out in the sections below.

Route design and micrositing

5.2.4 The refinement of the export cable routeing design will provide avoidance of known sensitive features (known black seabream nesting sites and NERC geogenic and biogenic reef habitats and peat and clay exposures) within the offshore export cable corridor area (as far as practicable) (C-269), as well as maximising the potential to achieve cable burial (C-45). Cable burial will aid seabed habitat recovery in sediment areas and reduce the need for secondary protection, consequently minimising any potential for longer-term residual effects.

5.2.5 As discussed in **Section 4**, pre-construction surveys will be undertaken ahead of installation works and the results of these, along with the export cable specifications and installation equipment parameters, will inform the final routing/micrositing of cables. However, on the basis of the current site-specific survey data, a routeing design exercise has been undertaken to demonstrate the principles of the approach that will be adopted for the final design. Outputs from this exercise have been used to illustrate the proposed route design mitigation process presented below.

5.2.6 The routeing design work will be undertaken in stages, commencing with an initial ‘macro-routeing’ engineering exercise. This first stage seeking to mitigate as far as possible the impact on sensitive receptors, whilst also maintaining the requirement to progress the shortest installable routes, within seabed conditions which maximise the potential for burial.

5.2.7 The resulting routes will then be used to produce refined export cable corridors within the wider offshore export cable corridor area, which place emphasis on both constraint avoidance / mitigation and feasible constructability. It is at this stage that relevant buffers from features will be applied,

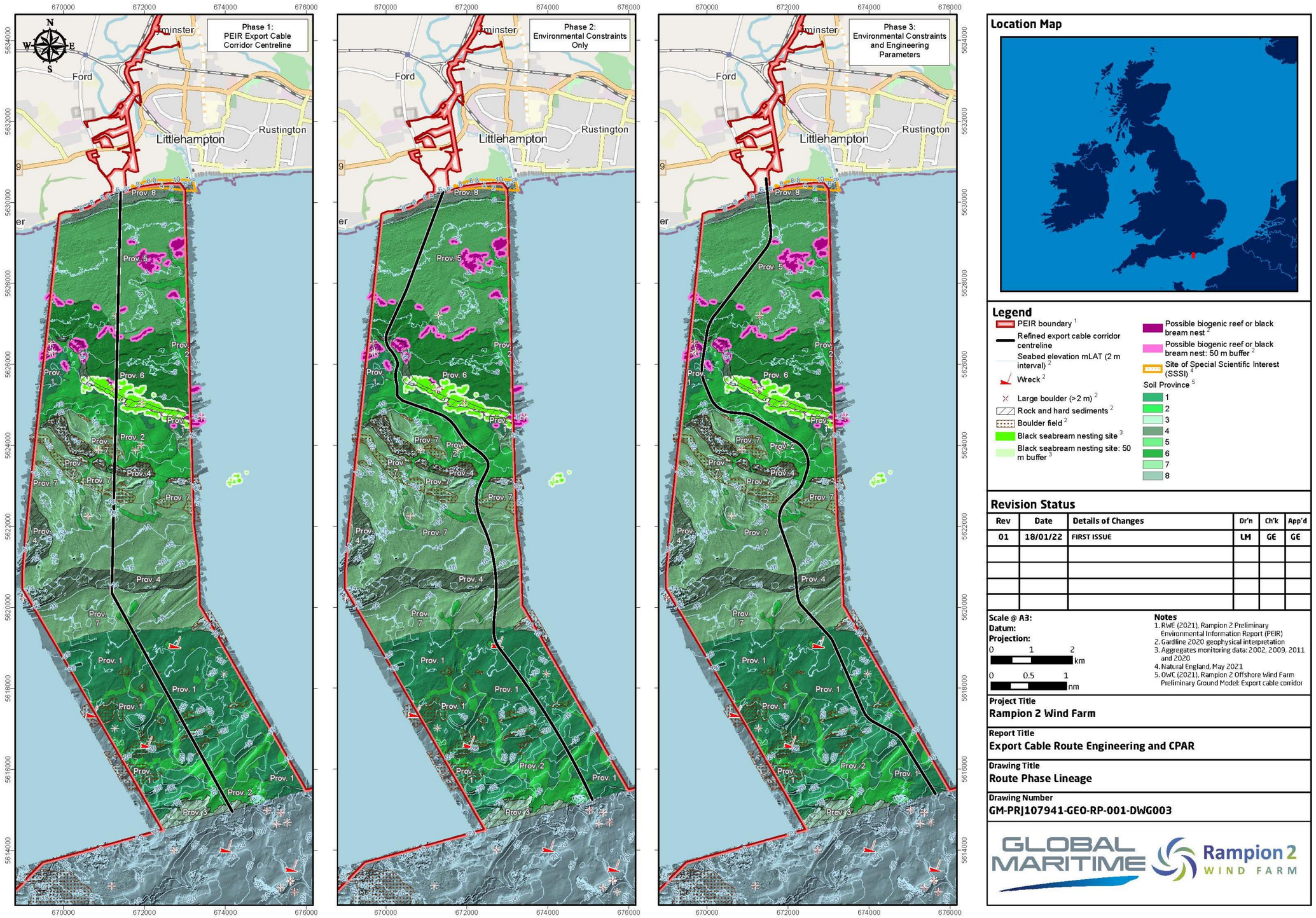
5.2.8 To illustrate the process from the initial routeing design exercise, indicative cable routes and refined offshore export cable corridor designs are shown below in **Figure 5.1** (located in this Plan page 40):

- The initial step is to define the offshore export cable corridor centreline. This acts as the shortest route between wind farm and landfall whilst maintaining maximum separation from the corridor perimeter, excluding all physical and technical constraints, and engineering design parameters (**Figure 5.1 Phase 1, l**ocated in this Plan page 40);
- The second step is to design a refined offshore export cable corridor centreline based on sensitive environmental receptor avoidance only (including relevant separation buffers) (**Figure 5.1 Phase 2,** located in this Plan page 40), but not considering technical constraints or engineering design parameters; and
- The final stage is to produce a further refined offshore export cable corridor centreline, which takes into account both the environmental constraints along with the technical constraints and design parameters (**Figure 5.1 Phase 3,** located in this Plan page 40).

5.2.9 This design process, which will be based on the final project parameters and pre-construction data, enables the generation of a refined offshore export cable corridor which both avoids sensitive environmental receptors and is feasible from an engineering and installation perspective.

5.2.10 Further detail on appropriate buffers and constraint rules associated with bream nesting areas and NERC reef habitats are given in sections below.

Figure 5.1 Route Phase Lineage (extract from Global Maritime routing study)



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Developing appropriate buffer distances for sensitive receptors

5.2.11 Whilst avoidance by routeing design reduces the potential for direct impacts from export cable installation works, the mitigation Plan will also utilise appropriate buffering from sensitive receptor locations to similarly reduce the potential for indirect impacts to arise.

5.2.12 Buffering distances from sensitive receptors will be set on the basis of the potential indirect effects of the cable installation as informed by the findings of the physical processes assessment work (**Chapter 6: Coastal processes, Volume 2** of the ES **[APP-047]**). As set out within the ES, this is predicted to comprise a maximum average local thickness of deposition in the case of predominantly gravelly sediments of 30 to 60cm, over an area up to 5 to 10m downstream of the trenching as the work proceeds along the length of the trench. For sands, the depositional area is greater, however this is predicted to be limited in terms of both deposition and extent, comprising a depositional depth range of 3-6cm over an area up to 100 to 200m downstream of the active trenching location as installation proceeds along the length of the trench. Fine sediment material is expected to become widely dispersed and although elevated SSC will result for a short period, elevated SSC levels will reduce gradually over time through dispersion, to less than measurable levels (<10mg/l) within two to three days. Furthermore, fines are not predicted to resettle on the seabed with measurable thickness locally.

5.2.13 Taking these results into account, noting that the exact nature of the disturbance will vary along the offshore export cable route depending on the sediment conditions, the final length of installed cable, burial depth, and burial method, buffer distances that will be adopted for the Final Plan for black seabream nesting locations and NERC habitats are set out below.

Black seabream nesting sites

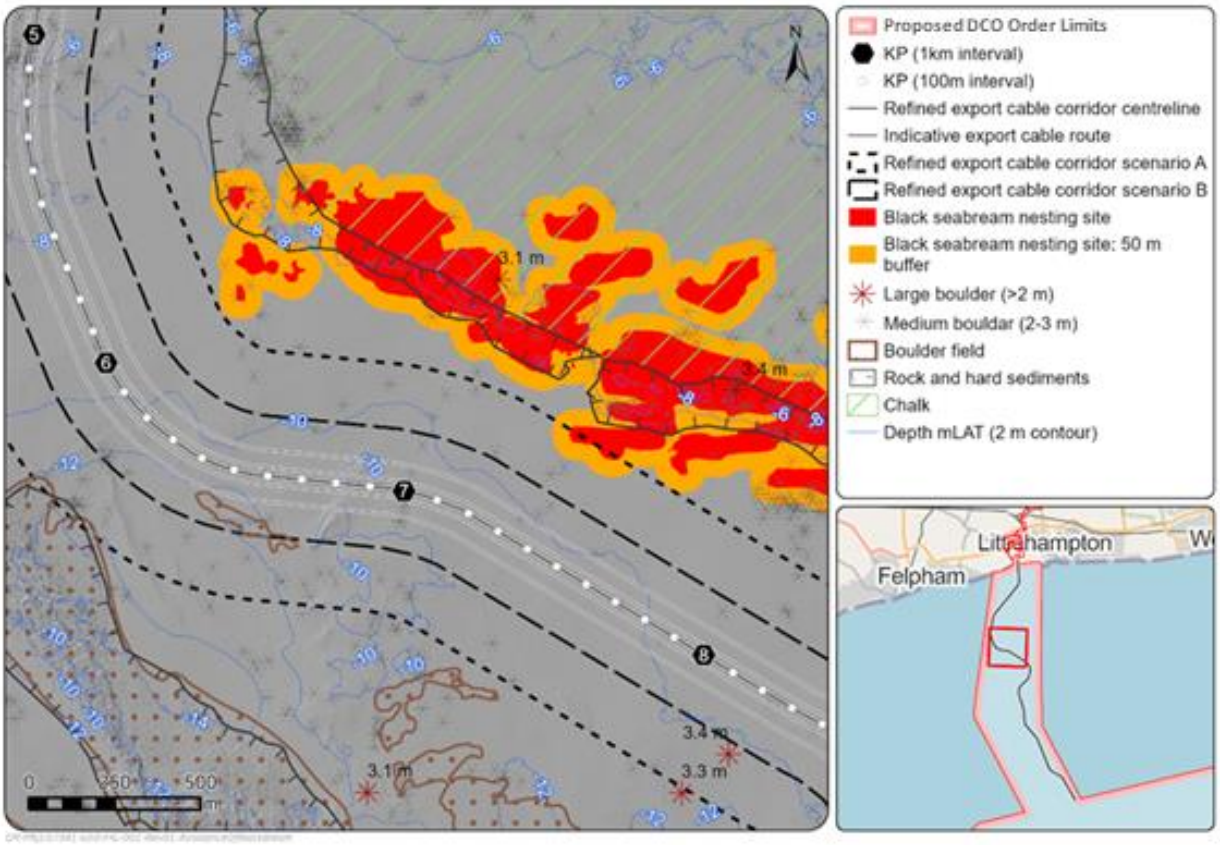
5.2.14 Known locations of black seabream nesting sites based on current data within the Rampion 2 offshore export cable corridor area are shown in **Figure 5.1** (located in this Plan page 40). For the Final Plan, principal densities and aggregations of these nesting sites will be mapped utilising historic desk studies, survey data drawn from the aggregates industry surveys, geophysical survey data for the export cable corridor carried out in 2020 and the pre-construction data that will be collected post-consent. Identified nest sites will be considered as a hard constraint and therefore routeing design will seek to avoid direct overlap with these areas as far as practicable.

5.2.15 In order to ensure sufficient separation distance from sensitive features is afforded in the routeing, a target distance for laying cables within the refined offshore export cable corridor (within the wider offshore export cable corridor area) for the outermost cable will be set at around 250m inside the refined offshore export cable corridor. For the purposes of the routeing, an additional 50m buffer will also be added outside of the refined offshore export cable corridor area (effected by adding this to the boundaries of each sensitive feature). This target for buffering will, therefore, provide for a separation distance of actual cable installation activity from the edge of any black bream nesting area of circa 300m, which will ensure protection of known bream nesting sites from any significant localised and

temporary re-suspension and settling of sediments as a result of cable installation activities. It should also be noted that even at pinch-points, should these occur in the final design, where separation distances may be for example of the order of 150m or so, this would still ensure that the area would not be subject to significant deposition effects, which are largely limited to an area within 50m of the works as set out in the physical processes assessment (**Chapter 6: Coastal processes, Volume 2** of the ES **[APP-047]**). Any such reductions of buffers that might be required will be clearly set out in the Final Plan, which will be submitted to MMO in consultation with Natural England for approval pre-construction.

5.2.16 An example graphic from the routeing design, avoiding a black seabream nesting area is presented in **Figure 5.2** below.

Figure 5.2 Example output from routeing study showing bream nest area and separation distance (extract from Global Maritime routeing study)

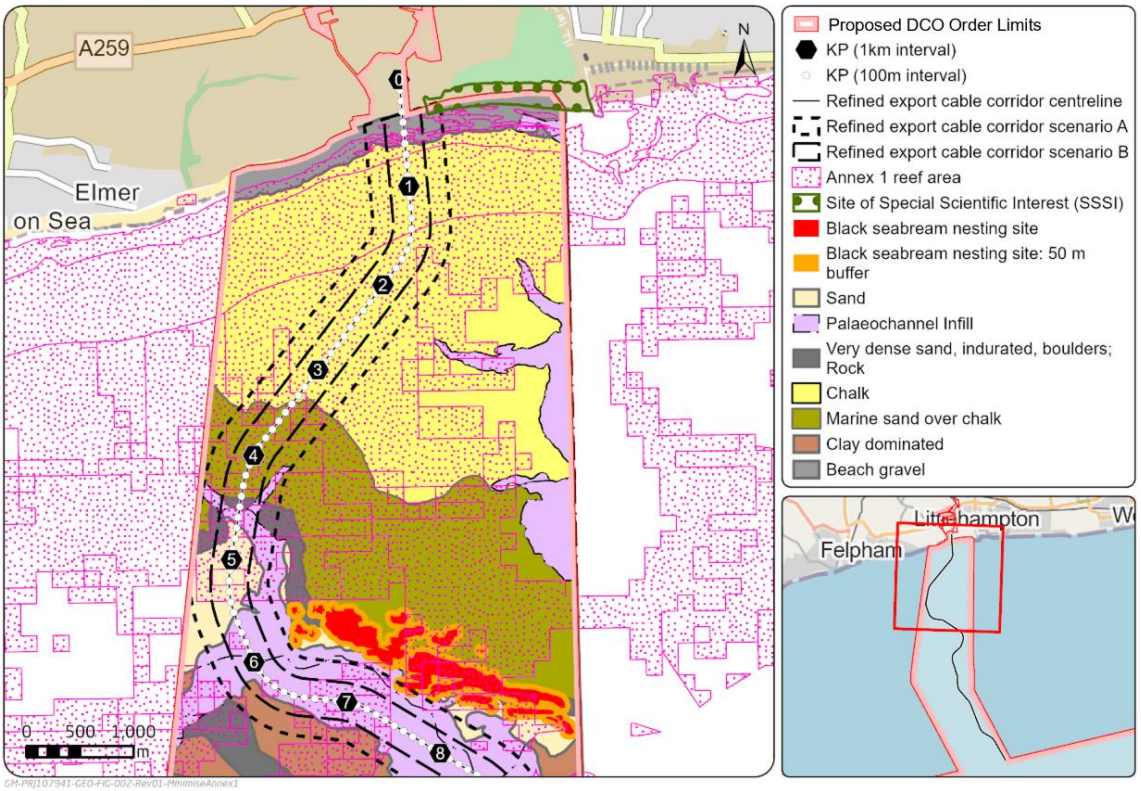


NERC reef habitats

5.2.17 NERC reef habitats within the route corridor take the form of rock reefs at seabed, formed by outcropping chalk, peat and clay exposures, and harder/indurated lithologies within the Palaeogene deposits. The same buffering distances will be applied to these features for the Phase 2 and Phase 3 routeing design presented above in relation to black seabream nest areas, with the objective of avoiding impacts to these features.

5.2.18 With reference to the extents of such features across the wider offshore export cable corridor area, whilst it is possible to avoid interaction with the majority, it will not be possible to provide complete avoidance of all reef features (see **Figure 5.1**, located in this Plan page 40). At points along the refined offshore export cable corridor where NERC reef habitats cannot be wholly avoided, the Applicant will seek to utilise the most appropriate equipment to minimise the width of disturbance through the feature (or permanent loss in the event that cable protection is used). In addition, and where relevant, the route will also take the shortest path through underlying chalk substrate, for example to the west of the offshore export cable corridor area to minimise the impact footprint and also to route into paleochannels infilled with soils where possible. An example of routeing around black seabream nesting areas, targeting paleochannels and minimising the distance over which interaction with chalk substrata and peat and clay exposures arises derived from the initial routeing design work is presented in **Figure 5.3** below.

Figure 5.3 Cable routeing through paleochannel, avoidance of bream nest area and minimised chalk and clay interaction (extract from Global Maritime routeing study)



Maximising export cable burial potential through route design to minimise cable protection

5.2.19 It is widely recognised in the offshore industry that burial is the most cost-effective means of achieving cable protection. In addition, minimising the use of cable protection at the seabed surface also serves to limit areas over which a longer-term change impact) to seabed habitats will arise, as the presence of such material can limit the potential for such areas to return to baseline condition through the action of natural sediment transport processes following cessation of construction activities.

5.2.20 The Applicant is committed to using only essential cable protection (i.e., where required for cable/pipeline crossings and should burial not be possible for sections of the cable length), in order to minimise effects on the Kingmere MCZ features and NERC habitats.

5.2.21 Routeing design will therefore be undertaken to maximise burial potential along the route and the targeting of paleochannels and areas where cable burial is most likely to be successful will be included as a criterion within the routeing design work in order to minimise the potential for secondary cable protection to be required. It is important to note that in the offshore export cable corridor area, in common with the wider area off the Sussex coast, the geological conditions are not entirely conducive to burial. Even so, many of the geological formations along the route are considered trenchable with mechanical cutting, although other formations that are strongly cemented are likely to pose an issue.

5.2.22 There is thus a hierarchy that will be followed in the routeing design, with (wherever possible) route design targeting sediment infilled paleochannels to maximise burial potential with conventional jetting methods, with trenchable geological formations targeted next, thus minimising cable routeing through harder more strongly cemented formations in the area.

5.2.23 **Chapter 4: The Proposed Development, Volume 2** of the ES **[APP-045]** provides a description of the types of cable protection that may be deployed at Rampion 2. The need for such be determined based on the results of the pre-construction survey and a route-specific cable burial risk assessment.

Use of specialist cable laying and installation techniques

5.2.24 Where relevant and required, the adoption of specialist offshore export cable laying and installation techniques will minimise the direct and indirect (secondary) seabed disturbance footprint to reduce impacts, which will provide mitigation of impacts to all seabed habitats, but particularly chalk, peat and clay exposures and reef areas, as well as potential (unknown) black seabream nesting locations, where avoidance is not possible. The Applicant will seek to utilise the most appropriate technology available at the time of construction to reduce the direct footprint impact from cable installation.

5.2.25 The design work to inform practical mitigation for the cable installation works undertaken at the pre-Application stage has included investigation of the techniques that can be employed to reduce impact footprints where this is required to reduce the potential for significant effects to arise. Whilst the initial offshore cable routeing exercise demonstrated feasible avoidance of the majority of the

sensitive features within the wider offshore export cable corridor area, it is recognised by the Applicant that there remain instances where full avoidance will not be possible as described above, in addition to uncertainties on the locations of 'all' bream nesting activities, where this has not been identified with sufficient confidence from the available survey data to comprehensively represent in mapping.

5.2.26 The following sections therefore provide additional information on the techniques, approaches and equipment that are available to ensure both direct (footprint) and indirect (SSC and deposition) effects are reduced for all receptors, both known and unknown. The mitigation is aimed at reducing impact risks to non-significant levels for NERC features and potential (unknown) black seabream nesting locations, where avoidance is not possible in the final routeing design.

Cable installation methodology

5.2.27 With regards to trenching and burial, it is clear from the geophysical survey data for the offshore export cable corridor area that a mechanical trencher is required to achieve burial in chalk areas without sufficient soft sediment cover. There are a number of considerations as to which particular trenchers may be suitable, which are not resolvable at the pre-consent stage as noted previously. Key considerations include:

- The need or requirement for a support vessel to house pumps and power systems;
- The ability to operate in lay-back from a cable lay barge, and the distance over which this is possible;
- The degree of disturbance to the seabed, both in terms of the dimensions of the trench excavated, and the disturbance caused by machine tracks;
- The manoeuvrability of the trencher and ability to traverse seabed irregularities; and
- The ability of the nearshore trencher to continue on to successfully complete the offshore scope, thus reducing both repeat impact to the environment and mobilisation costs.

5.2.28 However, there are a number of potentially suitable trenching solutions available, which would reduce the temporal and spatial impact to the NERC features, as well as minimise suspended sediment impact to the black seabream nest areas, examples of which are presented below. Details of the specific equipment that would be utilised, if required, will be presented in the Final Plan.

Aratellus Leviathan – Onshore, Nearshore and Offshore Mechanical and Jet Trencher

5.2.29 The Aratellus Leviathan – Onshore, Nearshore and Offshore Mechanical and Jet Trencher utilises a combination of a mechanical cutting chain and jetting to deliver burial in a post-lay mode. It is unique in its capability to automatically self-level through a suspension system, and to independently steer it's front and rear tracks, giving enhanced manoeuvrability. It is largely independently operated but would require a separate support vessel for shallow water and beaching operations.

5.2.30 This trencher could continue from the nearshore section to trench the remainder of the route in both jetting and cutting modes. The total footprint of the trencher is small in comparison to other cable laying equipment such as cable ploughs, being approximately 4m, with the direct trench cutting area of 1m, and a trenching speed of approximately 75-100m an hour.

Van Oord Deep Dig-It – Nearshore, Offshore Mechanical and Jet Trencher

5.2.31 A similar proposition to the Aratellus Leviathan with deeper burial capability and more power, but less manoeuvrable. The Van Oord Deep Dig-It – Nearshore, Offshore Mechanical and Jet Trencher is remotely operated and therefore does require support vessels in the nearshore environment.

5.2.32 Other trenchers exist on the market for nearshore conditions, in hard seabed soils and soft rocks, such as Enshore's T1 and SWT1 combined jetting and cutting trenchers.

Seasonal restriction for cable installation works

5.2.33 As described previously, during the breeding season, black seabream are reported to return to the same area every year. As a result of this focused area of nesting activity, Kingmere MCZ was created to protect this important breeding and spawning site and enforced seasonal restrictions on certain activities during the black seabream nesting period. Although the restricted period is specifically relevant to the protected site, the same spawning period also applies to bream nesting outside of the MCZ boundaries. Additionally, whilst Rampion 2 is outside of the MCZ, the proximity of the Proposed Development to the MCZ requires consideration in terms of indirect impacts arising, in this instance from the cable installation works.

5.2.34 The mitigation measures presented in the preceding sections will ensure that direct impacts to known black seabream nesting areas can be avoided and that installation methodologies can be employed to ensure indirect impacts do not pose a risk of significant effect to spawning habitats for the species. The adoption of the installation methodologies also results in mitigation, by impact footprint reduction, for areas where bream may nest but which are not represented in the available data sets. Notwithstanding, it is recognised that even with these mitigation measures in place, there is the potential for a risk of impact through disturbance to nesting black seabream or, for unknown seabream nesting areas at least, an uncertain level of risk of direct or indirect effects arising from the seabed disturbance during offshore cable laying, together with subsequent raised SSC and deposition.

5.2.35 In order to provide a higher level of protection to avoid potential for significant effects to arise, the Applicant has also committed to a seasonal restriction on the offshore export cable corridor installation works. As black seabream vacate nests outside of the breeding season, the impact of disturbance to nesting individuals from the offshore export cable installation is only relevant during the breeding season, therefore the Applicant is committed to ensuring that all cable installation activities within the offshore export cable corridor area are undertaken outside of the identified breeding season of March to July.

5.3 Mitigation of noise generated by foundation installation within the offshore array area

5.3.1 The piling noise mitigation plan presented below sets out the approaches and methodologies proposed to be employed to provide mitigation of construction noise impacts offshore identified in the ES that could lead to potentially significant effects. The Plan draws upon engagement undertaken throughout the pre-application phase, including statutory consultation and through the Evidence Plan ETG meetings. The proposed approaches to delivering mitigation for potentially significant effects are supported by information and examples of the types of equipment that may be used. Details of available mitigation technology have been presented to provide confidence that the required levels of noise attenuation can be delivered (either through one of the examples given, or through other future potential mitigation technology) and can therefore be relied upon to avoid potentially significant effects that may arise in the absence of mitigation.

5.3.2 Delivery of the plan and measures are secured within the draft deemed Marine Licence (dML) Condition 11 of Schedules 11 and 12 of the draft DCO to provide certainty on the provision of the mitigation commitments made by the Applicant in progressing the development of Rampion 2, whilst maintaining the flexibility required at the pre-consent stage, allowing the Applicant to select the most appropriate options closer to the time of construction works, once project design has been finalised.

5.3.3 The principles underpinning the foundation installation activities (piling) mitigation are set out below in **paragraph 5.3.4**. The primary driver for the noise mitigation Plan is avoidance of significant effects on noise sensitive species during breeding/nesting periods. As set out within **Chapter 8: Fish and shellfish ecology, Volume 2** of the ES **[APP-049],** the full range of noise impacts (mortality/permanent injury, temporary injury or disturbance) have been assessed, however ranges of mortality or injurious effects are predicted to be very localised, even with unmitigated piling scenarios, and not found to represent an impact at a population scale on any receptor. The mitigation measures are therefore focused on the lower noise levels that might still elicit potential Temporary Threshold Shift and behavioural disturbance responses during these sensitive periods on sensitive receptors. Noise sensitive receptors comprised a range of species, as assessed within the ES, but notably include black seabream, seahorse and herring.

- Black seabream
  - Recognising that the wider area in the vicinity of the Kingmere MCZ is known to support black seabream spawning (nesting), there is a focus for the mitigation on the MCZ itself as it is within this site that specific protection is afforded to the species during the spawning season. Notwithstanding, a reduction in noise propagation extents as a result of the mitigation measures proposed will ensure an attendant reduction in the risk of impact to all nesting areas for the species in the wider area.
- Seahorse
  - Records of seahorses are limited across the south-eastern region, however there are specific MCZs where seahorse is a listed feature (see Section 2) where the species will be focused whilst breeding through the summer

period. As outlined for black seabream, there are also wider areas within which seahorse will represent noise-sensitive receptors, specifically during the overwintering period for these species when it is understood they migrate to deeper waters further offshore. As noted above, the focus of the noise mitigation Plan is on the relevant MCZ sites where seahorse are a designated feature, with offshore piling noise attenuation measures mitigation applied to construction activities also minimising risks of noise impacts to seahorse when in its overwintering phase, where it remains protected under The Wildlife and Countryside Act (1981).

- Herring
  - With regard to herring, the mitigation measures and approach presented in this Plan will provide mitigation for the risk of disturbance to herring spawning activity through the reduction in noise propagation extents effected by the measures, however on the basis of the evident separation distance from the locations of piling, there is a low risk of any adverse effects arising even without mitigation as set out within **Chapter 8: Fish and shellfish ecology, Volume 2 [APP-049]**. The focus of this Plan is to set out the required mitigation measures, for qualifying features of designated sites. The noise abatement offered by the proposed mitigation as detailed within this Plan, is detailed as relevant to herring in **Applicant's Post Hearing Submission – Issue Specific Hearing 1 Appendix 9 - Further information for Action Points 38 and 39 – Underwater Noise [REP4-061]**. As detailed in paragraph 5.3.57 *et seq*. of this Plan, the Applicant has committed to the implementation of DBBC throughout the piling campaign. The implementation of this measure will successfully mitigate against impacts to spawning herring, with underwater noise impact ranges reduced such that there is no overlap with areas of key importance to spawning herring (as presented in Figures 3.5 to 3.8 in **Applicant's Post Hearing Submission – Issue Specific Hearing 1 Appendix 9 - Further information for Action Points 38 and 39 – Underwater Noise [REP4-061]**.

Design principles for the spatial and temporal zoning plan

5.3.4 The noise mitigation plan has been designed on the following principles:

- Noise abatement in the form of DBBC will be in place for the entirety of the piling operations with additional measures put in place during the black seabream breeding season.
- Noise abatement is focused on reducing noise immission levels at the locations of sensitive receptors (i.e., at relevant MCZs) below the level at which a meaningful behavioural response might be expected to occur, which could then result in a significant effect on the breeding population (of black seabream or seahorse) during the breeding/nesting season, subsequently impacting upon the conservation objectives for the MCZ.
- Assumptions on attenuation performance of the noise mitigation techniques are based on demonstrable performance of the technology, in relevant

environmental conditions to ensure confidence in delivering the required noise level reductions.

- Actual installation equipment choice and secondary noise abatement techniques will be selected pre-construction but will conform to the noise reduction levels required to meet the criteria set for the piling zonation plan.

5.3.5 In developing the spatial zoning strategy, the primary noise mitigation measure proposed is DBBC (the Project has committed to the use of DBBC throughout the piling campaign). Further details of bubble curtain systems are set out below.

Double Big Bubble Curtain (precautionary assumption 15dB reduction in source level)

5.3.6 Bubble curtains are the only far-from-pile noise abatement system available on the market and comprise either the single or double Big Bubble Curtain (BBC or DBBC respectively). These abatement systems have been widely utilised in the offshore renewables industry and is the most common method for reducing underwater noise emissions for offshore wind piling activities.

5.3.7 Bubble curtain systems solution pump compressed air through a perforate hose / pipe laid in a circular configuration on the seabed. The compressed air is then released from the seabed and creates a ‘curtain’ of rising bubble rings, also known as a pneumatic barrier, which is used to attenuate the propagation of sound waves through the water column, thus reducing noise emissions.

5.3.8 Bubble curtain systems are deployed from a secondary vessel supporting the main installation vessel. The vessel is normally a platform supply vessel (PSV) with a number of air compressors on the back deck and a launch and recovery system for the perforated hose/pipe. The PSV is required to be on site for the full period that the main installation vessel is chartered to a project.

5.3.9 Bubble curtain systems have been proven to provide efficient noise reduction and are suitable for use in Germany where the emissions level limit is 160dB SEL at 750m from the source (Bellmann *et al*, 2020). Noise reductions of up to 16dB have been achieved by means of use of DBBC, at 40m water depth (Bellmann *et al*, 2020). Taking into account the efficacy of DBBC within the environmental conditions of the site, for the proposed turbine locations with water depth ≤ 40m, overall noise reductions of up to 15dB are anticipated (as detailed in **Information to support efficacy of noise mitigation / abatement techniques with respect to site conditions at Rampion 2 Offshore Windfarm (Document Reference 8.40)**). The efficacy of the system has also been demonstrated by empirical monitoring data collected during piling at another RWE project, the details of which have been shared (confidentially) with the MMO, Cefas and Natural England.

5.3.10 Besides the use of DBBC, other noise abatement measures may be used in combination, as appropriate and practicable. These could include the following:

- General hammer noise mitigation;
- Low noise installation hammers; or
- Hydrosound damper.

5.3.11 Examples of these types of equipment are provided below.

General hammer noise mitigation

5.3.12 Procedural measures such as “HiLo” can be implemented to reduce noise emissions. This procedure uses a high frequency low energy blow method and has been proven to have good noise control capabilities but may not be suitable for all ground conditions due to the lower energies utilised.

PULSE hammer (by IHC IQIP) (6 to 10dB reduction in source level[2])

5.3.13 As a result of the need to reduce noise emission from percussive hammering construction activities, IHC IQIP has developed an add-on noise mitigation which can be jointed with all existing hammers and will sit between the ram-weight and the anvil, called PULSE (Pile Under Limited Stress), it consists of two pistons with a water cushion of 150 – 300mm.

5.3.14 For the S-4000 model, currently the largest hammer available from this company, IHC IQIP have calculated a noise reduction capability of 6 to 10dB.

5.3.15 To ensure a precautionary approach, an assumption of 6dB reduction in piling noise has been made for this equipment[3].

MNRU hammer by MENCK (9 to 12dB reduction in source level[4])

5.3.16 The biggest hammer MENCK has currently build is the MHU-4400. The MHU-4400 was built during 2020 and is currently available for use. A 5500 – 6000kJ hammer is currently being planned but further information is not currently available.

5.3.17 MENCK has enveloped a noise mitigation unit, the MNRU, for its hammer. The unit is inserted between the ram weight and the anvil. The unit consists of six individual round silencer blocks (800x800) acting like a spring. The blocks are guided inside and connected to the housing using plastic/nylon strakes. The unit is currently designed to be used on the 3500kJ and 4400kJ hammer. The maximum hammer energy Rampion 2 is applying for as part of the DCO application is 4,400kJ.

5.3.18 The unit has been used on the Borsele I + II project and a follow up meeting would be organised with MENCK to fully understand the performance of the system with respect to use at Rampion 2.

5.3.19 MENCK has modelled the estimated reduction of the MNRU which resulted in a Sound Exposure Level (SEL) reduction of 9dB and peak reduction of 12dB.

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[2] https://windeurope.org/ElectricCity2021/files/exhibition/exhibitor-highlight/iqip/iqip-pulse-piling-brochure.pdf (Date accessed: 1 August 2023)

[3] It should be noted that detailed octave or 1/3rd octave band attenuations for the PULSE (IQIP) and MNRU (MENCK) hammers were not supplied despite direct requests, and therefore these predictions are made with limited data and should be considered indicative for the equipment and conditions at Rampion 2.

[4] https://acteon.com/blog/challenges-of-offshore-underwater-acoustic-pollution/ (Date accessed: 1 August 2023)

5.3.20 To ensure a precautionary approach, an assumption of 9dB reduction in piling noise has been made for this equipment[5].

Hydrosound Damper

5.3.21 The Hydrosound Damper (HSD) is a near-field resonator system which is deployed in close proximity to the pile. The system essentially comprises a tubular mesh with sound dampening elements attached to the mesh which is deployed from a lowering/lifting system and a ballast box.

5.3.22 The sound dampening elements consist of various foam elements which can be of a range of sizes and materials. Each of these foam elements acts as a local resonator, which can be tuned in relation to sound frequencies and water depth criteria. The HSD is deployed around the pile from the seabed to the water surface, effectively shrouding the entirety of the pile within the water column.

5.3.23 When suitably designed and deployed, the system can reliably deliver noise reductions of 10dB as demonstrated on several hundred pile installations across five offshore wind farm projects in German waters (Bellmann *et al*., 2020).

Efficacy of mitigation measures at the Proposed Development

5.3.24 Additional work has been undertaken to provide a comparison of the environmental conditions at the Proposed Development with other projects where NAS have been deployed. The outputs of this work are detailed in **Information to support efficacy of noise mitigation / abatement techniques with respect to site conditions at Rampion 2 Offshore Windfarm [REP4-067].** This report was produced by ITAP who have considerable experience monitoring noise abatement measures in Germany.

5.3.25 As detailed in **Information to support efficacy of noise mitigation / abatement techniques with respect to site conditions at Rampion 2 Offshore Windfarm [REP4-067]**, live monitoring of numerous projects whereby NAS have been applied successfully (in accordance with German noise regulations), have made it evident that noise reductions delivered through currently available noise mitigation or abatement systems may not reliably deliver reductions greater than 20dB. Whilst greater noise reductions could be possible through equipment development or improvement, or through methodology adaptation in the future, in consideration of the currently understood soil conditions and bathymetry at the Proposed Development site, a precautionary approach has been adopted in developing the zoning exercise.

5.3.26 In consideration of the site characteristics and noise abatement levels it is apparent that up to 20dB noise reduction can be achieved (within depths of ≤ 40m, and other environmental parameters), through the use of a combination of measures, comprising the DBBC as the principal measure, together with an

[5] It should be noted that detailed octave or 1/3rd octave band attenuations for the PULSE (IQIP) and MNRU (MENCK) hammers were not supplied despite direct requests, and therefore these predictions are made with limited data and should be considered indicative for the equipment and conditions at Rampion 2.

additional noise abatement measure, which will be selected based on the most appropriate equipment available at the time of construction (see examples provided above).

5.3.27 The noise abatement of up to 20dB (rather than 22dB or 25dB as presented in the **In Principle Sensitive Features Mitigation Plan [REP3-045]** (updated at Deadline 4), has therefore been modelled for monopile and multileg foundations, to establish the potential implications on the proposed mitigation measures.

Developing an appropriate disturbance threshold

5.3.28 In order to design the noise mitigation zoning plan, it is necessary to establish a level of noise below which the risk of an effect arising is reduced to an acceptable level. This allows the areas within which piling can be undertaken to be delimited by identifying the relevant distances between noise source (piling location) and receptor (relevant MCZ) when applying different noise abatement techniques. In the absence of definitive empirical data, as is the case with behavioural responses of marine fish species, best use of relevant available data is required along with a proportionate level of precaution to address attendant uncertainties.

5.3.29 Whilst agreement on the appropriate threshold has not been reached through pre-application engagement and consultation, the zoning plan will apply a precautionary disturbance threshold of 141 decibels (dB) SEL_{ss}[6] based on research by Kastelein *et al*. (2017), which concluded that seabass (a fish species of the same order as seabream) exhibited an initial reaction to impulsive noise at levels of 141 dB SEL_{ss}, noting that the response was short lived, and further that there was no evidence for any consistent sustained response at levels up to 166 dB SEL_{ss}. The study concluded that exposure to noise at this level was unlikely to result on any adverse effects on their ecology. It is also important to note that this noise level is substantially below the 147 dB SEL_{ss} from research by Radford *et al*. (2016), which showed a minor stress response (increased ventilation) in the proxy species seabass when exposed to simulated pile driving noise.

5.3.30 The appropriateness of the 141 dB SEL_{ss} threshold was also supported by an alternative approach to defining a meaningful threshold for behavioural response using noise level relative to (i.e., above) the existing background (ambient) soundscape at Kingmere MCZ. There is supporting information in the literature for the importance of context (as well as physiology/anatomy) in the hearing ability and potential reactivity of fish to noise impacts (e.g., Popper and Hawkins, 2019), particularly in behavioural studies; the key distinction being the difference between background noise and the received sound of interest, often referred to as a signal-to-noise ratio. This approach also serves to reduce uncertainty around defining a threshold based on a low number of empirical studies, the majority of which are drawn from studies on suitable proxy species, by ensuring context relevance is factored in.

5.3.31 From the studies reviewed, an increase of 30 dB above ambient noise levels was identified as representing an appropriate benchmark and this was used in conjunction with existing data from measured ambient noise levels at sea at the

[6] SELss : Sound Exposure Level (single strike)

Rampion 1 site (Collett *et al*., 2012). The values from the Collett *et al*. (2012) study showed a baseline of 113 to 120 dB SPL_{RMS}, which was recorded prior to wind turbine foundation installation. On this basis, 30 dB above the ambient noise at the site would therefore be 143 to 150 dB, which equates relatively closely to the thresholds for disturbance response developed from the studies noted above (i.e., 141-147 dB).

5.3.32 Additional information was obtained from the underwater noise monitoring survey at Kingmere MCZ in July 2022 (RED, 2022b), recording background noise levels, including SPL_{RMS} (underlying noise level) and SPL_{peak} (highest noise level within sample period) over a 15-day period, at a resolution of one minute intervals. Clear cyclical variations were evident in the data, driven by tides: the periods of high tidal flow leading to the highest background noise in a day. A typical minimum background noise level during low tidal flow periods was 103 dB SPL_{RMS}, whereas during periods of high tidal flow the background level commonly exceeded 120 dB SPL_{RMS}. Peak noise levels naturally occurring were normally in excess of 140 dB SPL_{peak} and exceeded 160 dB SPL_{peak} at multiple times on any given day.

5.3.33 As it is recognised that the ambient noise survey undertaken at Kingmere MCZ was relatively short-term (15 days), the Applicant has completed further continuous monitoring at the same location through the March to July period in 2023, this is documented in **Appendix 8.4: Black Seabream Underwater Noise Technical Note and Survey Results - Revision A, Volume 4 [PEPD-023]**. The aim of this work is to provide for a longer period of monitoring to provide the insight into variations, maxima and minima of ambient noise levels in the vicinity of the MCZ and provide a more robust basis for developing and supporting an acceptable disturbance threshold for black seabream, specifically relevant to the Kingmere MCZ site.

5.3.34 The 2023 results support the findings of the 2022 survey and demonstrate that noise levels varied generally between 105 dB and 125 dB SPLRMS, although exceedance of 135 dB SPLRMS and 140 dB SPLRMS was observed. In respect of SPL_{peak} noise levels, measurements of up to 150 dB SPL_{peak} were a typical daily occurrence and occasional events led to exceedances of over 160 dB SPL_{peak}. As such, the results support the setting of a baseline against which an exceedance-based threshold can be taken forward. In addition to this, Sussex IFCA stated in its Relevant Representation **[RR-380]** *"The threshold for disturbance of breeding black seabream is unknown, therefore we suggest a baseline of background noise occurring during a successful nesting season is used to inform a suitable target for noise abatement mitigation to achieve"*

5.3.35 These data will inform the Final Plan, which will be submitted to MMO in consultation with their advisors and Natural England prior to commencement of construction, as secured within Condition 11 and 12 of Schedules 11 and 12 of the draft DCO.

Spatial and temporal zoning plan design

5.3.36 The following sections set out the initial zoning plan across the offshore array area, incorporating both temporal (seasonal) and spatial elements. The development of the zoning plan has been based on site-specific information, such as bathymetry, and underwater noise modelling, using data on the efficacy of

mitigation techniques to provide for protection of sensitive noise receptors, being informed by receptor sensitivity and location. The proposed mitigation strategy has been developed on the basis of measures that deliver the most effective underwater noise abatement, whilst retaining economic viability for Rampion 2.

5.3.37 As noted previously, the Final Plan will be designed on the basis of the finalised project, installation methodologies and specific noise abatement equipment, however a zoning plan based on the maximum design scenario is presented below to illustrate the approach that will be adopted.

Zoning exercise

5.3.38 A zoning exercise was undertaken to delimit areas of the offshore array area where piling could be undertaken whilst maintaining noise levels below a 141dB re 1 μPa^2s (SEL single strike (ss)) threshold, either with or without the application of noise abatement measures. Where areas within which noise modelling indicated immission levels at the MCZ would exceed this threshold, noise abatement mitigation was applied (either singly or in combination) and noise propagation re-modelled to identify distance limits from the MCZs at which the required noise threshold could be achieved at receptor locations. These outputs were then used to develop a zoning plan of areas that would be subject to specific mitigation values during sensitive periods, i.e., black seabream at Kingmere MCZ during the spawning/nesting season, and seahorse during its summer breeding season, when resident at the relevant MCZs Beachy Head East and West MCZs, and the Selsey Bill and the Hounds MCZ.

5.3.39 Underwater noise modelling was undertaken for the worst-case piling scenarios with noise abatement systems implemented, for both the installation of monopile and multileg foundations. The following worst-case piling scenarios were modelled:

- 13.5m diameter monopiles, 4,400kJ hammer energy; and
- 4.5m diameter pin piles for multileg foundations, 2,500kJ hammer energy.

5.3.40 The noise abatement systems modelled are presented below alongside the source level reduction that may be expected when implemented. The noise reduction levels have been informed by the outputs of the assessment presented in the document **Information to support efficacy of noise mitigation / abatement techniques with respect to site conditions at Rampion 2 Offshore Windfarm [REP4-067]**, and available literature, with minimum reduction values used to inform the modelling where performance ranges are provided:

- DBBC – 15 dB reduction in source level; and
- DBBC and another noise abatement measure – 20 dB reduction in source level.

5.3.41 Behavioural impact ranges for both black seabream and seahorse have been modelled using the 141dB re 1 μPa^2s (SEL_{ss}) threshold, based on the findings of Kastelein *et al*. (2017) as set out previously. The maximum extents of the noise contours were aligned with the nearest MCZ boundary (Kingmere MCZ) and used to delineate a piling exclusion boundary across the Rampion 2 array area. In doing so, a piling exclusion area is defined, within which piling activities would be

predicted to exceed the 141dB re 1 μPa^2s (SEL_{ss}) received noise threshold within the MCZ. Piling in areas outside of these exclusion zones would not result in an exceedance of this noise level within an MCZ.

5.3.42 The noise contours used to delineate exclusion buffers for each piling and noise abatement system scenario, in relation to the MCZs are presented in **Figure 5.4** to **Figure 5.7** below (located in this Plan pages 58 to 62). The zoning plans derived from the modelling outputs for each foundation type (i.e. monopile and multi-leg) are presented in the relevant sections that follow, specified for the relevant months of the sensitive breeding / spawning / nesting periods (paragraph 5.3.48 *et seq*., paragraph 5.3.50 *et seq*., and paragraph 5.3.52 *et seq*.,).

Figure 5.4 Mitigated monopile piling impact contours (141dB re 1 µPa2s (SELss)) used to define piling exclusion zones (DBBC) (15dB reduction)

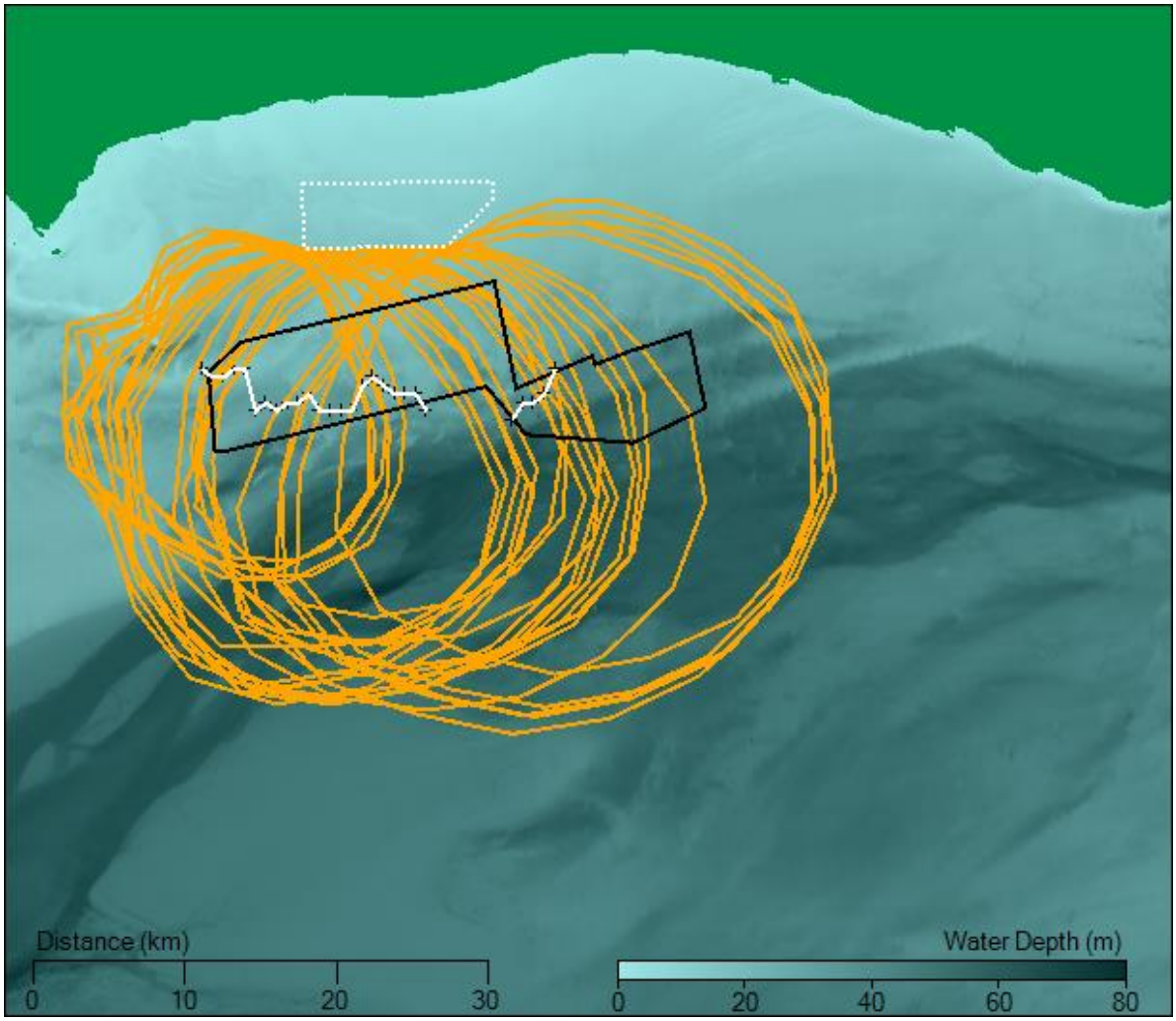


Figure 5.5 Mitigated multileg foundation piling impact contours (141dB re 1 µPa2s (SELss)) used to define piling exclusion zones (DBBC) (15dB reduction)

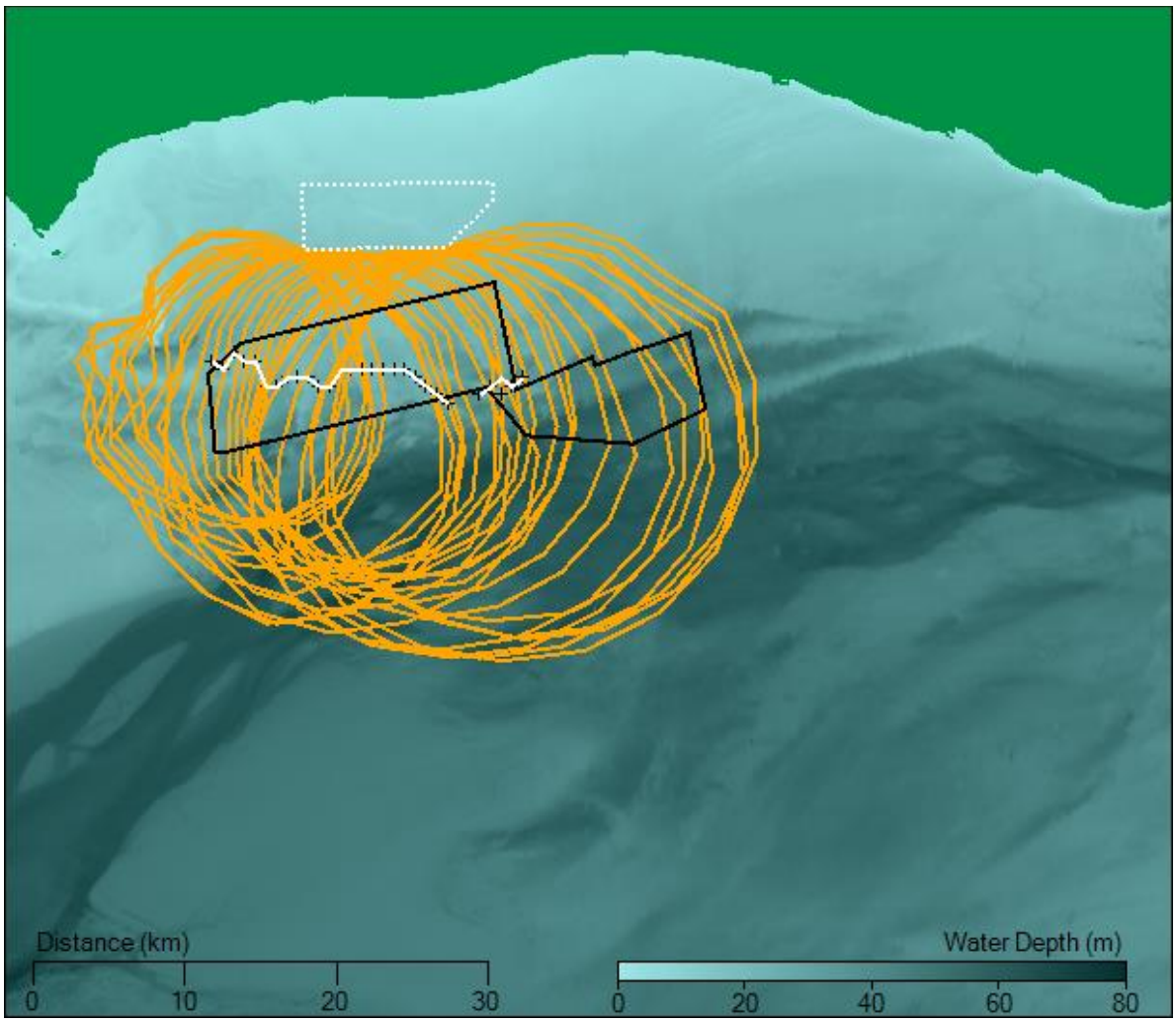


Figure 5.6 Mitigated monopile piling impact contours (141dB re 1 µPa2s (SELss)) used to define piling exclusion zones (DBBC and hammer mitigation) (20dB reduction)

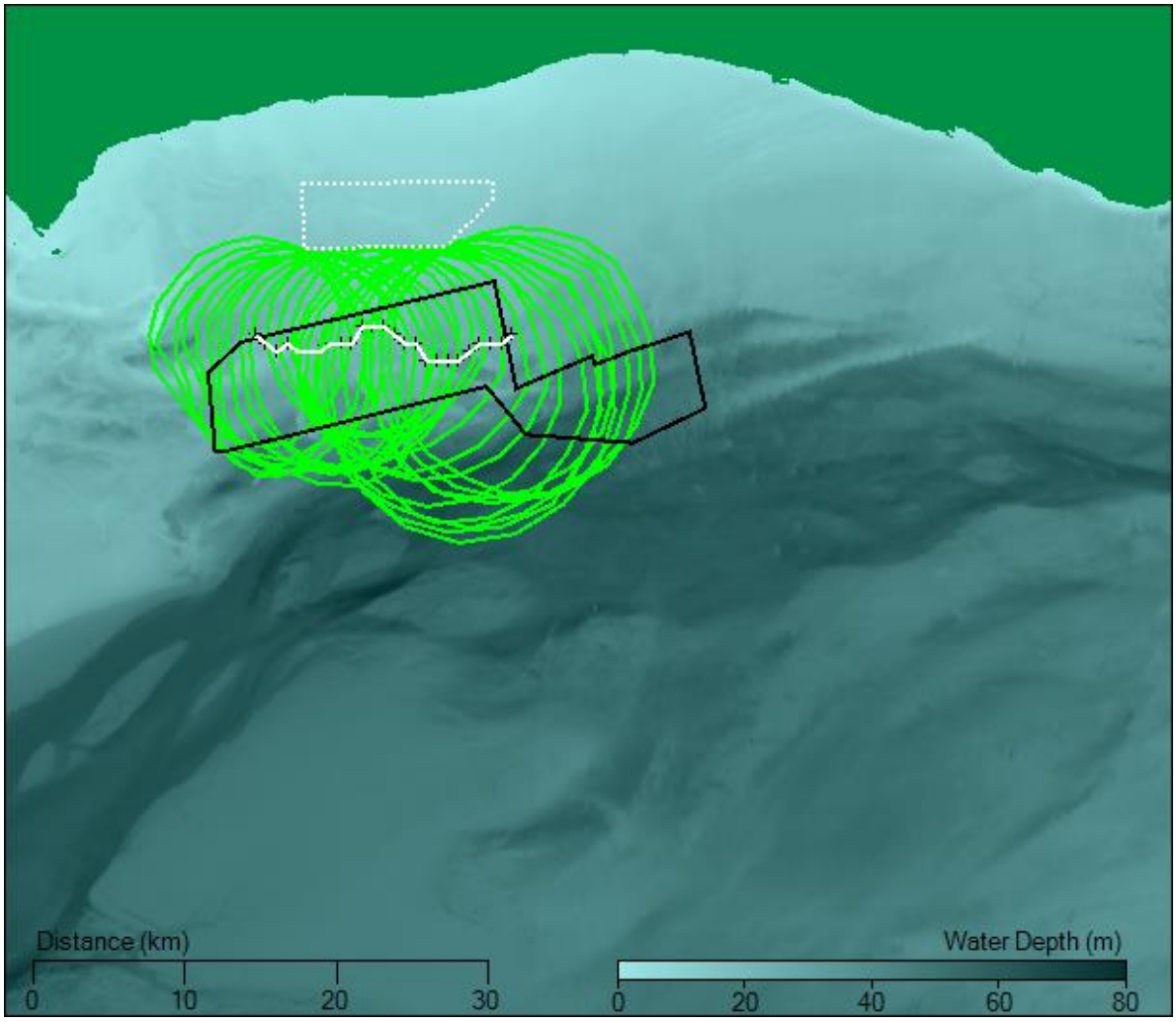
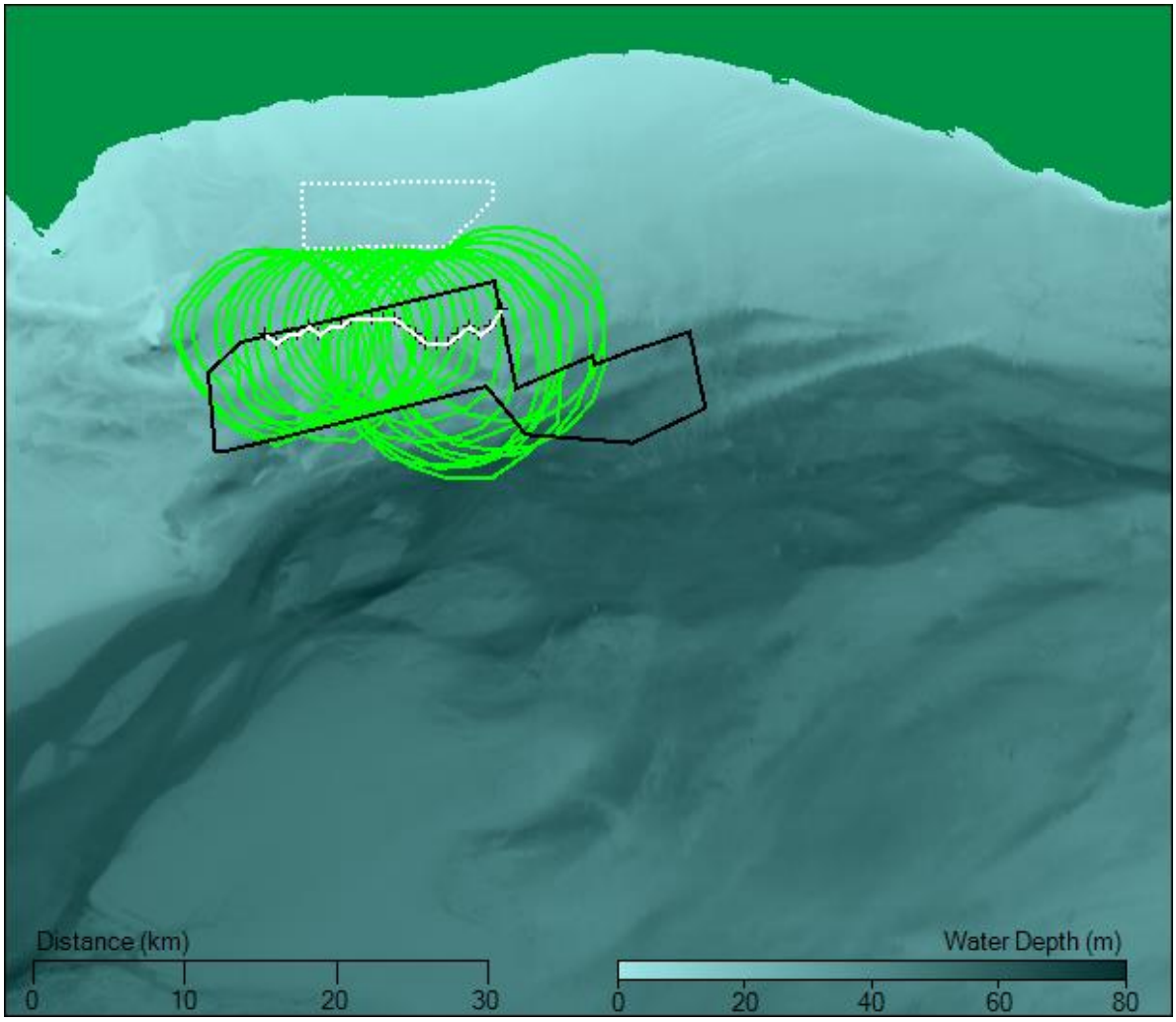


Figure 5.7 Mitigated multileg piling impact contours (141dB re 1 µPa2s (SELss)) used to define piling exclusion zones (DBBC and hammer mitigation) (20dB reduction)



5.3.43 The modelling outputs depicted in **Figure 5.4** to **Figure 5.7** (located in this Plan pages 59 to 62) define areas within which mitigated piling using DBBC noise abatement techniques, or a combination of DBBC and another noise abatement measure serves to reduce received noise levels at the relevant MCZs below a disturbance threshold of 141dB re 1µPa2s (SELss) during the March to July spawning/nesting period for black seabream. The remaining areas of the offshore array therefore become piling exclusion areas during the same period, as the available mitigation techniques do not provide sufficient noise reduction to ensure that noise immission levels at the MCZs are below this threshold.

5.3.44 Taking this forward, and using the assumption of the maximum design scenarios for both monopile and multileg foundations, **Figure 5.8** to **Figure 5.11** (located in this Plan pages 64 to page 65) show the Rampion 2 boundary alongside the Kingmere MCZ, the Beachy Head East and West MCZs and the Selsey Bill and the Hounds MCZ. The red area on each plot shows the piling exclusion areas derived from the modelling, according to the following scenarios:

- Piling of monopiles, with DBBC (15dB reduction) (**Figure 5.8,** located in this Plan on page 62);
- Piling of multileg foundations, with DBBC (15dB reduction) (**Figure 5.9,** located in this Plan on page 65);
- Piling of monopiles with DBBC and another noise abatement measure (20dB reduction) (**Figure 5.10**, located in this Plan on page 66); and
- Piling of multileg foundations with DBBC and another noise abatement measure (20dB reduction) (**Figure 5.11** located in this Plan on page 67);

Figure 5.8 Piling exclusion zone for the piling of monopiles, with DBBC (15dB reduction)

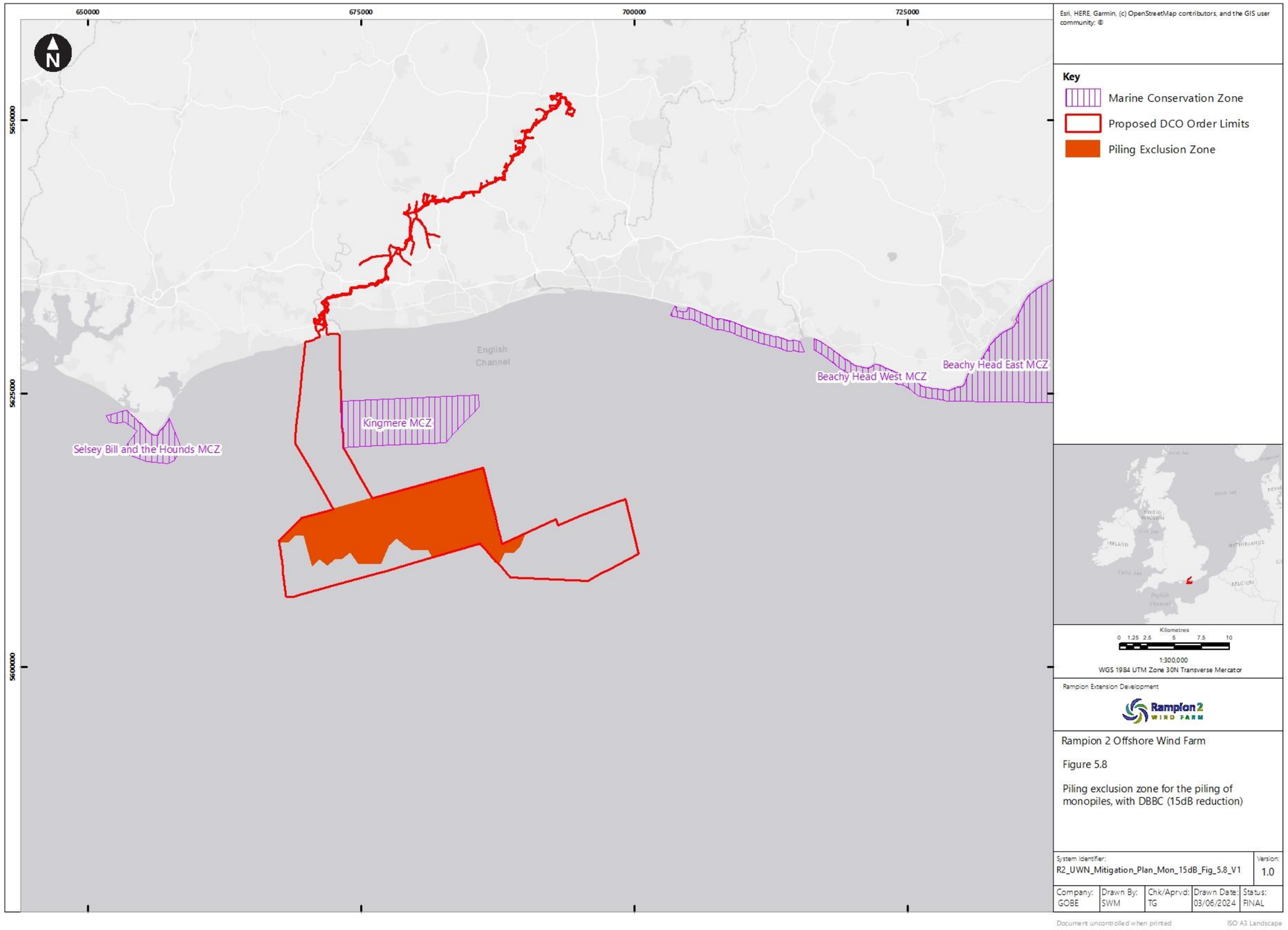


Figure 5.9 Piling exclusion zone for the piling of multileg foundations with DBBC (15dB reduction)

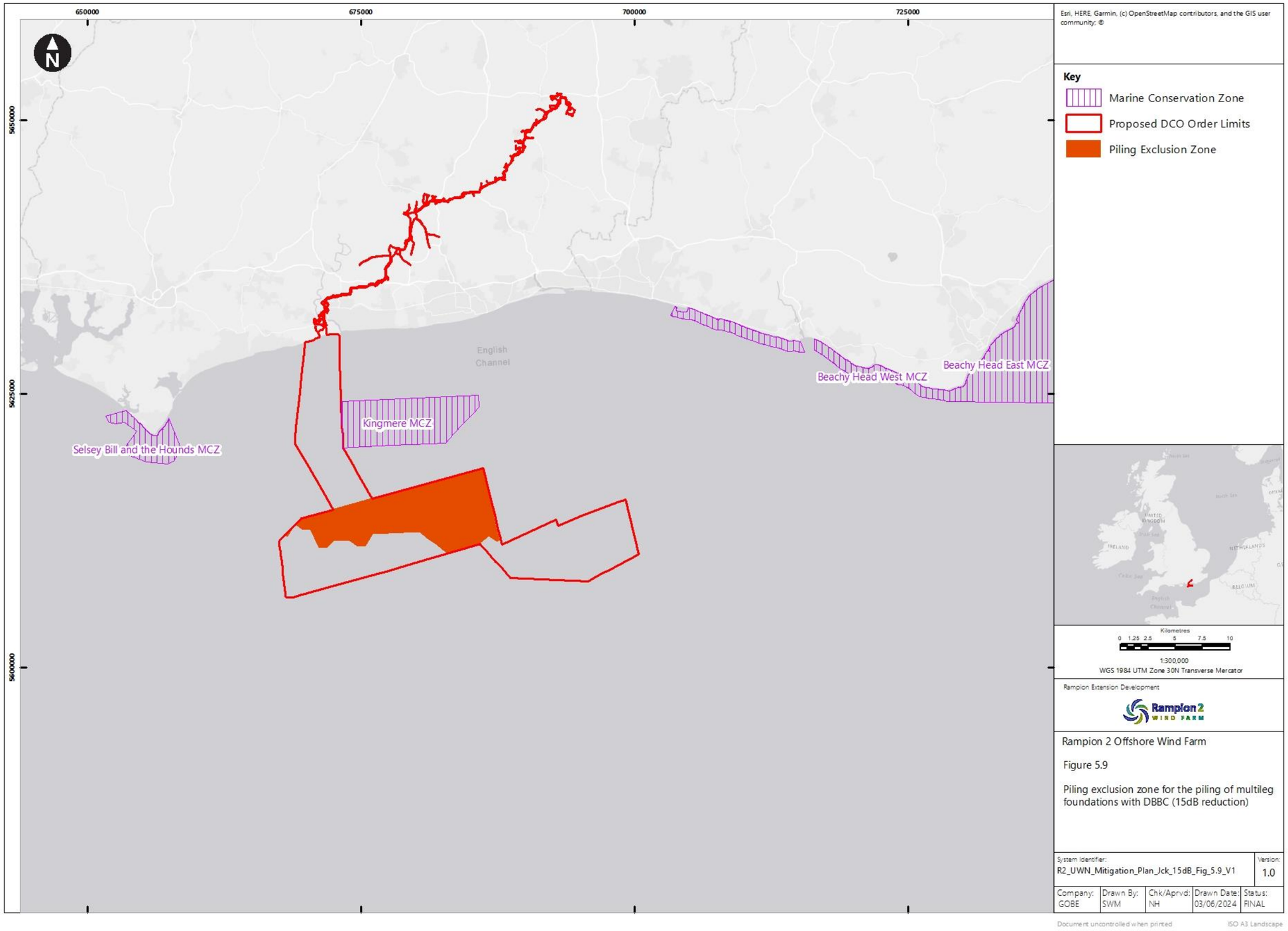


Figure 5.10 Piling exclusion zone for the piling of monopiles with DBBC and another noise abatement measure (20dB reduction)

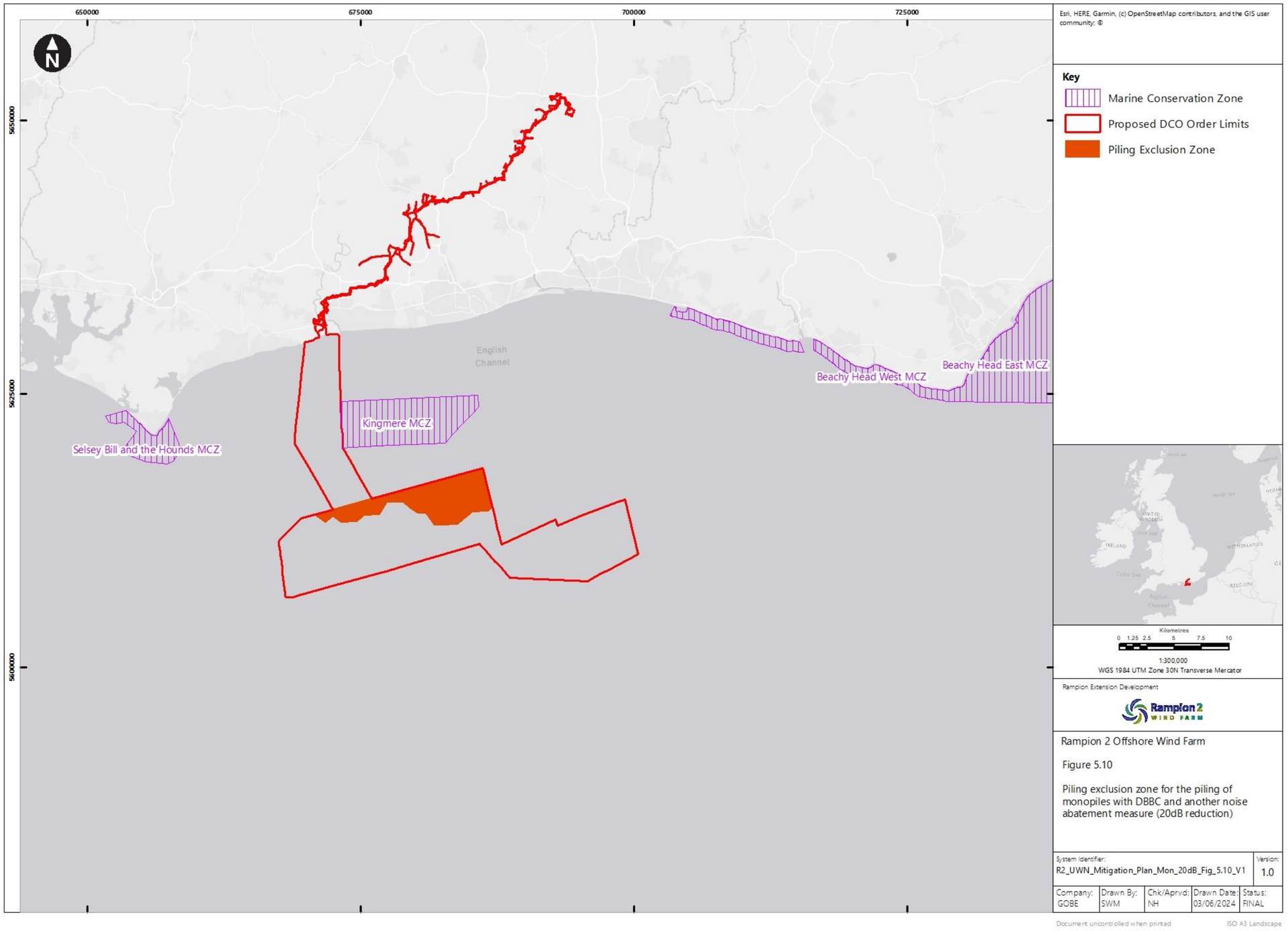
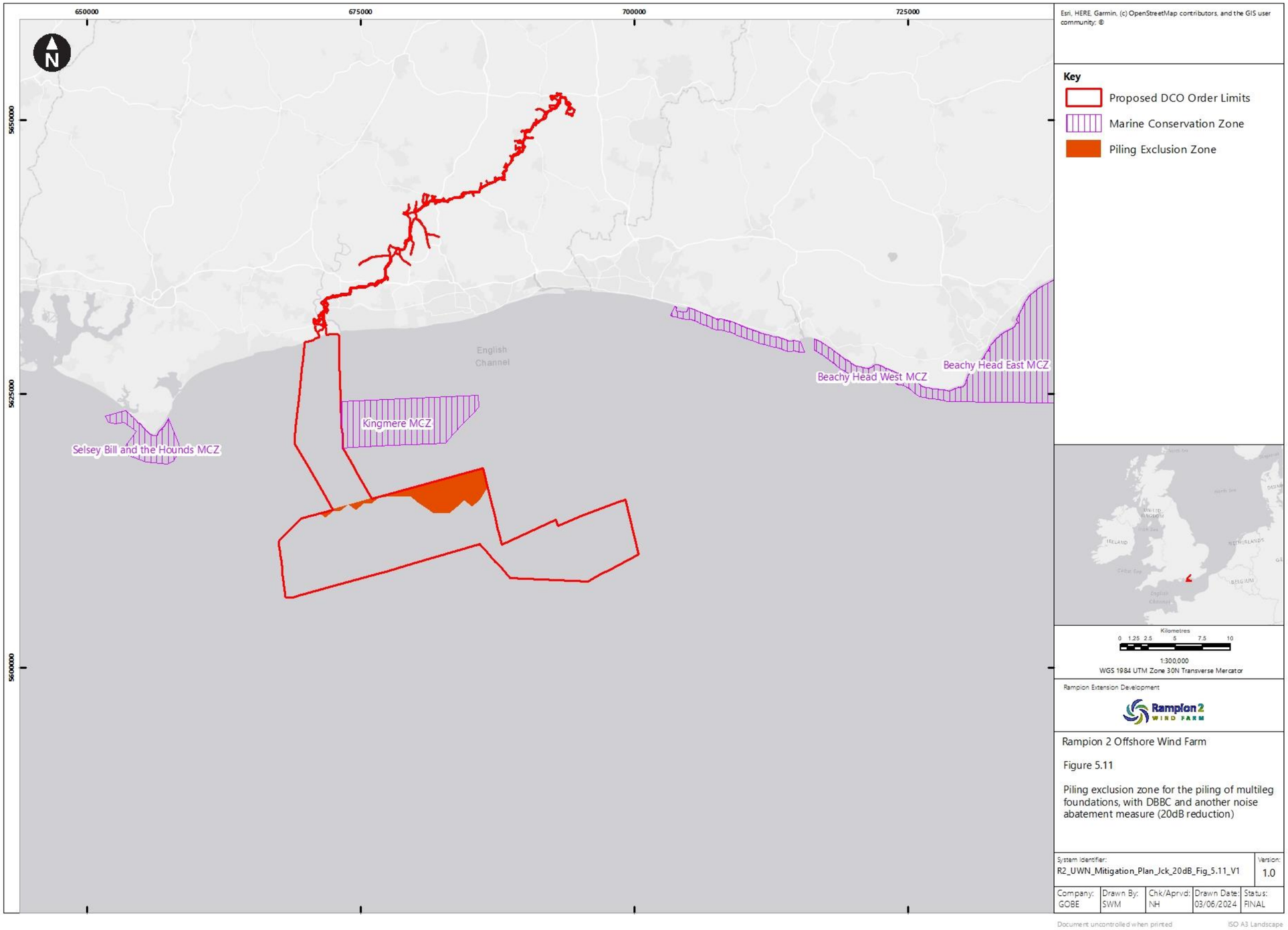


Figure 5.11 Piling exclusion zone for the piling of multileg foundations with DBBC and another noise abatement measure (20dB reduction)



5.3.45 As evident in **Figure 5.11** (located in this Plan on page 67) the piling of multileg foundations with a combination of DBBC and another noise abatement measure results in the smallest piling exclusion area, in the northern section of the offshore array area, closest to the Kingmere MCZ. The piling of monopiles with mitigation in the form DBBC and another noise abatement measure (**Figure 5.10,** (located in this Plan page 66)), results in a comparatively larger piling exclusion area. Due to the reduced hammer energy when piling multileg foundations compared to that of monopiles, the impact ranges are smaller under the same mitigation scenarios.

5.3.46 As evidenced in **Figure 5.8** and **Figure 5.9** (located in this Plan on pages 64 and 65 respectively), the piling of monopiles or multileg foundations using DBBC as a noise abatement, results in large piling exclusion areas, that encompasses the majority of the western portion of the array, and in the case of monopile installation (**Figure 5.8**), the exclusion zone also encroaches into the eastern portion of the array.

5.3.47 As noted previously, whilst the specific equipment, and therefore the achievable noise reductions delivered from the mitigation measures, will be confirmed once the project design process has been finalised, the initial zoning exercise demonstrates the way in which regions of the offshore array that remain piling exclusion areas during the March to July period will be quantified using modelling for the Final Plan. However, as there remains disagreement on the acceptability of piling during the March to July period as a result of, *inter alia*, uncertainties in establishing a disturbance threshold relevant to black seabream, the Applicant proposes to increase the level of mitigation provision during this period. This additional mitigation will serve to increase the separation distance between piling operations, where noise is generated, and the Kingmere MCZ. The approach to delivering this additional layer of precaution is set out below, being based on further spatial and temporal zoning rules.

Piling restriction, March to June

5.3.48 During the majority of the black seabream nesting period (1st March to 30th June), the piling exclusion area will be extended to encompass the western part of the offshore Array. No piling will therefore be undertaken to in the western part of the Array as shown in **Figure 5.12** (located in this Plan page 68).

5.3.49 Through this March to June period, piling will therefore only be undertaken in the eastern part of the offshore Array area, and subject to mitigation using the combination of DBBC and another noise abatement measure. Additionally, piling in the eastern area will commence in the part of the array furthest from the Kingmere MCZ; i.e. in the south east corner as illustrated in **Figure 5.13** (located in this Plan page 69). Under this scenario, piling would commence with foundations located in the part of the eastern area intersecting with the band A buffer shown on the chart, subsequently progressing to band B and so on as construction proceeds. The detailed scheduling of piling locations will be determined once the layout of WTGs and substations has been finalised and will be detailed in the Final Plan.

Piling restriction, July

5.3.50 During July, if piling is to be undertaken in the western part of the offshore Array, foundation installation will again be conducted using the combination of DBBC another noise abatement measure. Activities will also be subject to a sequencing plan such that piling in July will commence at locations of the western part of the Array furthest from the Kingmere MCZ. The detailed scheduling of piling locations will be determined once the layout of WTGs and substations has been finalised, but will commence from the pile locations in the furthest south-west corner of the western part of the Array (commencing in the area of the western part of the Array intersecting with the band C buffer shown on **Figure 5.13** (located in this Plan page 69)

5.3.51 Sequencing in this manner will ensure risk to sensitive noise receptors in the latter part of the spawning/nesting season, when the main spawning activity has been completed, is further minimised, whilst maintaining construction progress during what is a critical installation month for the Proposed Development. The proposed sequence of piling in the western part of the offshore Array will be presented within the Final Plan.

Figure 5.12 Zoning Plan: Piling Restriction for period 1st March to 30th June

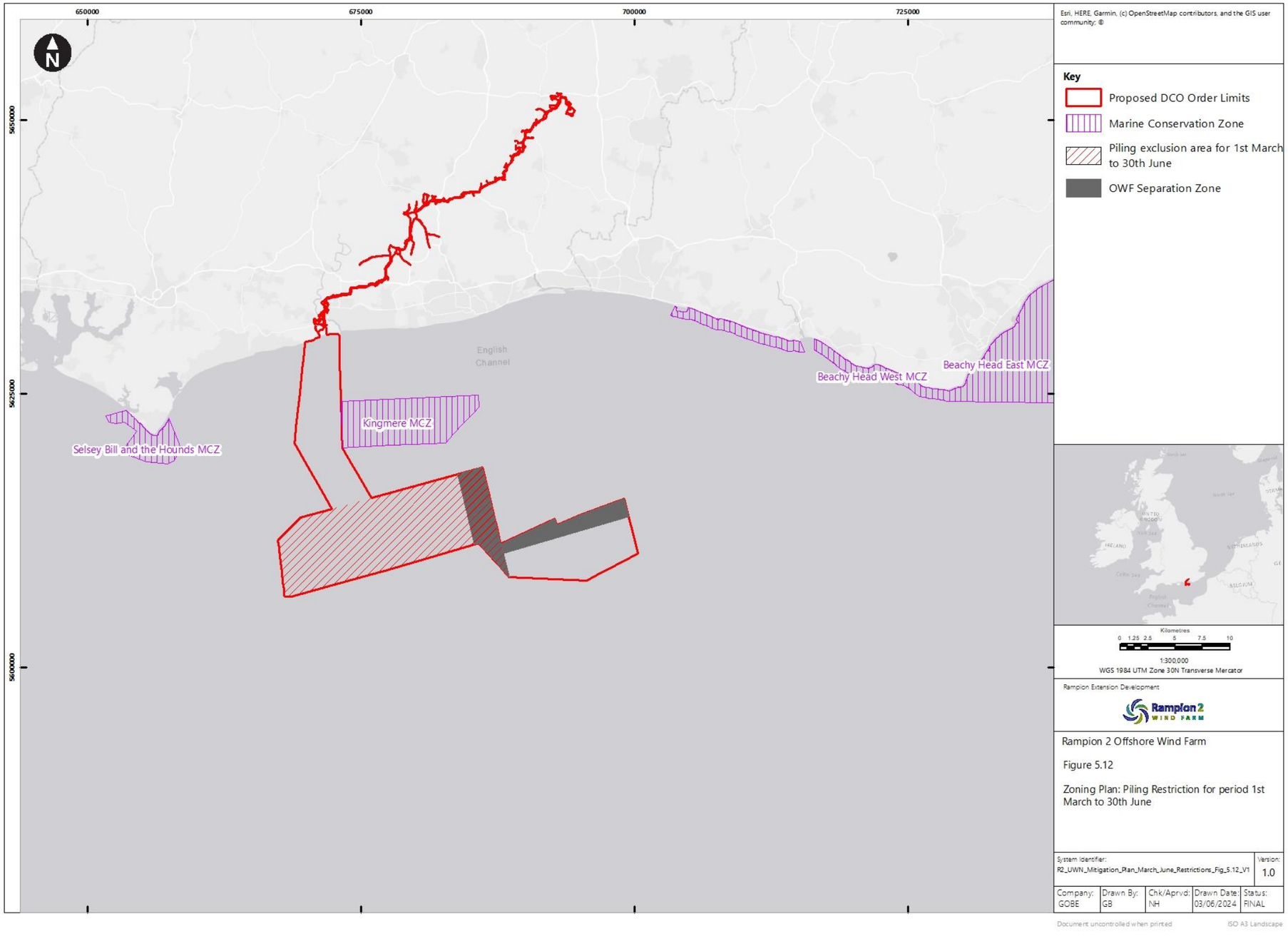
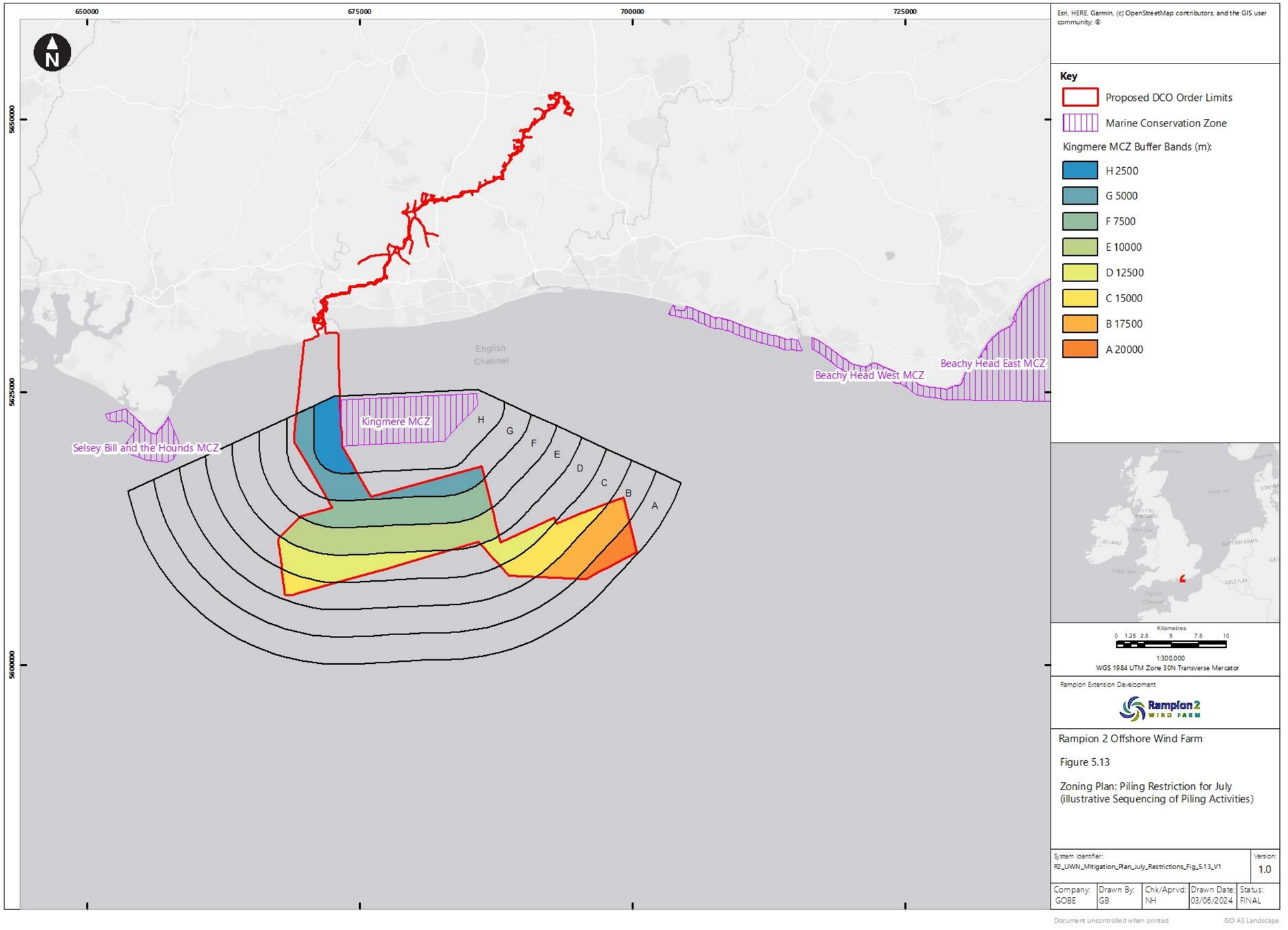


Figure 5.13 Zoning Plan: Piling Restriction for July (illustrative Sequencing of Piling Activities)



Piling mitigation, August through to February

5.3.52 Whilst there is no requirement for a spatial zoning plan for the remainder of the year, the Applicant will continue to mitigate piling noise. Therefore, from 1st August through to 28th February during the construction period, the Applicant will propose to utilise DBBC noise mitigation technology as detailed previously in this report (**Section 5.3**)

5.3.53 The implementation of this mitigation will further reduce the impact ranges of underwater noise (including behavioural effect ranges) to sensitive features such as seahorse as features of the Beachy Head East and West MCZs and the Selsey Bill and the Hounds MCZ.

5.3.54 The mitigated impact ranges from the implementation of DBBC (as defined using the 141dB SELss disturbance threshold) are presented in **Figure 5.14** and **Figure 5.15**, relative to the Beachy Head East and West MCZs and the Selsey Bill and the Hounds MCZ. As evident in these figures, the use of DBBC further mitigates the underwater noise contours away from the MCZs designated for seahorse. Therefore, the use of DBBC throughout the piling campaign, will ensure the Conservation Objectives of the MCZs are not hindered.

5.3.55 As detailed in **Chapter 8: Fish and shellfish ecology, Volume 2 [APP-049]**; a threshold of 135 dB SELss, based on a study by Hawkins et al. (2014) has been suggested by the MMO as a suitable threshold for behavioural responses of sensitive fish receptors. It is important in this context to note that the use of the 135 dB SELss threshold in an open water receiving environment characterised by shipping is highly precautionary and very unlikely to elicit a comparable response to that observed by Hawkins *et al*. (2014.). The use of this threshold is also not supported in the literature for use in impact assessments. It is on this basis, that the Applicant does not support the use of this threshold, to determine potential behavioural effects of noise sensitive species.

5.3.56 Notwithstanding this, the Applicant has presented the 135 dB SELss threshold, with the implementation of mitigation in the form of DBBC, relative to the Beachy Head East and West MCZs and the Selsey Bill and the Hounds MCZ. As evident in **Figure 5.16**, and **Figure 5.17**, the mitigated impact ranges, as defined using the overly precautionary 135dB SELss threshold, also do not overlap with any of the MCZs.

Figure 5.14 Predicted Worst Case and Mitigated (DBBC) Behavioural Response Impact Ranges for Sensitive Features from the Piling of Monopile Foundations (141dB SELss)

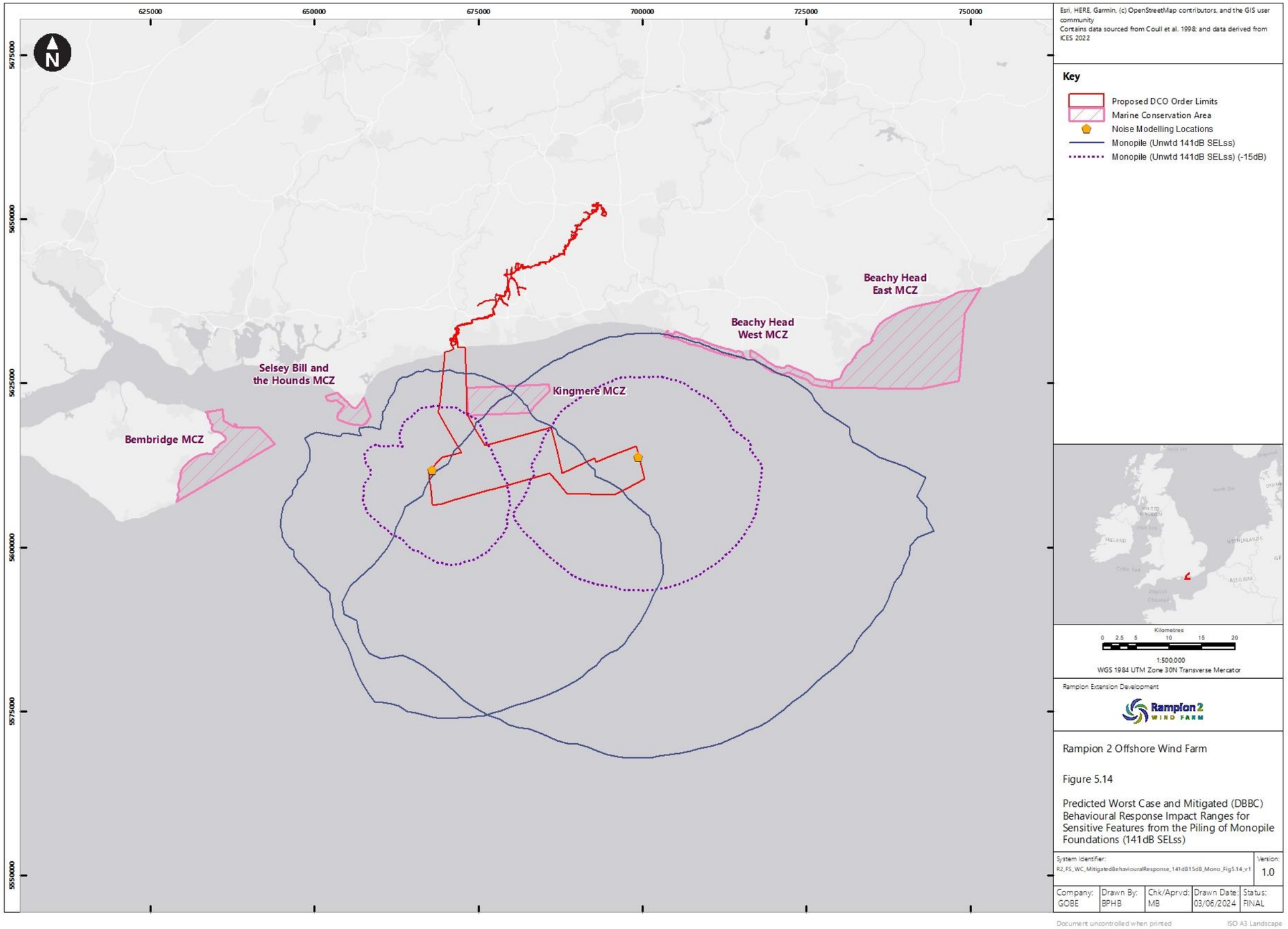


Figure 5.15 Predicted Worst Case and Mitigated (DBBC) Behavioural Response Impact Ranges for Sensitive Features from the Piling of Multileg Foundations (141dB SELss)

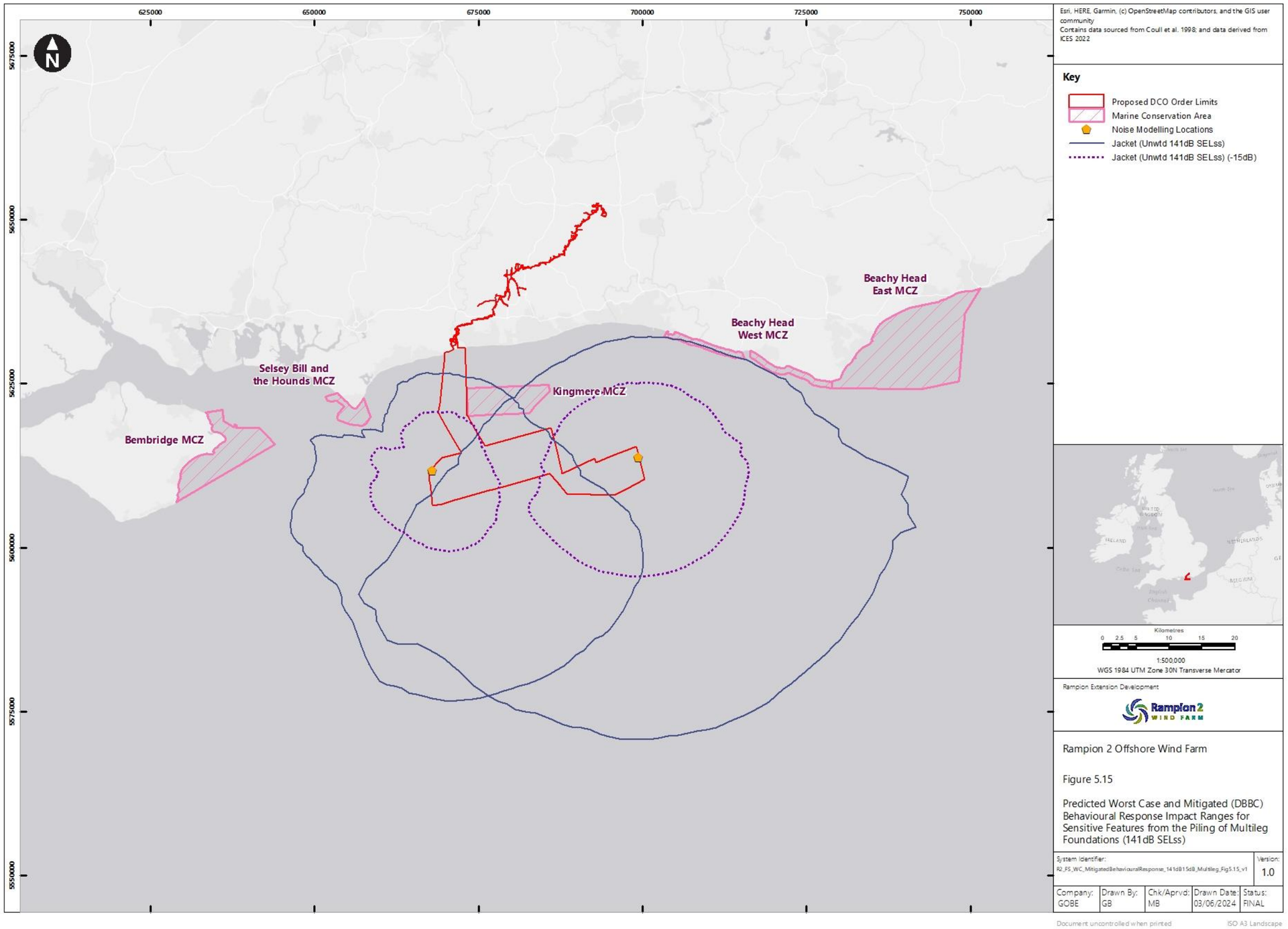


Figure 5.16 Predicted Worst Case and Mitigated (DBBC) Behavioural Response Impact Ranges for Sensitive Features from the Piling of Monopile Foundations (135dB SELss)

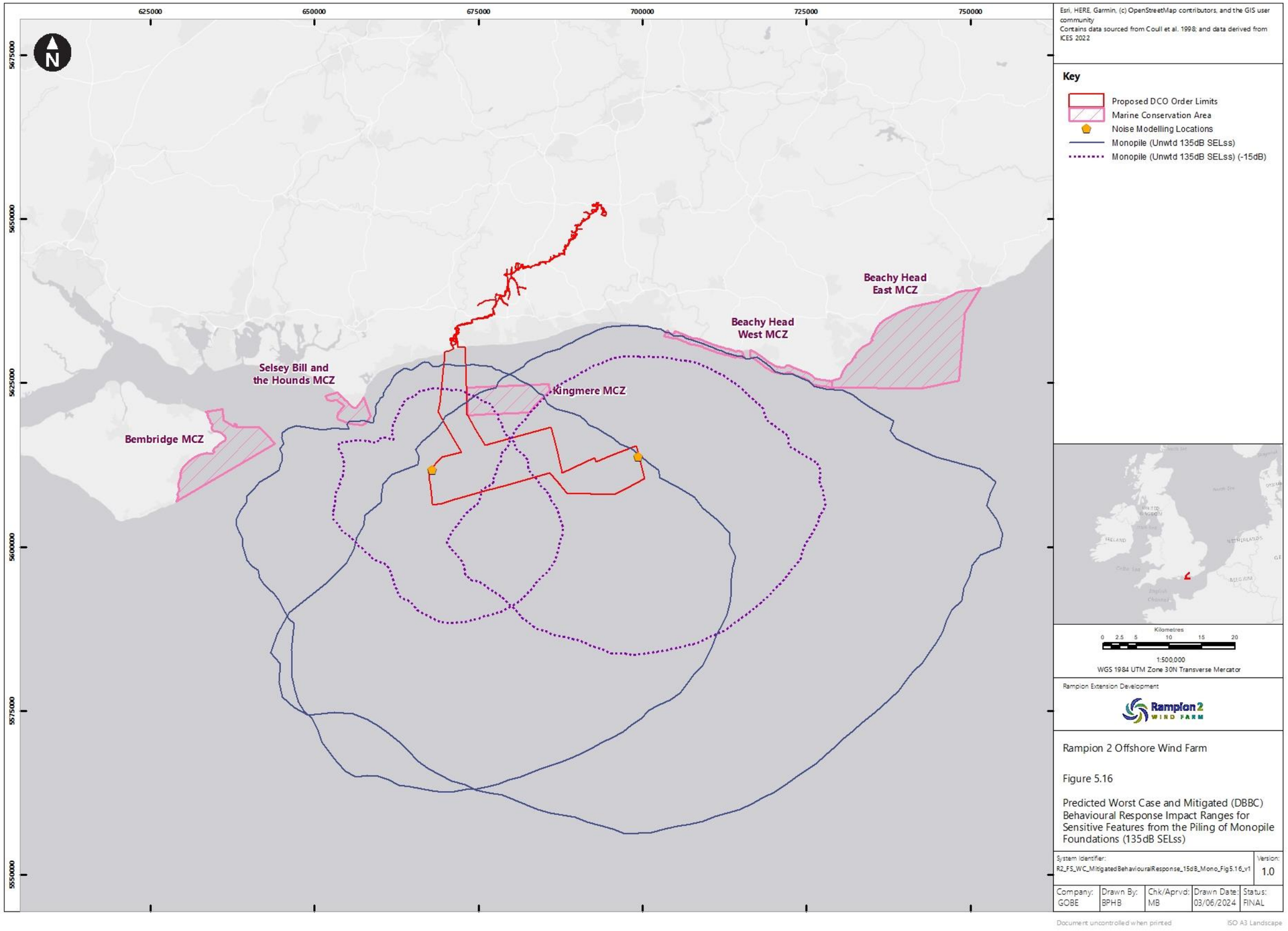
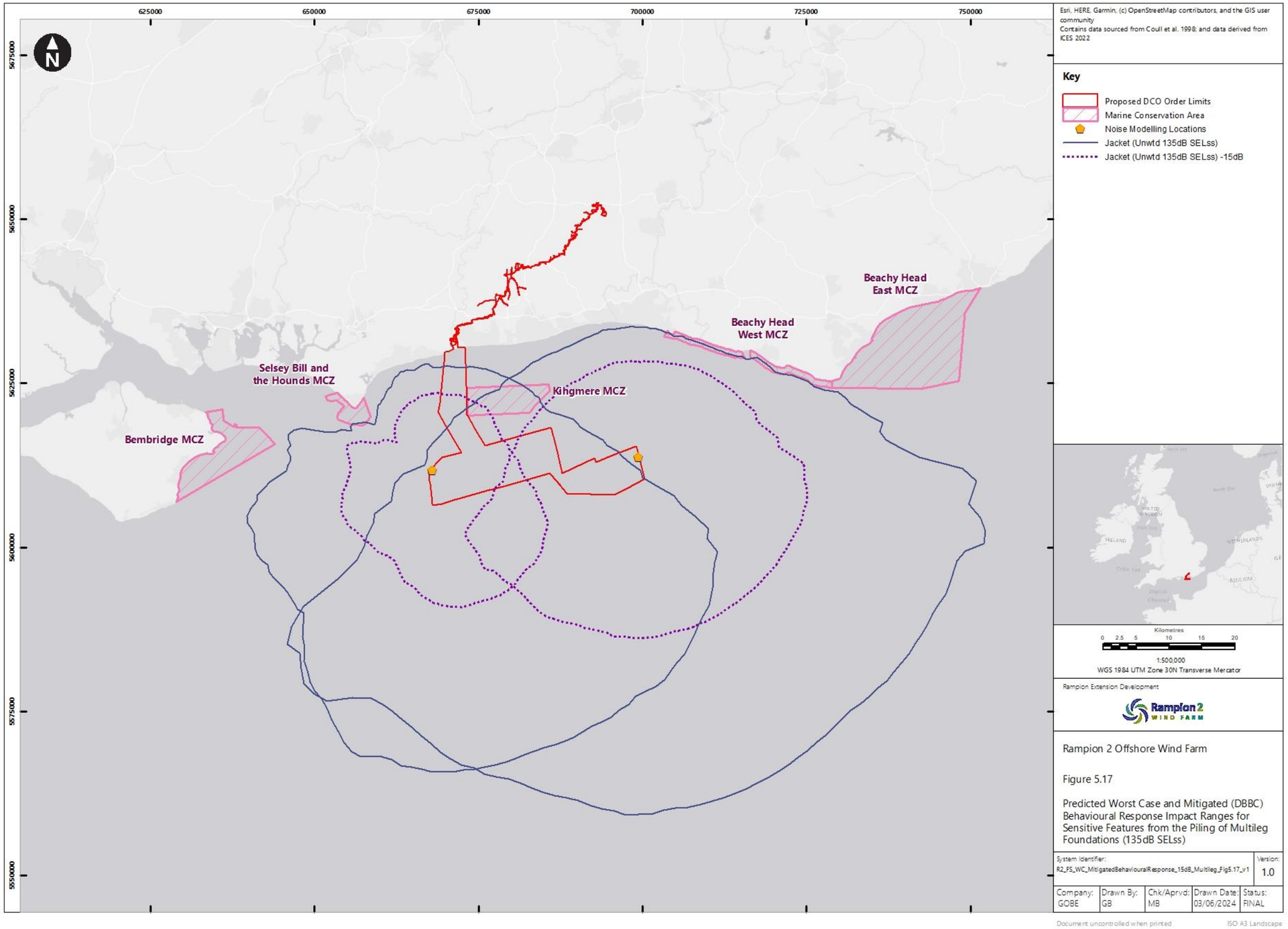


Figure 5.17 Predicted Worst Case and Mitigated (DBBC) Behavioural Response Impact Ranges for Sensitive Features from the Piling of Multileg Foundations (135dB SELss)



Summary of mitigation measures in the offshore array area

5.3.57 Mitigation options including noise abatement systems and seasonal restrictions/zoning, will ensure noise reduction is achievable to reduce impact ranges, thereby avoiding significant effects on sensitive features of the designated MCZs. For black seabream, this means no significant disturbance to nesting features within the Kingmere MCZ. Regarding seahorse, no significant disturbance of breeding seahorse will occur within the Beachy Head East and West MCZs and the Selsey Bill and the Hounds MCZ.

5.3.58 As it is concluded that the greatest impact of disturbance to sensitive receptors is likely to occur during the breeding seasons, seasonal restrictions are proposed for black seabream and the Kingmere MCZ, as well as relevant measures through the summer months for seahorse breeding at the Beachy Head East and West MCZs and the Selsey Bill and the Hounds MCZ. Furthermore, the implementation of DBBC throughout the remainder of the piling campaign, will ensure no disturbance of breeding seahorse in the MCZs will occur from underwater noise, and therefore the conservation objectives of the sites will not be hindered.

5.3.59 In the case of migrating seahorse to deeper water outside of the Beachy Head East and West MCZs and the Selsey Bill and the Hounds MCZ, the risk of interaction is low as set out **Chapter 8: Fish and shellfish ecology, Volume 2 [APP-049]**. Nonetheless, the continued use of DBBC for the duration of the construction phase will ensure any potential for impact on seahorse in its offshore winter phase is minimised.

5.4 Optimisation of mitigation measures

5.4.1 Following the establishment of the final design of Rampion 2, the Plan will be finalised with the optimised project design information and will be submitted for agreement with the MMO and Natural England, prior to the commencement of construction.

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6. Overview of mitigation commitments

6.1.1 Below is a summary of the individual commitments made by the Applicant to mitigate against impacts upon sensitive benthic habitats and fish receptors from the development of Rampion 2.

Export cable installation

- C-269 - Cable routeing design will be developed to ensure micrositing where possible to identify the shortest feasible path avoiding subtidal chalk and reef features, peat and clay exposures and areas considered to potentially support black seabream nesting.
- C-270 - As part of the routeing design, a working separation distance (buffer) will be maintained wherever possible from sensitive features, notably black seabream nesting areas, as informed by the outputs of the physical processes assessment, to limit the potential for impacts to arise (direct or indirect).
- C-271 - The offshore export cable routeing design will target areas of the seabed that enable maximising the potential for cables to be buried, thus providing for seabed habitat recovery in sediment areas and reducing the need for secondary protection and consequently minimising any potential for longer-term residual effects.
- C-272- Adoption of specialist offshore export cable laying and installation techniques will minimise the direct and indirect (secondary) seabed disturbance footprint to reduce impacts, which will provide mitigation of impacts to all seabed habitats, but particularly chalk and reef areas, peat and clay exposures, as well as potential (unknown) black seabream nesting locations, where avoidance is not possible. The Applicant will seek to utilise the most appropriate technology available at the time of construction and operation, if required, to reduce the direct footprint impact from cutting machinery, where practicable.
- C-273 A seasonal restriction will be put in place to ensure Offshore Export Cable Corridor activities (including: construction and installation, preparatory works during cable installation, UXO clearance, preventive or scheduled maintenance, inspections and decommissioning) are undertaken outside the black seabream breeding period (1st March- 31st July inclusive) to avoid any effects from installation works on black seabream nesting within or outside of the Kingmere MCZ. This does not apply to emergency work required to maintain the operation, safety and integrity of the infrastructure.
- C-305 –Excavated chalk will be used to infill cable trenches produced by mechanical cutters, where practicable.

Foundation installation (piling)

- C-265 Double big bubble curtains will be deployed as the minimum single offshore pilling noise mitigation technology to deliver underwater noise attenuation for all foundation installations throughout the construction of the Proposed Development where percussive hammers are used in order to reduce predicted impacts to:
  - sensitive receptors at relevant Marine Conservation Zone (MCZ) sites and reduce the risk of significant residual effects on the designated features of these sites;
  - spawning herring; and
  - marine mammals.
- C-280 Commitment that no piling will occur in the piling exclusion zones during the seabream breeding period (March-July) which will be defined by the modelling in the Final Sensitive Features Mitigation Plan.
- C-281 Commitment to no piling within the western part of the Rampion 2 offshore array closest to the Kingmere MCZ during the majority of the black seabream breeding period (March-June); and sequenced piling in the western part of the Offshore Array Area during July in accordance with the zoning plan to be set out in the Final Sensitive Features Mitigation Plan, to reduce the risk of significant effects from installation works on breeding black seabream within or outside of the Kingmere MCZ.
- C-274 Commitment to commence piling at locations furthest from the Kingmere MCZ during the black seabream breeding period (March-July), to reduce effects from installation works on breeding black seabream within or outside of the Kingmere MCZ.

7. Monitoring

7.1.1 Following the assessment of potential effects and identification of mitigation measures, consideration will be given to the requirement for monitoring to be undertaken. The details of monitoring will be agreed with the MMO in consultation with Natural England prior to construction.

7.1.2 **Table 7-1** provides a summary of the likely monitoring to be undertaken, as detailed in the **Offshore In Principle Monitoring Plan [REP4-055]** (updated at Deadline 5)**.**

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Table 7-1 In principle monitoring

Survey	Phase	Monitoring Proposal
Geophysical survey to determine the location and extent of any chalk habitat, stony reef, peat and clay, and potential *S. spinulosa* reef.	Pre-construction	• A single survey geophysical (Sidescan Sonar and Multi-Beam Echo Sounder) will be carried out to identify chalk habitat, stony reef, peat and clay exposures and potential *S. spinulosa* reef; and • In areas where chalk reef, stony reef, peat and clay exposures and potential *S. spinulosa* reef is identified from the review of the geophysical data, drop down video and/or stills will be deployed to confirm presence and extent.
	Post-construction	• Where chalk habitat, stony reef, peat and clay exposures and *S. spinulosa* reef is identified during the baseline survey, a single post-construction survey, specifically targeting those habitats and reefs identified in the baseline survey will be undertaken as a check on their condition using the same methodology set out for pre-construction monitoring. • Where no stony reef and/or *S. spinulosa* reef is identified by the pre-construction survey of the proposed works (and associated buffers), no post-construction surveys of these features will be undertaken.
In-principle underwater noise monitoring	Construction	• Construction noise monitoring of ~~four~~ eight of the first twelve (12) piles is proposed to validate the assumptions made within the ES. • Construction noise monitoring of ~~four~~ eight of the first twelve (12) piles is proposed to validate the performance of the mitigation measures against assumptions made within the ES. • Construction noise monitoring proposed during the black seabream breeding season (1st March to 31 July) at the Kingmere MCZ if foundation installation using percussive hammers is undertaken during these months. Data will be collected to validate compliance with the specified noise

Survey	Phase	Monitoring Proposal
		threshold proposed for black seabream at the Kingmere MCZ site, should one be implemented. • Noise measurements shall be made in line with the Good Practice Guide No.133: Underwater Noise Measurement (National Physical Laboratory, 2014). Noise monitoring will be achieved using hydrophones, with full specifications provided in the final monitoring plan. • Underwater data shall be recorded in a format that allows analysis using un-weighted metrics, such as peak sound pressure level, sound exposure level and peak to peak pressure level, and all conclusions and discussions should be made in relation to the un-weighted metrics. Construction noise monitoring should include measurements of noise generated by the installation of the first four piled foundations of each piled foundation type to be installed. • In addition, the requirements of the UK Marine Noise Registry shall be adhered to as necessary. This would cover geophysical survey activities and UXO clearance as well as impact pile driving.

8. Glossary of terms and abbreviations

Table 8-1 Glossary of terms and abbreviations

Term	Definition
BAP	Biodiversity Action Plan
BBC	Big Bubble Curtain
Baseline	Refers to existing conditions as represented by latest available survey and other data which is used as a benchmark for making comparisons to assess the impact of development.
Baseline conditions	The environment as it appears (or would appear) immediately prior to the implementation of the Proposed Development together with any known or foreseeable future changes that will take place before completion of the Proposed Development.
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Centre for Environment Fisheries and Aquaculture Science (Cefas)	The Government's marine and freshwater science experts, advising the UK government and overseas partners.
CfD	Contract for Difference
Coastal processes	The processes that interact to control the physical characteristics of a natural environment, for example: winds, waves, currents, water levels, sediment transport, turbidity, coastline, beach and seabed morphology.
Construction effects	Used to describe both temporary effects that arise during the construction phases as well as permanent existence effects that arise from the physical existence of development (for example new buildings).
DBBC	Double Big Bubble Curtain
Decommissioning	The period during which a development and its associated processes are removed from active operation.
Development Consent Order (DCO)	This is the means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects, under the Planning Act 2008.

Term	Definition
DCO Application	An application for consent to undertake a Nationally Significant Infrastructure Project made to the Planning Inspectorate who will consider the application and make a recommendation to the Secretary of State, who will decide on whether development consent should be granted for the Proposed Development.
DDV	Drop Down Video
dML	Deemed Marine Licence
Embedded environmental measures	Equate to 'primary environmental measures' as defined by Institute of Environmental Management and Assessment (2016). They are measures to avoid or reduce environmental effects that are directly incorporated into the preferred masterplan for the Proposed Development.
Environmental Impact Assessment (EIA)	The process of evaluating the likely significant environmental effects of a proposed project or development over and above the existing circumstances (or 'baseline').
EIA Regulations, 2017	The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. The EIA regulations require that the effects of a project, where these are likely to have a significant effect on the environment, are taken into account in the decision-making process for the project.
Environmental Statement (ES)	The written output presenting the full findings of the Environmental Impact Assessment.
Evidence Plan Process (EPP)	A voluntary consultation process with specialists' stakeholders to agree the approach, the information to support, the EIA and HRA for certain aspects.
ETG	Expert Topic Group
ES	Environmental Statement
FEED	Front End Engineering Design
Formal consultation	Refers to the situation in future years without the Proposed Development.
Geophysical	Relating to the physical properties of the earth.
Horizontal Directional Drill (HDD)	A trenchless drilling technique avoiding open trenches.
HRA	Habitats Regulations Assessment

Term	Definition
Impact	The changes resulting from an action.
Indirect effects	Effects that result indirectly from the Proposed Development as a consequence of the direct effects, often occurring away from the site, or as a result of a sequence of interrelationships or a complex pathway. They may be separated by distance or in time from the source of the effects.
Informal consultation	Informal consultation refers to the voluntary consultation that the Applicant undertakes in addition to the formal consultation requirements.
Inshore	The sea up to two miles from the coast.
Inshore Fisheries and Conservation Authority (IFCA)	There are 10 Inshore Fisheries and Conservation Authorities (IFCAs) in England. The 10 IFCA Districts cover English coastal waters out to 6 nautical miles from Territorial Baselines. The IFCAs have shared powers and duties which are found in the Marine and Coastal Access Act, 2009.
ITAP	Institute of Technical and Applied Physics
Intertidal	The area of the shoreline which is covered at high tide and uncovered at low tide.
JNCC	Joint Nature Conservation Committee
Magnitude (of change)	A term that combines judgements about the size and scale of the effect, the extent of the area over which it occurs, whether it is reversible or irreversible and whether it is short term or long term in duration'. Also known as the 'degree' or 'nature' of change.
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	The Marine Life Information Network
Marine Conservation Zone (MCZ)	Marine Conservation Zone (MCZ) is a type of marine nature reserve in UK waters. They were established under the Marine and Coastal Access Act (2009) and are areas designated with the aim to protect nationally important, rare or threatened habitats and species.
Marine Management Organisation (MMO)	MMO is an executive non-departmental public body, sponsored by the Department for Environment, Food & Rural Affairs. MMO license, regulate and plan marine activities in the seas around England so that they're carried out in a sustainable way.
MBES	Multi-Beam Echo Sounder

Term	Definition
MHWS	Mean High Water Springs
MMMP	Marine Mammal Mitigation Protocol
MNRU	MENCK Noise Reduction Unit
Nationally Significant Infrastructure Project (NSIP)	Nationally Significant Infrastructure Projects are major infrastructure developments in England and Wales that bypass normal local planning requirements. These include proposals for renewable energy projects.
Natural England	The government advisor for the natural environment in England.
NERC	Natural Environment and Rural Communities
Noise sensitive receptors	Locations or receptors that may potentially be adversely affected by the addition of a new source of noise. These can include residential properties, people and sensitive species.
Offshore	The sea further than two miles from the coast.
Offshore area	An area that encompasses all planned offshore infrastructure.
Offshore Wind Farm	An offshore wind farm is a group of wind turbines in the same location (offshore) in the sea which are used to produce electricity.
PSV	Platform Supply Vessel
Proposed Development	The development that is subject to the application for development consent, as described in **Chapter 4: The Proposed Development, Volume 2** of the ES **[APP-045].**
Receptor	These are as defined in Regulation 5(2) of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 and include population and human health, biodiversity, land, soil, water, air, climate, material assets, cultural heritage and landscape that may be at risk from exposure to direct and indirect impacts which could potentially arise as a result of the Proposed Development.
RED	Rampion Extension Development Limited.
SEL	Sound Exposure Level
Sensitivity	A term applied to specific receptors, combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value associated to that receptor.

Term	Definition
Significance	A measure of the importance of the environmental effect, defined by criteria specific to the environmental aspect.
Significant effects	It is a requirement of the EIA Regulations to determine the likely significant effects of the development on the environment which should relate to the level of an effect and the type of effect. Where possible significant effects should be mitigated. The significance of an effect gives an indication as to the degree of importance (based on the magnitude of the effect and the sensitivity of the receptor) that should be attached to the impact described. Whether or not an effect should be considered significant is not absolute and requires the application of professional judgement.
Suspended sediment concentration (SSC)	The mass concentration (mass/volume) of sediment in suspension.
Stakeholder	Person or organisation with a specific interest (commercial, professional or personal) in a particular issue.
Study area	Area where potential impacts from the Proposed Development could occur, as defined for each aspect.
Subtidal	The region of shallow waters which are below the level of low tide.
Temporary or permanent effects	Effects may be considered as temporary or permanent. In the case of wind energy development, the application is for a 30-year period after which the assessment assumes that decommissioning will occur and that the site will be restored. For these reasons the development is referred to as long term and reversible.
Type or Nature of effect	Whether an effect is direct or indirect, temporary or permanent, positive (beneficial), neutral or negative (adverse) or cumulative.
UXO	Unexploded Ordnance
WTG	Wind Turbine Generator
Zone of Influence (ZOI)	The area surrounding the Proposed Development which could result in likely significant effects.

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Rampion 2
WIND FARM