MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Annex 3.3 to the Applicant's response to Relevant Representations from Marine Management Organisation (RR-020.65)

Applicant's response to Relevant Representation from Marine Management Organisation: Fish and Shellfish 4.6.12

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Image of an offshore wind farm

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RPS

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Morgan Offshore Wind Limited

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Glossary

Term	Meaning
Applicant	Morgan Offshore Wind Limited.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP).
Morgan Offshore Wind Project: Generation Assets	This is the name given to the Morgan Generation Assets project as a whole (includes all infrastructure and activities associated with the project construction, operations and maintenance, and decommissioning).

Acronyms

Acronym	Description
DCO	Development Consent Order
MDS	Maximum Design Scenario
MMO	Marine Management Organisation
OWF	Offshore Wind Farm
SEL	Sound Exposure Level
SEL_{ss}	Single Strike Sound Exposure Level
SPL	Sound Pressure Level
SPL_{pk}	Peak Sound Pressure Level
TTS	Temporary Threshold Shift
UWN	Underwater Noise
UWSMS	Underwater Sound Management Strategy

Units

Unit	Description
%	Percentage
dB	Decibel
kJ	Kilojoules
km	Kilometre
μPa	Micropascal

1 Annex 3.3 to the Applicant's response to Relevant Representations from Marine Management Organisation

1.1 Introduction

1.1.1.1 This document has been prepared by the Applicant in response to a Relevant Representation by the Marine Management Organisation (MMO) in response to the Morgan Offshore Wind Project: Generation Assets Development Consent Order (DCO) Application (EN010136; RR-020). The point raised by the MMO in RR-020.65 (item **4.6.12**) is as follows:

- *The UWN modelling presented includes contours for each 5 dB increment. When these graduating contours are overlaid onto the spawning and nursery grounds maps from Coull et al. (1998) and Ellis et al. (2012), the figures become overloaded with information which affects ease of interpretation. The MMO recommend that these figures should be kept as simple as possible.*
- *The spawning and nursery grounds maps from Coull et al. (1998) and Ellis et al. (2012) need to be included on UWN modelling figures. However, the UWN contours which are of consequence to the assessment should be the only ones presented, namely: the thresholds for Group 3 and 4 fish with high hearing sensitivity for mortality and potential mortal injury (207 SELcum); recoverable injury (203 SELcum); and, TTS (186 SELcum) as per the pile driving threshold guidelines described by Popper et al. (2014).*
- *For the purpose of modelling behavioural responses in herring and other hearing sensitive fish at their spawning ground, a threshold of 135dB (SELss), based on research by Hawkins et al. (2014), is recommended by MMO.*
- *UWN contours for this threshold should also be presented on the relevant figures as appropriate. Presenting fewer, more relevant, UWN contours will make the modelling presented much clearer.*

1.2 Response

1.2.1 Modelled fish injury ranges

1.2.1.1 The contour decibel levels presented in Figure 3.8, 3.9, 3.10 and 3.11 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) are derived from the contours generated for the single strike sound exposure level (SEL_{ss}) metric to provide a visual representation of the relevant cumulative sound exposure level (SEL_{cum}) thresholds. This is based upon the injury ranges (Temporary Threshold Shift; TTS, recoverable injury and mortality) outlined within Tables 3.22, 3.23 and 3.24 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) for Group 3 and 4 fish, drawn directly from Volume 3, Annex 3.1: Underwater sound technical report (APP-028).

1.2.1.2 The SEL_{ss} contour values are included within Figures 3.8, 3.9, 3.10 and 3.11 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) for transparency; these contour values were used in the derivation of the relevant contours from the SEL_{ss} data to visually present the TTS, recoverable injury and mortality ranges. The Applicant has also provided a fuller explanation in response to the MMO's comments in RR-020 (item 4.6.12) to define the relevance of these in providing a visual representation of fish injury ranges. This is set out above.

1.2.1.3 For herring, nursery grounds are not shown within Figures 3.8 and 3.9 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) due to the relative widespread nature of these grounds, with the greater risk considered to be to herring spawning at discrete spawning grounds, due to their substrate specificity. Nursery grounds are not limited in the same way, therefore temporary avoidance of specifically impacted nursery areas is not considered to pose the same risk to herring. Further, spawning ground maps (Figures 3.8 and 3.9 of Volume 2, Chapter 3: Fish and shellfish ecology; APP-021) for herring are based upon polygons from Coull *et al.* (1998) only, as Ellis *et al.* (2012) do not provide updated polygons for herring spawning.

1.2.1.4 For cod, nursery grounds are not presented within Figures 3.10 and 3.11 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) due to the widespread nature of these grounds, indicating that temporary avoidance of these areas, or temporary displacement into adjacent nursery areas is unlikely to pose the same risk to cod as when spawning and using vocalisations to support courtship and territorial behaviours. Further, for cod, Figures 3.10 and 3.11 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) are based upon the Ellis *et al.*, (2012) spawning grounds, as these are considered more up to date than Coull *et al.* (1998), but Ellis *et al.* (2012) also considers Coull *et al.* (1998) when defining these grounds.

1.2.2 Modelled fish behavioural ranges

1.2.2.1 Following the Benthic Ecology, Fish and Shellfish Ecology and Physical Processes Expert Working Group (EWG) 02 (29 November 2022; E3: Consultation report (APP-088)), with regard to assessment of behavioural effects to fish from underwater sound, Cefas clarified in a post-meeting note that “the recommendation was for modelling to be carried out based on a 135dB threshold […] as this is recommended by Cefas fisheries advisors as a conservative indicator for determining the impact range in which clupeid species (including herring) are likely to exhibit behavioural responses”.

1.2.2.2 Following this feedback and further discussion during EWG 04 (11 July 2023; APP-088), assessment of behavioural effects to herring in Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) was underpinned by the use of a sound level of 135 dB re 1μPa^2.s SEL_{ss}. The Applicant wishes to reiterate the precautionary nature of this sound level for the assessment of behavioural effects to herring (and other clupeids). This is due to the acoustically quiet nature of the environment in which the study was undertaken which is not considered reflective of the study area associated with the Morgan Generation Assets, the method undertaken to generate sound during the study (i.e. playback of recordings), and the nature of perceived sound changing with distance from the source (Hawkins *et al.*, 2014). Further, Hawkins *et al.* (2014) state that the results of this particular study “cannot yet be used to define the sound exposure criteria” and that further detailed behavioural studies are required to determine whether the responses exhibited may lead to reduced survivability.

1.2.2.3 As such, a sound level of 160 dB re 1μPa SPL_{pk} was also considered (based upon a range of sources, including McCauley *et al.* (2000) which considered the clupeid, Perth herring *Nematalosa vlaminghi*), although the more precautionary underwater sound modelling contours were used to underpin the assessment of underwater sound impacts from piling in Volume 2, Chapter 3: Fish and shellfish ecology (APP-021), based upon those with the highest degree of overlap with the mapped herring spawning grounds at Douglas Bank. Figures showing the behavioural ranges based upon the 160 dB re 1μPa SPL_{pk} for herring are provided within Figure 3.7 and 3.13 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021), for a 4,400 kJ hammer energy, and 3,000 kJ hammer energy, respectively. These figures have not been recreated herein, due to the more precautionary 135 dB re 1μPa^2.s SEL_{ss} sound level underpinning the assessment. Contour plots showing the just the 135 dB re 1μPa^2.s SEL_{ss} contour for herring are provided below in Figure 1.1 and Figure 1.2 (please see section 1.2.3 for further information on these figures).

1.2.2.4 Behavioural ranges for cod are assessed using a sound level of 160 dB re 1μPa SPL_{pk} as presented at EWG 02 (November 2022) and EWG 03 (March 2023; APP-088) and with the Morgan Offshore Wind Project: Generation Assets Preliminary Environmental Information Report (Morgan Offshore Wind Ltd., 2023), with no objections raised. This sound level is based upon a range of published peer-reviewed literature as outlined within paragraph 3.9.3.46 to 3.9.3.48, and 3.9.3.54 to 3.9.3.55 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) and is therefore considered robust and sufficiently precautionary to assess the potential for behavioural effects to cod. Contour plots showing the just the 160 dB re 1μPa SPL_{pk} contour for cod are provided below in Figure 1.3 and Figure 1.4 (please see section 1.2.3 for further information on these figures).

1.2.3 Mapped underwater sound contours

1.2.3.1 Figure 1.1 below presents a version of Figure 3.6 from Volume 2, Chapter 3: Fish and shellfish ecology (APP-021) to show the mapped herring spawning grounds derived from Coull *et al.* (1998), an aggregated herring larval density layer, based upon kernel density estimation of collated larval densities from 2012 to 2021, and the modelled 135 dB re 1μPa^2.s SEL_{ss} underwater sound contour for single piling with a 4,400 kJ hammer energy only as requested by the MMO.

1.2.3.2 Figure 1.2 below presents the same information as Figure 1.1 but for single piling with a 3,000 kJ hammer energy for comparative purposes only, based upon Figure 3.12 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021).

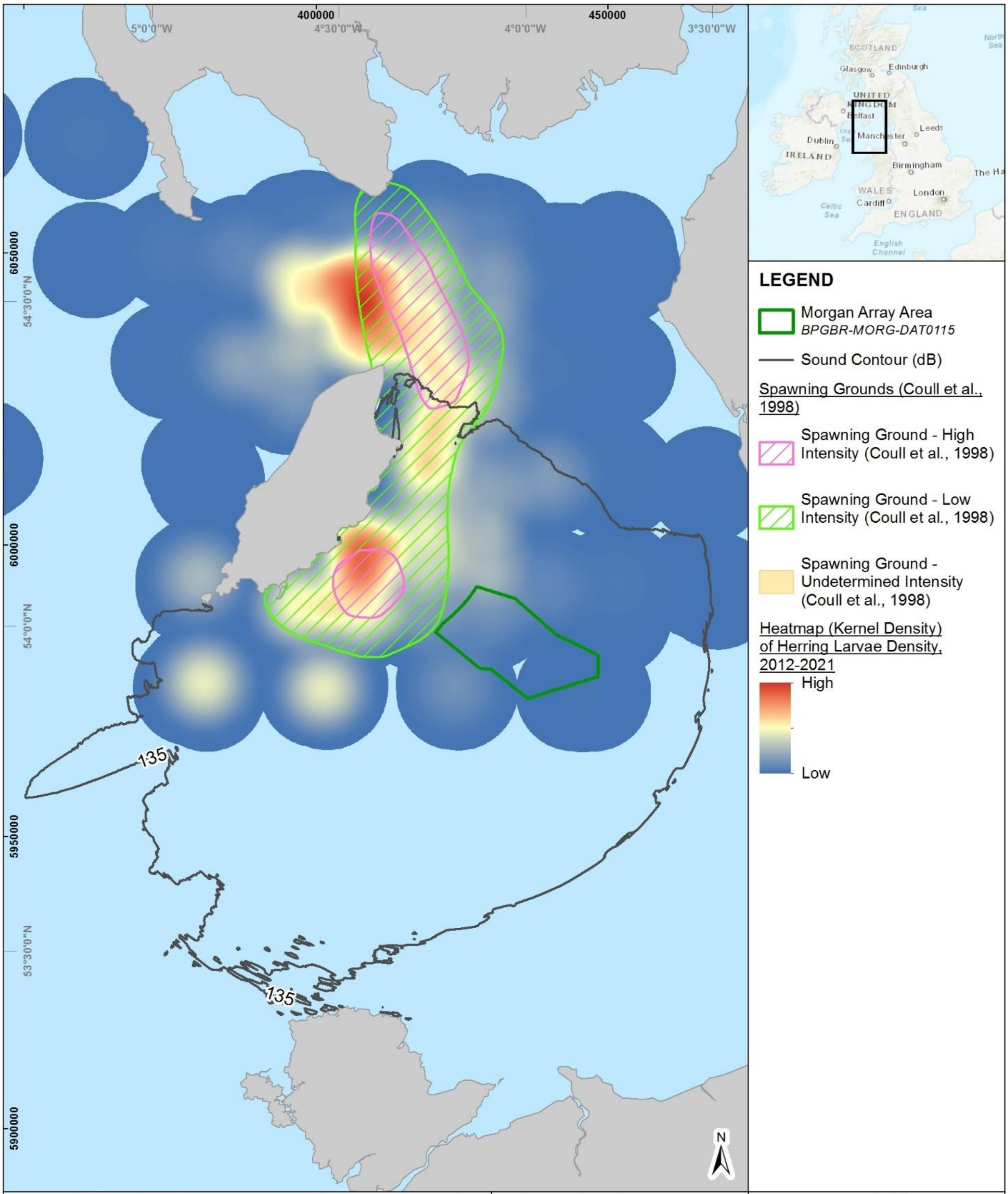
1.2.3.3 Figure 1.3 below presents mapped high and low intensity cod spawning grounds in the east Irish Sea derived from Ellis *et al.* (2012) with the modelled 160 dB re 1μPa SPL_{pk} underwater sound contour for single piling with a 4,400 kJ hammer energy only for clarity, based upon Figure 3.5 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021).

1.2.3.4 Figure 1.4 presents the same information as Figure 1.3 but for single piling with a 3,000 kJ hammer energy for comparative purposes only, based upon Figure 3.14 of Volume 2, Chapter 3: Fish and shellfish ecology (APP-021).

1.2.3.5 The behavioural assessment for herring and cod focuses on impacts to fish at spawning grounds, due to the discrete and highly specific nature of these areas for herring, and cod's reliance on communication by sound during courtship and spawning.

1.2.3.6 For herring, nursery grounds are not shown in Figure 1.1 and Figure 1.2 due to the relative widespread nature of these grounds, with the greater risk considered to be to herring spawning at discrete spawning grounds, due to their substrate specificity. Nursery grounds are not limited in the same way, therefore temporary avoidance of specifically impacted nursery areas is not considered to pose the same risk to herring.

1.2.3.7 For cod, nursery grounds are not presented in Figure 1.3 and Figure 1.4 due to the widespread nature of these grounds, indicating that temporary avoidance of these areas, or temporary displacement into adjacent nursery areas is unlikely to pose the same risk to cod as when spawning and using vocalisations to support courtship and territorial behaviours.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community	**Data Sources:** Client, CEFAS, Seiche, Ninel	EnBW bp Partners in UK offshore wind / rps
Project Name: MORGAN OFFSHORE WIND PROJECT	0 2.5 5 10 15 nm 0 5 10 20 30 km	**Drawing Number:** RPSE-MG-FAS-006-00
Drawing Title: Herring spawning grounds and aggregated herring larval density (2012-2021) heat map based on kernel density estimation with subsea sound contours (SELss, single piling, 4,400 kJ hammer energy, W piling location)	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:1,100,000	

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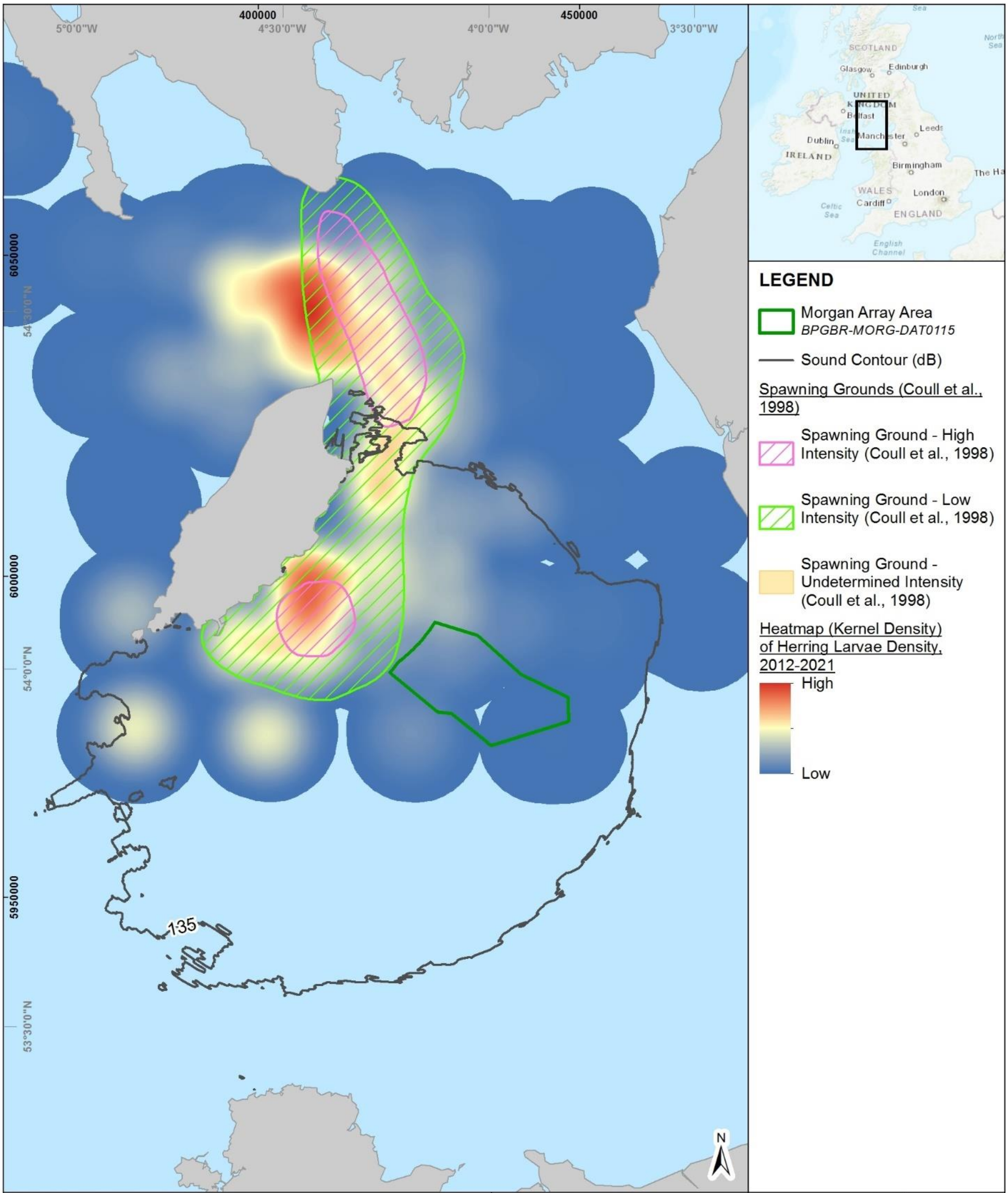
00	06/08/24	First Issue	MJ	LS

Figure 1.1: Mapped herring spawning grounds and aggregated herring larval density (2012-2021) based upon kernel density estimation with the 135 dB re 1μPa^2.s SEL_{ss} underwater sound contour, for single piling with a 4,400 kJ hammer energy.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, CEFAS, Seiche, Ninel

Project Name:
MORGAN OFFSHORE WIND PROJECT

0 2.5 5 10 nm
0 5 10 20 km

Drawing Number:
RPSE-MG-FAS-007-00

Drawing Title:
Herring spawning grounds and aggregated herring larval density (2012-2021) heat map based on kernel density estimation with subsea sound contours (SELss, single piling, 3,000 kJ hammer energy, W piling location)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,000,000

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Figure 1.2: Mapped herring spawning grounds and aggregated herring larval density (2012-2021) based upon kernel density estimation with the 135 dB re 1µPa^2.s SEL_{ss} underwater sound contour, for single piling with a 3,000 kJ hammer energy.

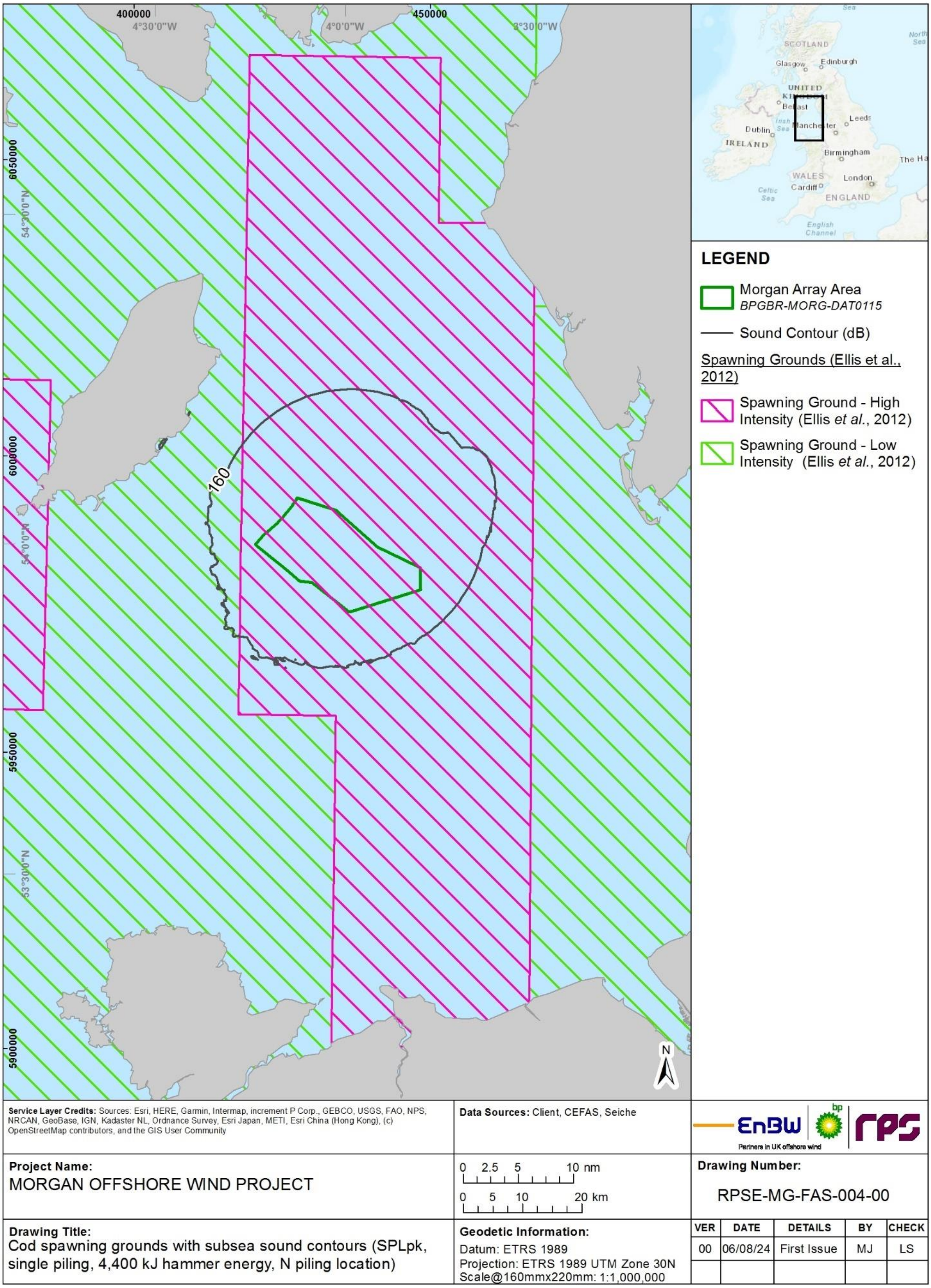
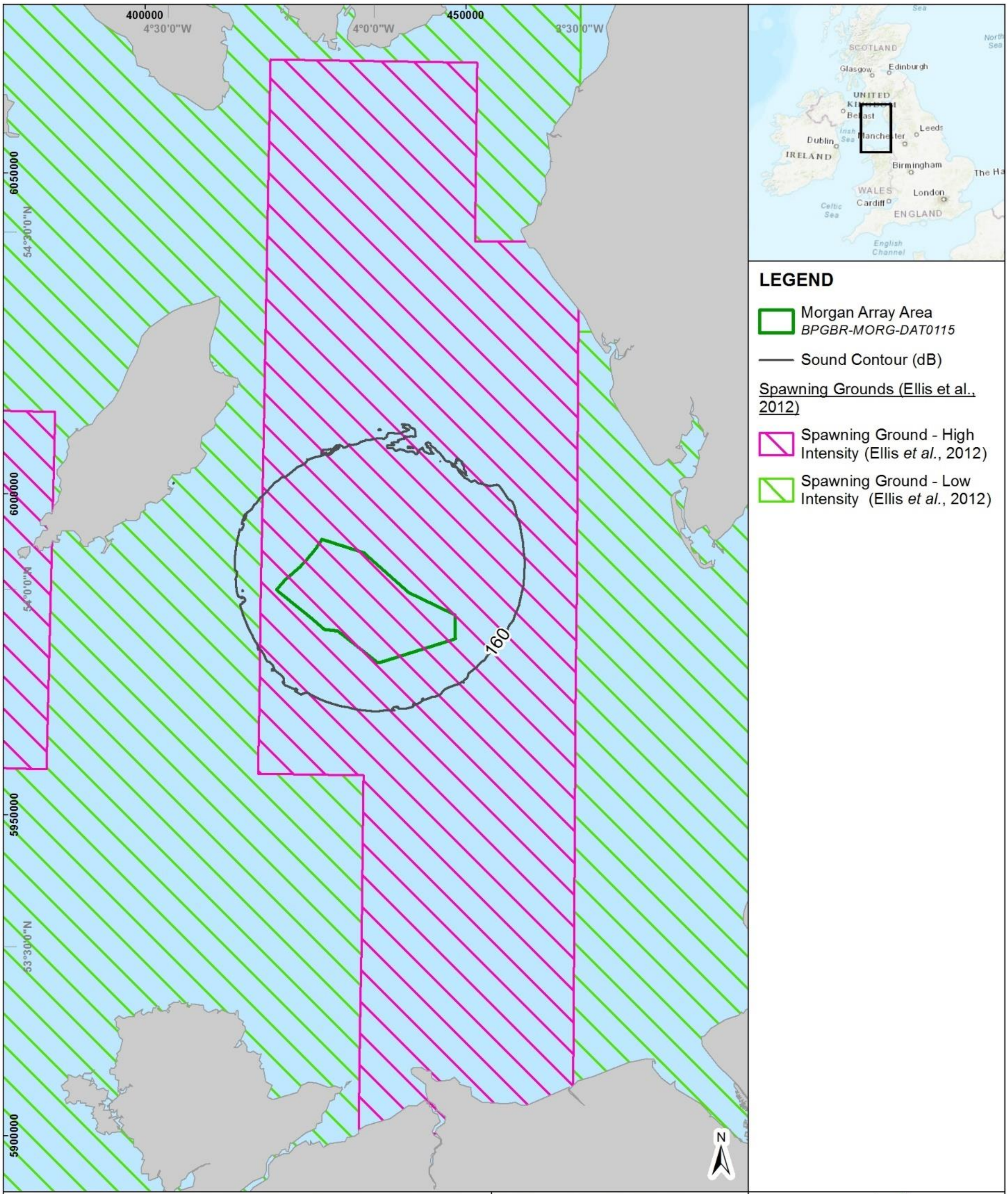


Figure 1.3: Mapped cod spawning grounds with the 160 dB re 1μPa SPL_{pk} underwater sound contour for single piling with a 4,400 kJ hammer energy.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Data Sources: Client, CEFAS, Seiche

Project Name: MORGAN OFFSHORE WIND PROJECT

0 2.5 5 10 nm
0 5 10 20 km

Drawing Number: RPSE-MG-FAS-005-00

Drawing Title: Cod spawning grounds with subsea sound contours (SPLpk, single piling, 3,000 kJ hammer energy, N piling location)

Geodetic Information:
Datum: ETRS 1989
Projection: ETRS 1989 UTM Zone 30N
Scale@160mmx220mm: 1:1,000,000

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Figure 1.4: Mapped cod spawning grounds with the 160 dB re 1μPa SPL_{pk} underwater sound contour for single piling with a 3,000 kJ hammer energy.

2 REFERENCES

Hawkins, A.D., and Popper, A.N. (2014). Assessing the Impact of Underwater Sounds on Fishes and Other Forms of Marine Life. Acoustics Today, 10(2), 30-41.

McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdosh, J. and McCabe, K. (2000) Marine seismic surveys: analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid. Report to Australian Petroleum Production Exploration Association. Centre for Marine Science and Technology. 203pp.

Morgan Offshore Wind Ltd. (2023) Morgan Offshore Wind Project: Generation Assets Preliminary Environmental Information Report. Available online: https://morecambeandmorgan.com/morgan/consultationhub/. Accessed: August 2024.