



**N O R T H F A L L S**

*Offshore Wind Farm*

# **Sandeel and Herring Habitat Heat Mapping**

## Clarification Note

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## 1 Introduction

1. This clarification note presents evidence in support of the sandeel and herring habitat heat mapping exercise used to inform ES Chapter 11 Fish and Shellfish Ecology [APP-025], including a comparison between the heat maps produced strictly following the methodologies presented in Marine Space et al. (2013a, 2013b) and their recent reviews (Reach et al., 2024 and Kyle-Henney et al., 2024) and those produced in support of the application and included in Appendix 11.1 Fish and Shellfish Ecology Technical report [APP-095].
2. The robustness of the outputs associated with the various heat maps and the implications, if any, with regards to the outcomes of the impact assessment presented in Chapter 11 Fish and Shellfish Ecology [APP-025] are also discussed.
3. This document complements the Applicant's Response to Written Questions [Document Reference 9.19, **REP2-020**] providing further information to the Examining Authority's written questions and requests for information (ExQ1) [**PD-009**], transcribed in Table 1.1, below.

**Table 1.1. Written Question comments addressed in this document**

Ref	Comment
Q.10.1.4	<p><i>Baseline data – fish and shellfish ecology</i></p> <p>(i) <i>Useful North Sea Sandeel survey data from International Council for the Exploration of the Sea has not been used for the characterisation of Sandeel habitat within the ES. Moreover, heat mapping for Sandeel habitat and fishing layer data applied should be more robustly clarified as per the commentary of the Marine Management Organisation. Can the Applicant confirm due updates and clarify the robustness of the data which informs the ES?</i></p> <p>(ii) <i>For herring, the ES appears to have omitted key fishing ground layer information in heat mapping and presented inaccurate vessel monitoring data. Therefore, the extent of herring spawning habitat may not be fully accounted for. The ExA requests further clarification on these issues and a reassessment of the likely impact(s).</i></p>

4. This document also complements the Applicant's Responses to Relevant Representations Received from Statutory Consultees and Non Prescribed Consultees [Document Reference 9.2, **REP1-045**] regarding the MMO Relevant Representations [**RR-216**] comments: MMO-164, MMO-165, MMO-168 and MMO-169.

## 2 Background

5. The methodology of the habitat heat maps proposed in Marine Space (2013a, 2013b) for sandeel and herring, are both based on the creation of GIS polygon layers which have a “confidence score” attributed to them. These layers are then overlaid and their scores summed up where there is overlap between them.
6. The confidence score of each individual layer is calculated using various “confidence tests” which are assigned scores ranging from 0 to 3. The following tests are applied to each layer:
  - Method
  - Vintage
  - Positioning
  - Resolution
  - Quality Standards
  - Indicator of Spawning
7. The formulas used to calculate the final confidence score for each layer are based on the sum of the scores of the confidence tests. These scores are then weighted and normalised as follows:
  - $\text{Total Weighted Score} = \text{Method} + \text{Vintage} + \text{Positioning} + \text{Resolution} + \text{Quality Standards} + (\text{Indicator of Spawning} * 5)$
  - $\text{Total Normalised Layer Score} = \text{Total Weighted Score} / 6$
8. In line with Marine Space (2013a and 2013b), the sandeel and herring heat maps included in Appendix 11.1 Fish and Shellfish Ecology Technical Report [APP-095] used the above methodology to calculate confidence scores.
9. Where appropriate, however, and in the interest of making sure that the resulting heat maps were robust and relevant to the area of the Project, some of the data layers proposed in Marine Space (2013a and 2013b) were omitted and/or substituted for layers considered to be more appropriate in areas of relevance to the Project.
10. The Applicant notes that since the initial preparation of the heat maps by the Applicant, updated methodologies for heat mapping have been published (Reach *et al.*, 2024 and Kyle-Henney *et al.*, 2024). The outcomes of the heat maps resulting from the application of these new methodologies are also presented and discussed within this document for completeness (Section 5).

### 3 Sandeel Heat Mapping

11. The results of the sandeel heat map included in Appendix 11.1 Fish and Shellfish Ecology Technical Report [APP-095] and those resulting from a strict application of the method described in Marine Space (2013a) are illustrated in Figure 3.1 and Figure 3.2, respectively.
12. As summarised in Table 3.1, both heat maps assigned the same confidence scores to the majority of the data layers. Exceptions to this are the data layers associated with Vessel Monitoring System (VMS) data and the Eastern Sea Fisheries Joint Committee (ESFJC) data layer on sandeel fishing grounds.

**Table 3.1 Total Scores by Data Layer**

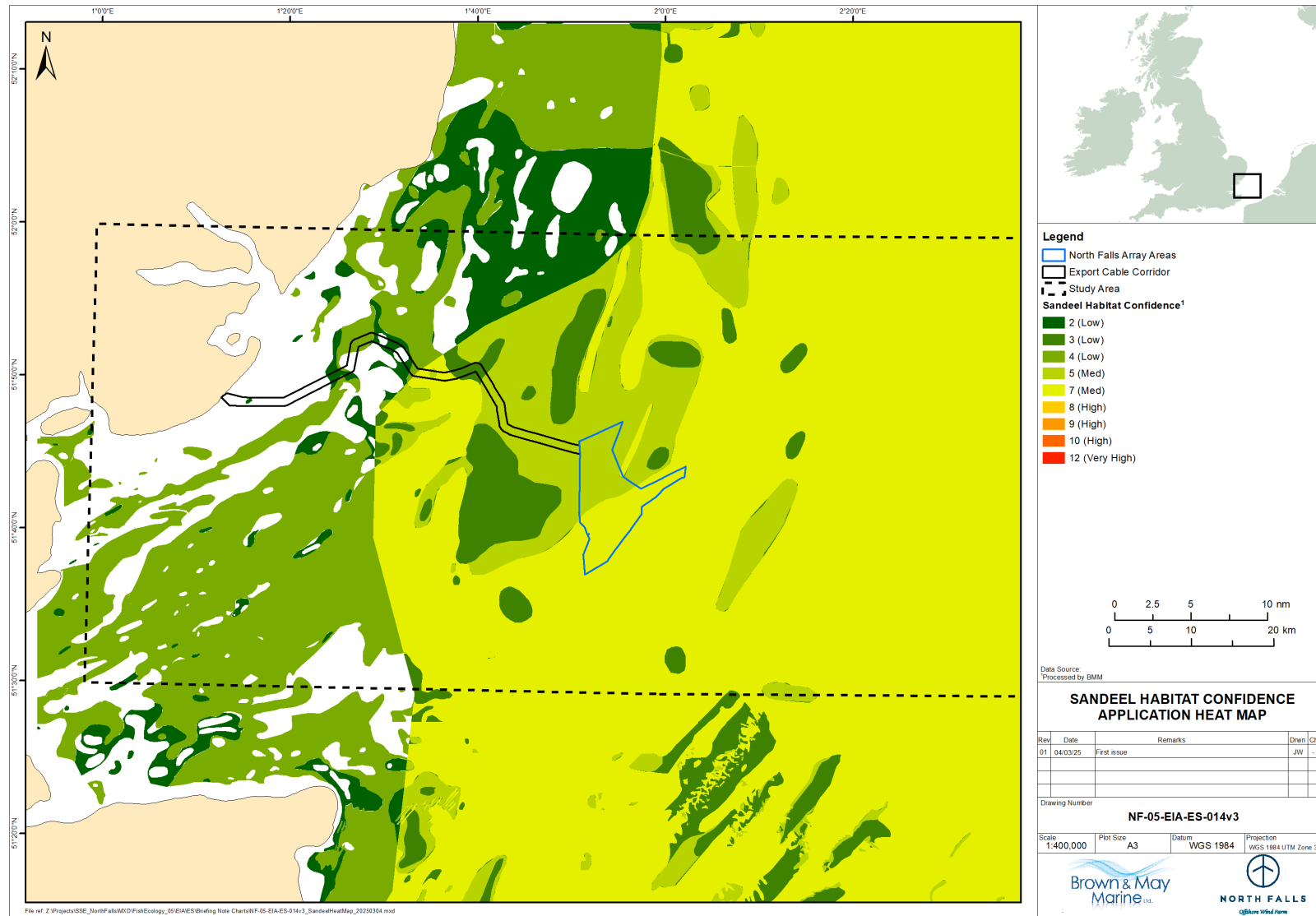
Data layer	Score (Marine Space, 2013a)	Score (application)
Sandeel spawning grounds from Coull <i>et al.</i> (1998)	3	3
MMO UK VMS demersal trawlers	2	Layer replaced for sandeel VMS layer
Danish VMS sandeel fishery	Not included (MMO UK VMS used instead)	5
BGS preferred sandeel sediment	4	4
BGS marginal sandeel sediment	2	2
ESFJC	3	Omitted

13. Whilst the outputs from the two mapping exercises are broadly consistent, there are some differences between them. With specific reference to the outcomes within the area of the Project, differences are a result of two key aspects:
  - The inclusion of UK MMO VMS data layer in the Marine Space (2013a) methodology and its substitution with the Danish sandeel VMS data layer in the heat map submitted with the Application; and
  - The different ranking system used for the scores identified in the two heat maps.
14. As discussed in Section 3.2 below, the omission of the ESFJC layer has no implications with regards to the outputs of the heatmaps in the area of the Project.
15. The score ranking systems used in each heat map are summarised in Table 3.2. As shown, the Marine Space (2013a) methodology ranks scores from 0 to 16. It should be noted that the ranking is based on the method developed for herring in Marine Space (2013b) and that this is not tailored to the available sandeel data. This results in the inclusion of scores that are not theoretically possible using the sandeel data layers proposed (specifically scores 1, 11, 13, 14, 15 and 16).
16. The ranking system used in the heat map developed for the Project (Figure 3.1) only includes scores which are possible, ranging from 2 to 12, with scores 6 and 11 not being theoretically possible and therefore excluded from the heat map.

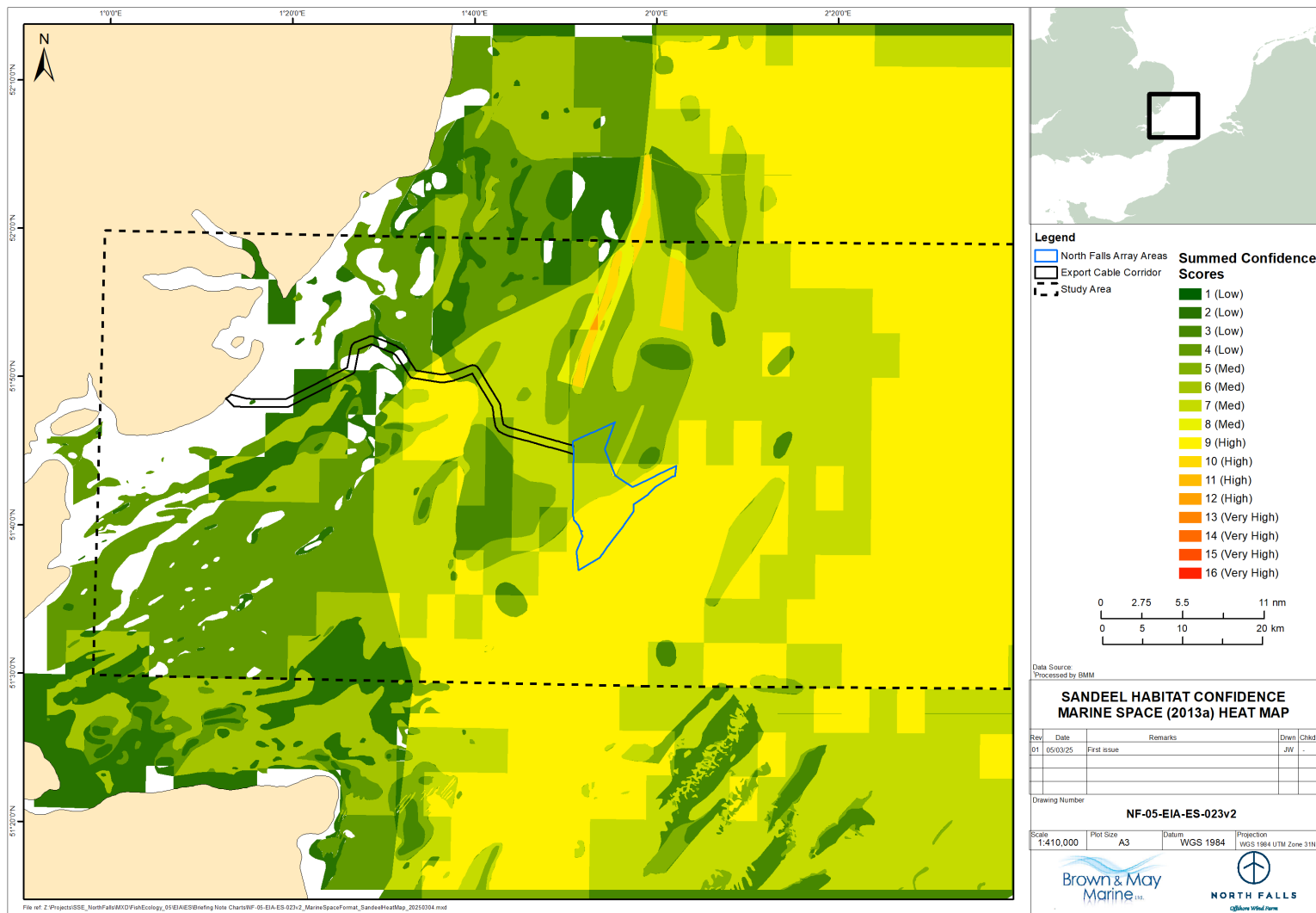
**Table 3.2 Score ranking used in the Heat Maps**

Rank	Marine Space (2013a)	Application
Low	1-4	2-4
Medium	5-8	5-7
High	9-12	8-10
Very high	13-16	>10 very high

17. As illustrated in Table 3.2, the approach to the ranking of scores adopted in the heat map presented within the Application is more conservative than that used in Marine Space (2013a), with lower scores ranked as “high” and “very high” sandeel habitat confidence.
18. Despite this, the array area and part of the cable corridor record higher scores in the heat map that uses the Marine Space (2013a) method (up to a score of 9) compared to that submitted with the Application (up to a score of 7) (Figure 3.1 and Figure 3.2). This is a result of the inclusion of UK MMO demersal trawling VMS data in the heat map based on Marine Space (2013a). This adds two additional points to the total score (Table 3.1).
19. The implications of the omissions and substitution of data layers in the heat map submitted with the Application are further explained in Section 3



**Figure 3.1 Sandeel Habitat Confidence Heat Map produced in support of the Application**



**Figure 3.2 Sandeel Habitat Confidence Heat Map produced strictly using guidance proposed in Marine Space (2013a)**

### 3.1 ESFJC Sandeel Fishing Data Layer

20. As shown in , the ESFJC sandeel grounds data do not overlap with the Project and therefore the omission of this layer has no implications with regard to the overall confidence scores assigned to the area of the Project and therefore to the outputs of the heat map in support of Chapter 11 Fish and Shellfish Ecology [APP-025].

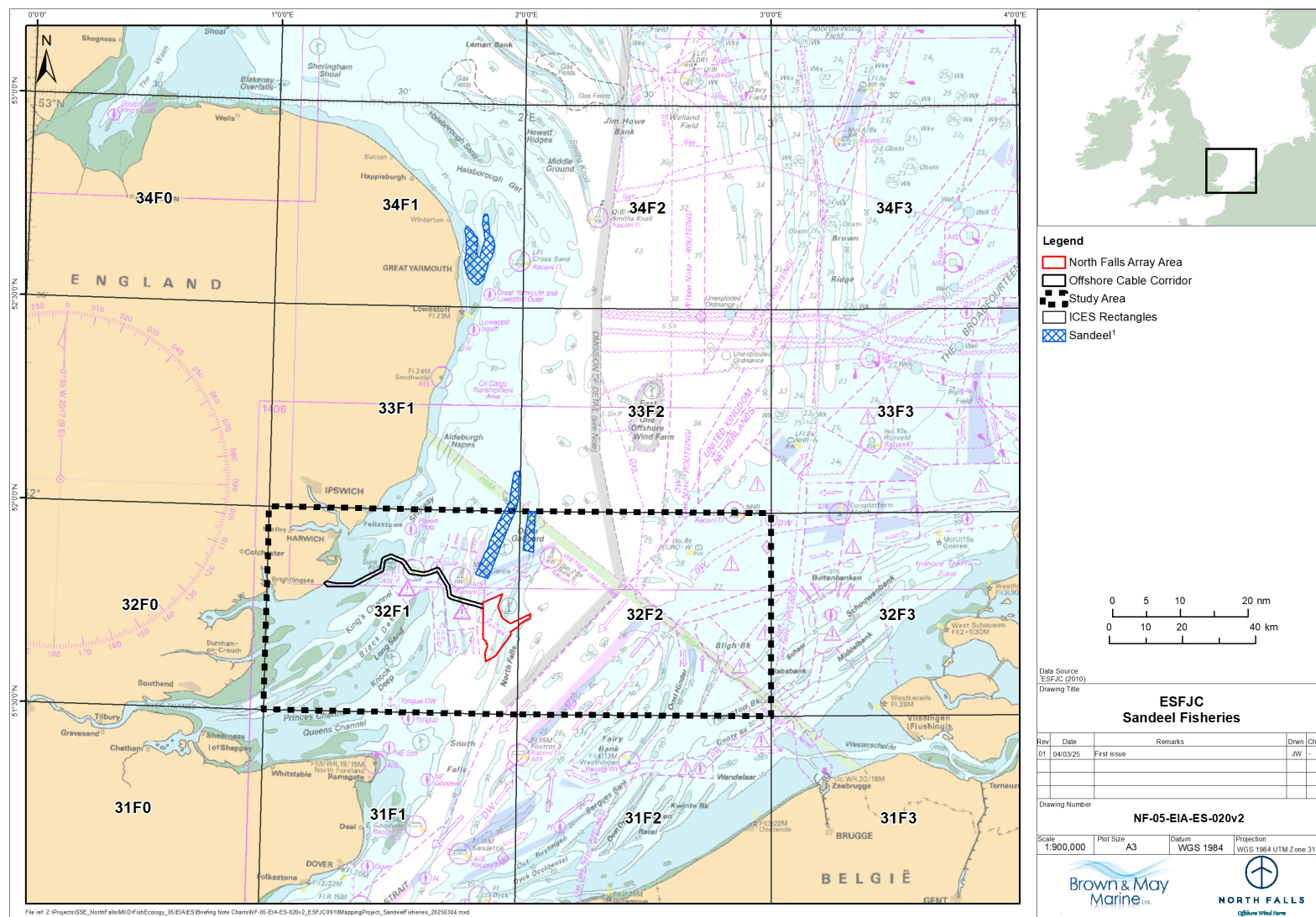


Figure 3.3 ESFJC Sandeel Fishery Data Layer (ESFJC, 2010)



21. It is important to note that the ESFJC sandeel fishery data layer was produced by the ESFJC as part of a wider Fisheries Mapping Project that was published in 2010. The mapping project aimed to describe the extent of the main fisheries within the ESFJC District. At the time of publication, the ESFJC noted that the data layers associated with this project were not exhaustive and that they should be used with discretion, not to replace full, proper consultation within the fishing industry, but rather be seen as illustrative of the types of activity within the district and, where information is available, an indication of seasonality (ESFJC, 2010). It is understood from communication with Eastern IFCA (pers comms, 29/1/2024) that the ESFJC data layers have not been available from the Eastern IFCA (formerly ESFJC) website for over five years and that these were purposely removed to avoid confusion, as the IFCA were made aware that the data was often used without the appropriate caveats.
22. The Applicant also notes that it is well established that there is no existing or historic sandeel fishery in the fish and shellfish study area nor in its immediate vicinity. This is well supported by fisheries statistics from the area and consistent with the fishing methods and specifications of the fishing gears used by vessels active in the study area.
23. With the above in mind and considering the limitations and scope of the information included in ESFJC dataset, this was not considered appropriate for inclusion to inform the sandeel habitat heatmap submitted with the Application.

### 3.2 VMS Data Layers

24. As mentioned in Table 3.1 the heat map submitted with the Application used VMS data from the Danish fishery instead of the MMO UK demersal trawling VMS data layer proposed in the Marine Space (2013a) methodology.
25. The Applicant notes that demersal trawling activity that takes place in the fish and shellfish ecology study area and that is captured in the MMO UK demersal trawling VMS data layer is not representative of a sandeel fishery in areas of relevance to the Project. It is well established that the UK demersal trawl fleet does not target sandeels in this area at present or historically (MMO, 2023). It is therefore considered that the inclusion of a data layer, which in effect illustrates the distribution of fishing by demersal trawlers that target other species (particularly flatfish and gadoids) is misrepresentative and misleading. The main European fleet that targets sandeels in the North Sea is the Danish fleet, as Denmark is the country that retains the vast majority of North Sea sandeel quota. This is the reason why the Danish sandeel fishery data was considered more appropriate as a proxy to illustrate the distribution of sandeel habitat for the purposes of informing the heat mapping exercise.
26. It is important to note that the inclusion of the MMO UK demersal trawling VMS data layer has implications for the heat mapping exercise in the area of the Project. As shown in Figure 3.4, whilst at very low levels, UK demersal trawling is identified across some sections of the export cable corridor and in the array area. Inclusion of this data layer results in a higher confidence score being assigned to the area of the Project than if actual sandeel fishing data was used. The sandeel specific fishery data layer included in the heat map submitted with the Application, indicates that there is no sandeel fishing grounds within the study area (see Figure 3.5). This is consistent with the existing information on

sandeel fishing grounds in the North Sea which has been reported in various publications and that is widely considered representative of the location of the main North Sea sandeel grounds (i.e. Jensen *et al.*, 2011, Wright *et al.*, 2019; see Figure 3.6).

27. The Applicant also notes that the information on the distribution of sandeel habitat reported from the sandeel fishery (Figure 3.5) and from the established sandeel fishing grounds (Figure 3.6) are also aligned with the high intensity spawning and nursery grounds identified in Ellis *et al.* (2012). As shown in Figure 3.7 the area of the Project and the wider study area are located in an area considered of low intensity spawning and nursery grounds for this species.

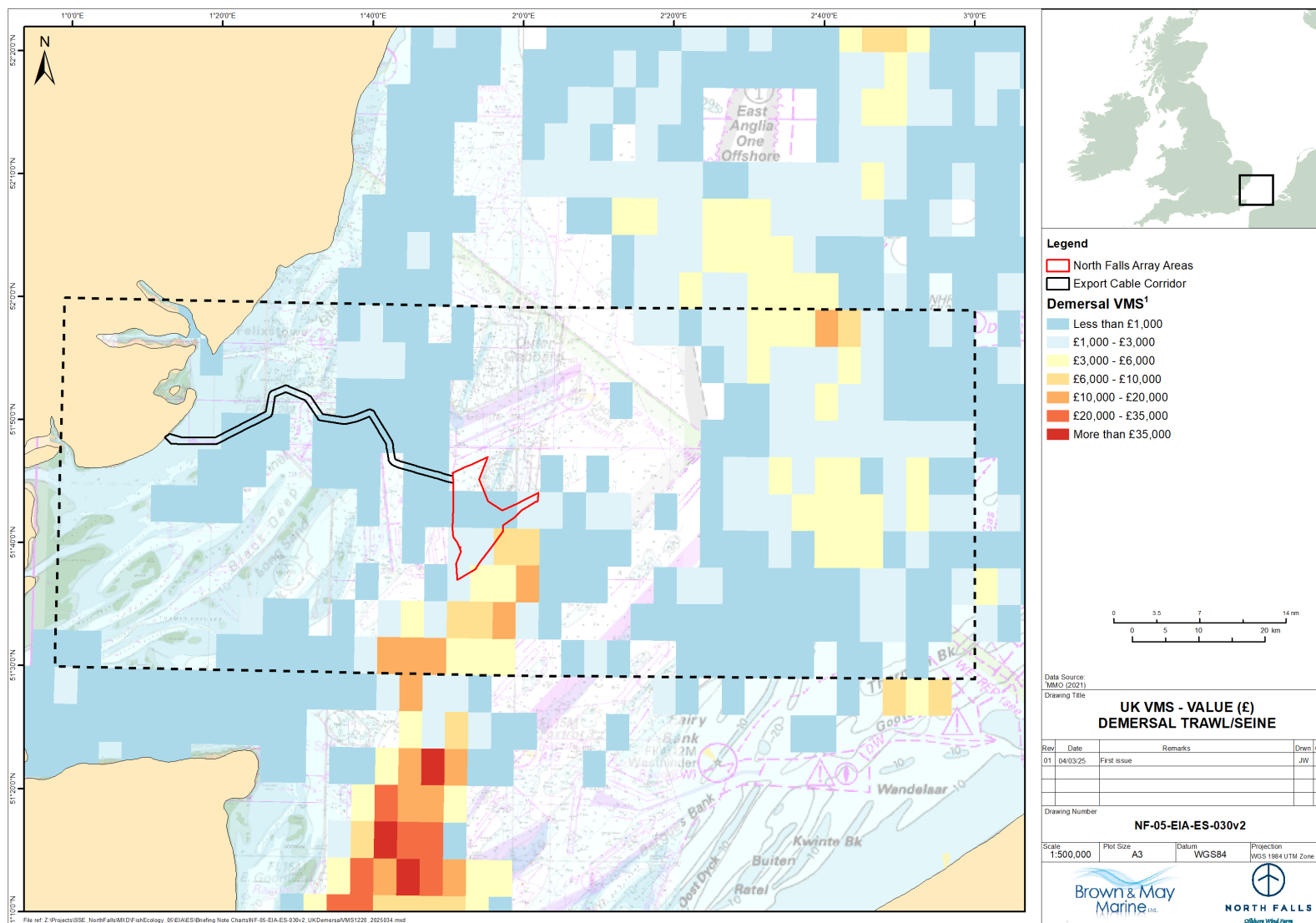
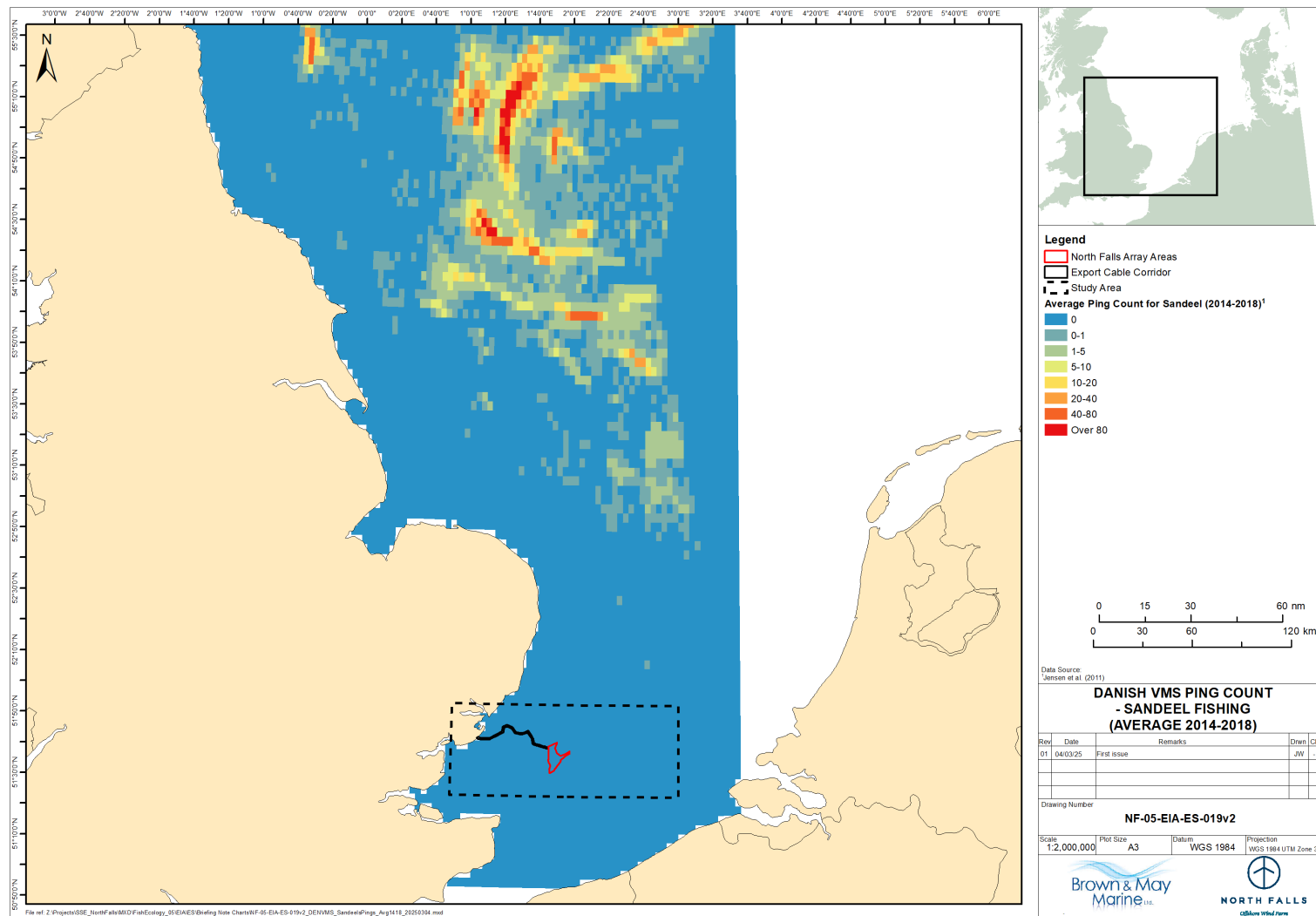
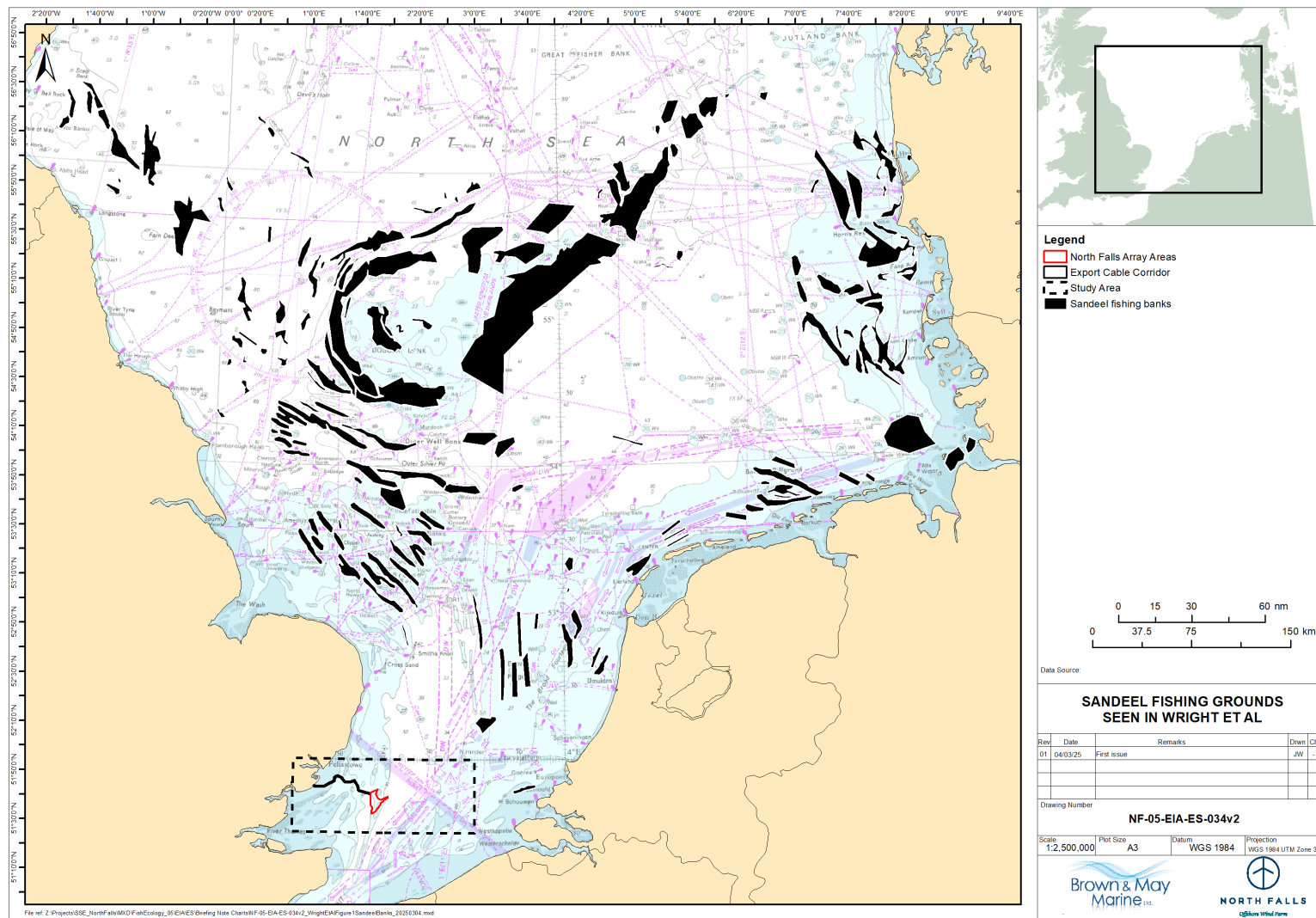


Figure 3.4 MMO UK VMS for demersal trawling



**Figure 3.5 Danish Sandeel VMS data**



**Figure 3.6 Sandeel fishing grounds in the North Sea (Wright *et al.*, 2019)**



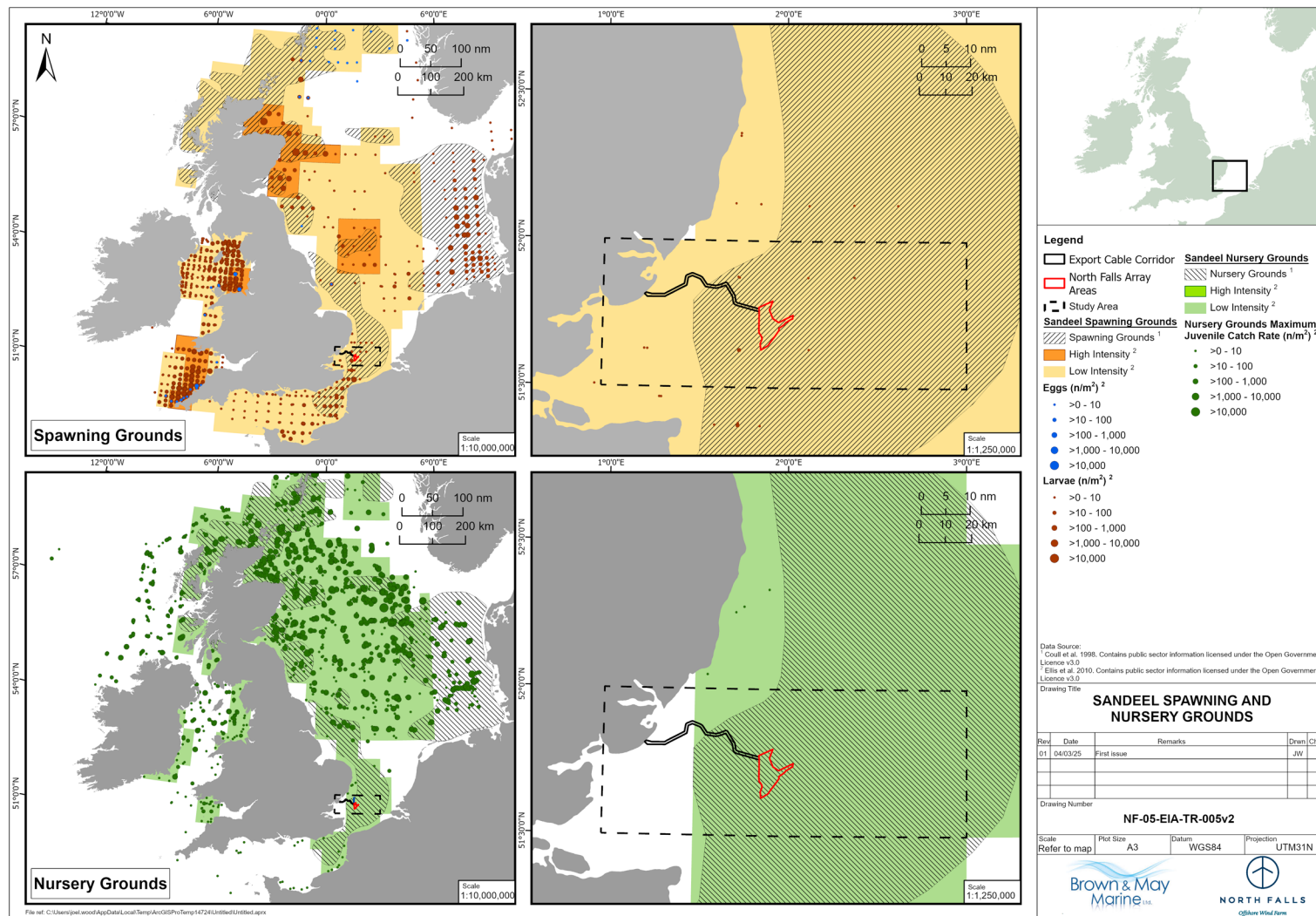


Figure 3.7 Sandeel spawning and nursery grounds (Ellis *et al.*, 2012)

## 4 Herring heat mapping

28. The results of the herring heat map included in Appendix 11.1 Fish and Shellfish Ecology Technical Report [APP-095] and those resulting from strict application of the data layers and method proposed in Marine Space (2013b) are illustrated in Figure 4.1 and Figure 4.2, respectively.
29. The outputs from the two mapping exercises are broadly consistent. As summarised in Table 4.1, both heat maps assigned the same confidence scores to the data layers included in the assessments (Table 4.1). The only exception to this is the ESFJC herring and sprat fishing data layer. As this data was omitted from the heat map presented with the Application, no score was assigned to it.

**Table 4.1 Total Scores by Data Layer**

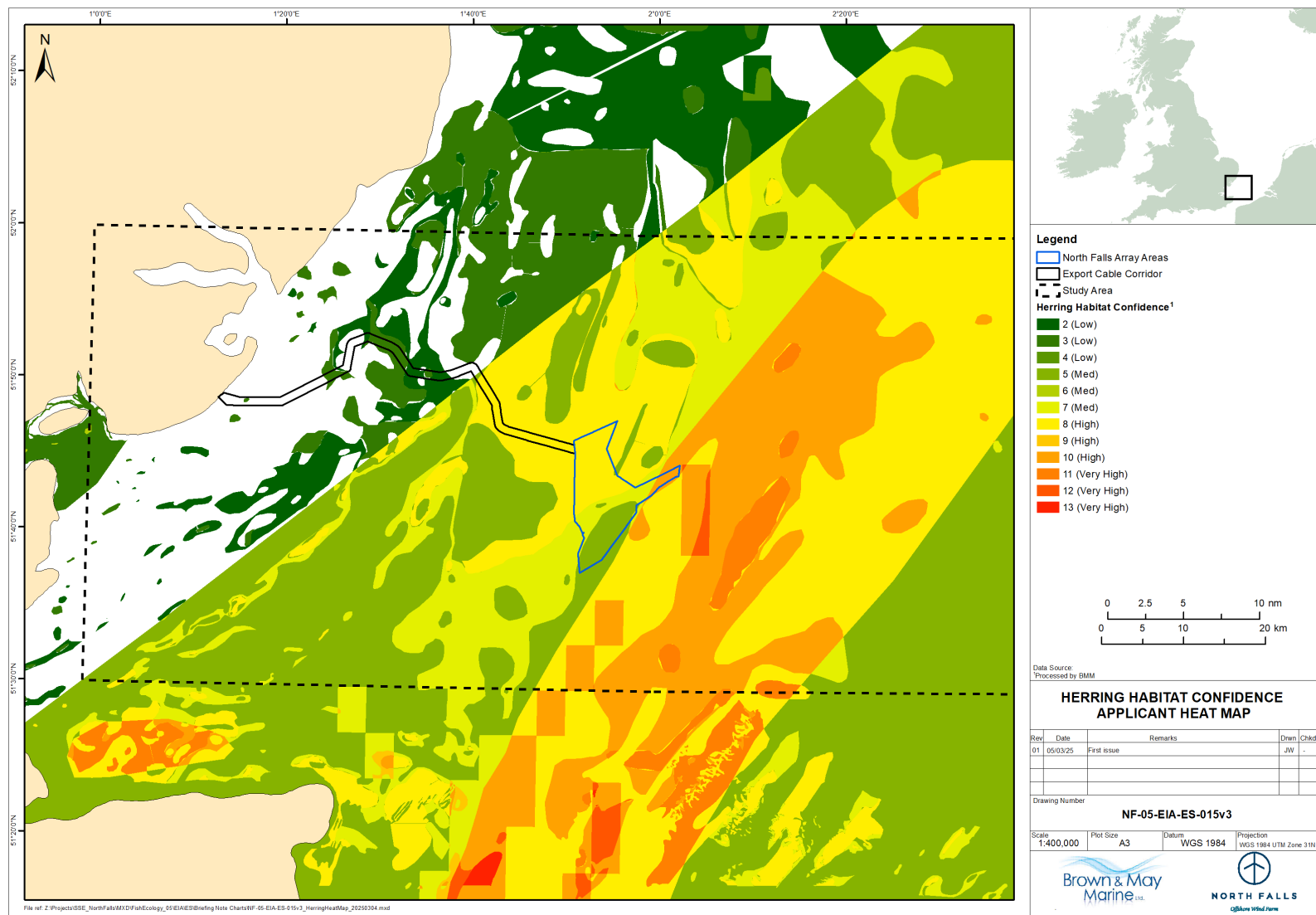
Data layer	Score (Marine Space 2013b)	Score (heat map submitted with application)
Herring spawning grounds from Coull <i>et al.</i> (1998)	3	3
VMS Pelagic trawling	2	2
BGS preferred herring sediment	3	3
BGS marginal herring sediment	2	2
International Herring Larvae Survey (IHLS) interpolated layer	5	5
ESFJC Herring and sprat fishing layer	3	Omitted

30. The information included in the ESFJC data layer is illustrated in Figure 4.3. This was omitted for the same reasons highlighted above with regards to the ESFJC Fisheries Mapping data layer for sandeels.
31. As there is no overlap between the sprat and herring grounds identified in the ESFJC Mapping project and the Project, its omission has no potential to result in material changes to the heat mapping outcomes (scores) in areas of relevance to the Project.
32. The main differences between the two heat maps are a result of the different ranks assigned to the scores (Table 4.2).
33. In the herring heat map produced in support of the Application (Figure 4.1) the habitat confidence scores were ranked from 2 to 13. This is the range of possible scores based on the data layers used.
34. The Marine Space (2013b) method ranks scores using ranges from 1 to 16. It should be noted that a total score of 1 is not theoretically possible and that the scores 14, 15 and 16 do not occur within the dataset used.
35. The approach to the score ranking adopted in the heat map presented within the Application is therefore more conservative than that used in Marine Space (2013b) and results in “high confidence” scores being identified over larger areas (Figure 4.1 and Figure 4.2). The underlying data and analysis included in both heat maps is however the same.

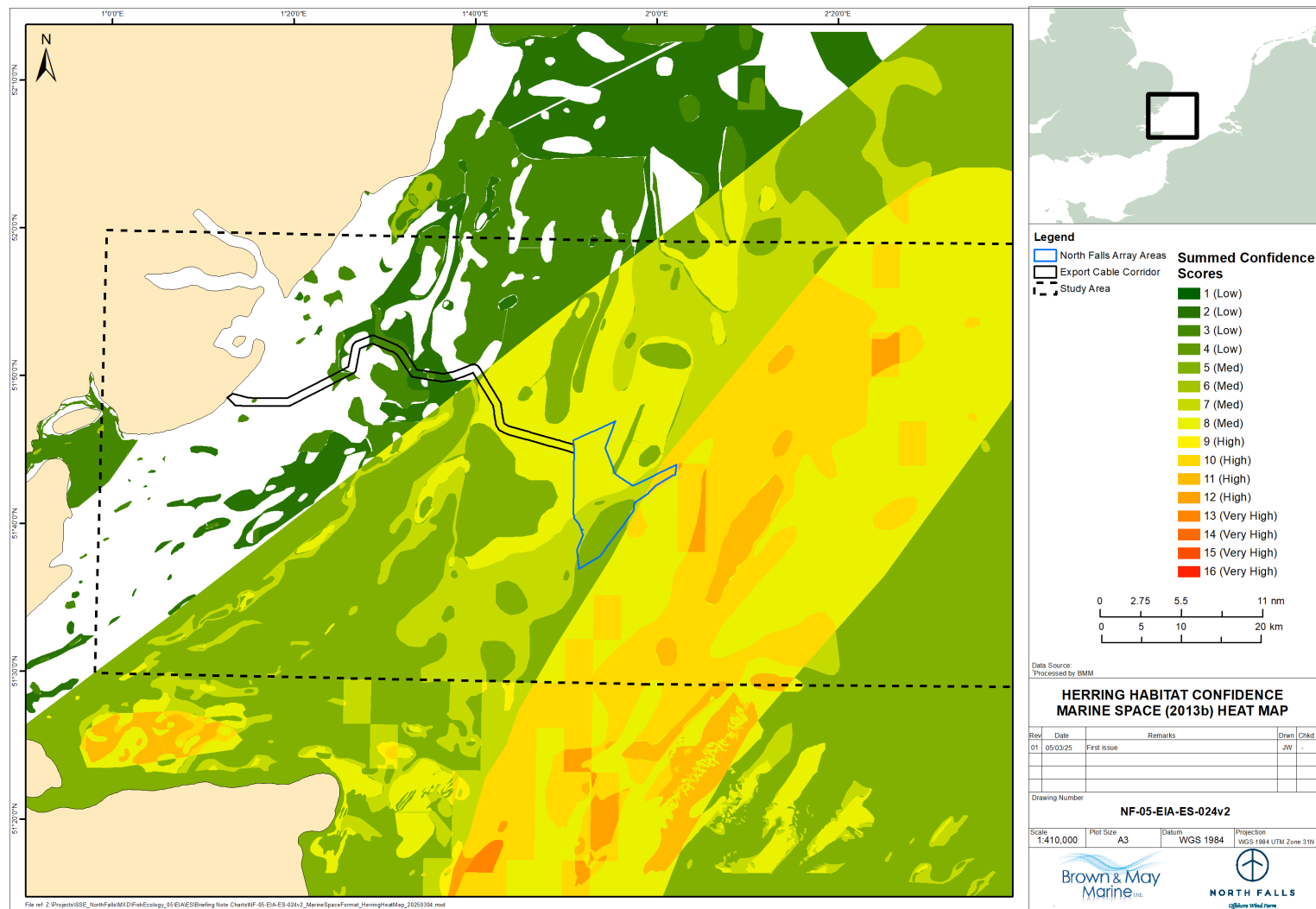
**Table 4.2 Score ranking used in the Heat Maps**

Rank	Marine Space (2013b)	Application
Low	1-4	2-4
Medium	5-8	5-7
High	9-12	8-10
Very high	13-16	11-13





**Figure 4.1 Herring Habitat Confidence Heat Map produced in support of the Application**



**Figure 4.2 Herring Habitat Confidence Heat Map produced strictly using guidance proposed in Marine Space (2013b)**

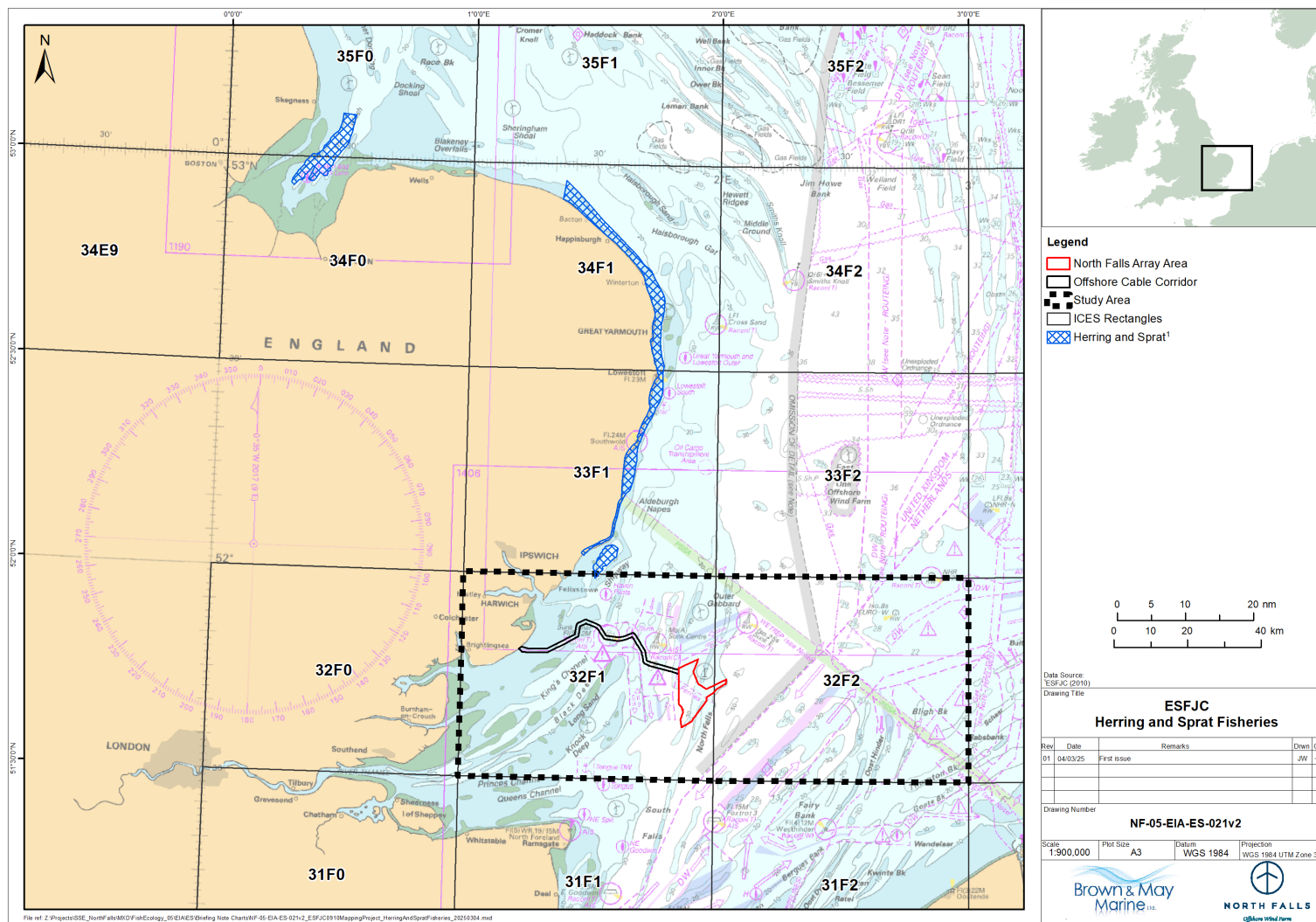


Figure 4.3 ESFJC Sprat and herring grounds data Layer (ESFJC, 2010)

## 5 Updated Heat Mapping Methodologies

36. As previously mentioned in Section 2, following the preparation of the heat maps that were submitted with the Application, updated methodologies for heat mapping were published (Reach *et al.*, 2024 and Kyle-Henney *et al.*, 2024).
37. The data layers used in the updated methodology and those included in the Marine Space (2013a and 2013b) and in the heat maps submitted in the application are outlined in Table 5.1 and Table 5.2 for sandeels and herring respectively. As shown, overall, the data layers that are included in the updated 2024 methodologies are consistent with those in Marine Space (2013a and 2013b). An exception to this is the sediment data layers used. The updated methodologies substitute BGS marginal and preferred habitat sediment data with similar data layers based on EMODnet basemaps. It should be noted that the boundaries of the areas of marginal and preferred sediment associated with these data layers are practically identical to those included in the BGS data set. As such, the change to the sediment data included in the updated methodology is not expected to result in any material change to the resulting heat maps.
38. In the particular case of the sandeel updated methodology (Reach *et al.*, 2024) it is noted that in addition to the change in the sediment data layers, two additional data layers are included for heat mapping. These are the OneBenthic Sandeel presence layer and the Wright *et al.* (2019) sandeel fishing grounds.

**Table 5.1 Data layers used in the 2024 and 2013 sandeel methodology and in the heat map used in support of the Application**

Data layers in the updated 2024 methodology	Included in Marine Space (2013a)	Included in the application
Sandeel spawning grounds (Coull <i>et al.</i> , 1998)	Yes	Yes
MMO UK VMS demersal trawlers	Yes	Layer replaced for sandeel VMS layer
Danish VMS sandeel fishery	Not included (MMO UK VMS used instead)	Yes
EMODnet Preferred sandeel sediment	No (based on BGS data)	No (based on BGS data)
EMODnet Marginal sandeel sediment	No (based on BGS data)	No (based on BGS data)
ESFJC sandeel fishery data layer	Yes	Omitted
OneBenthic Sandeel Presence Layer	No	No
Wright <i>et al.</i> (2019) sandeel fishing grounds	No	No

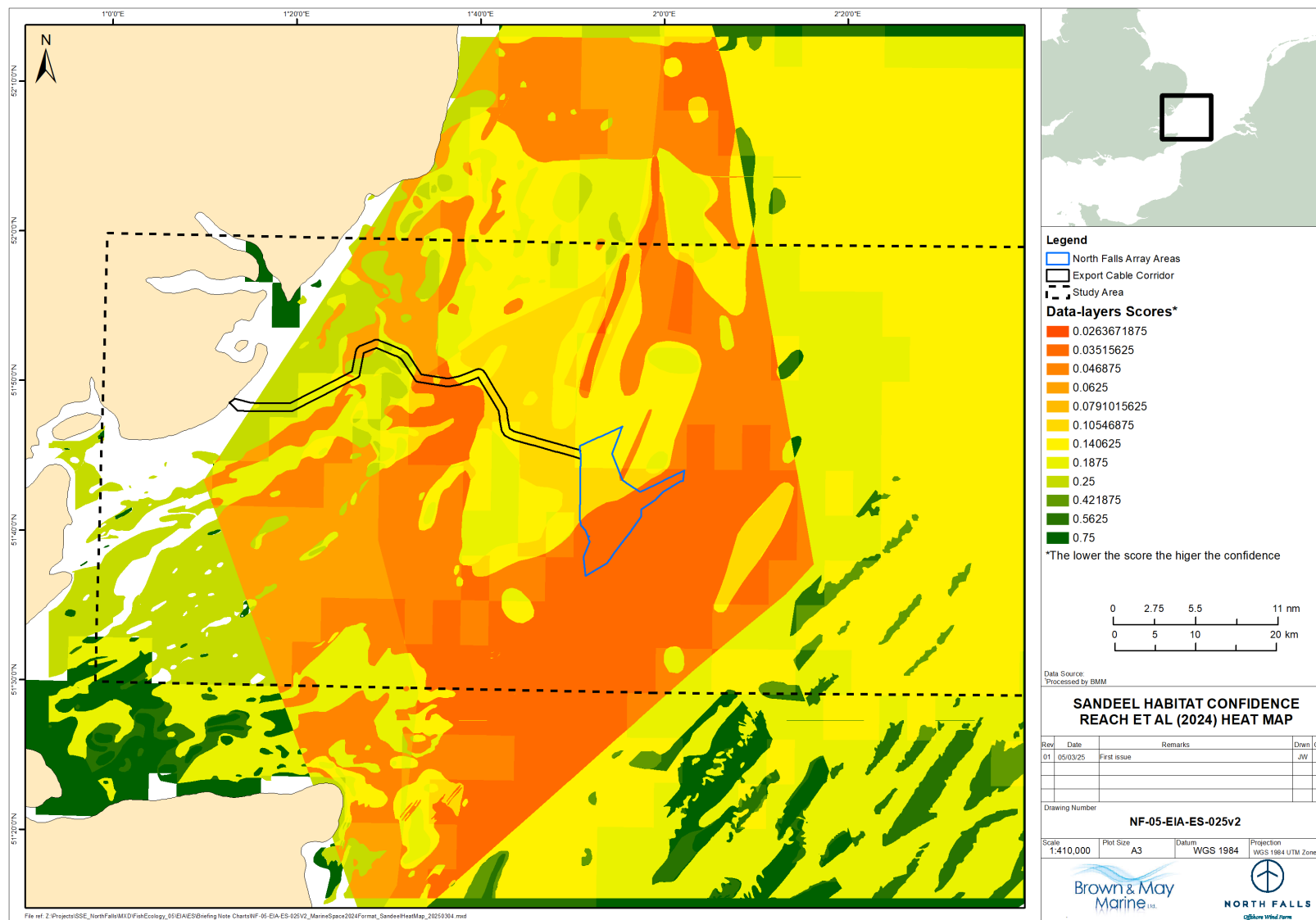
**Table 5.2 Data layers used in the 2024 and 2013 herring methodology and in the heat map used in support of the Application**

Data layers in the updated 2024 methodology	Included in Marine Space (2013b)	Included in the application
Herring spawning grounds from Coull <i>et al.</i> (1998)	Yes	Yes

Data layers in the updated 2024 methodology	Included in Marine Space (2013b)	Included in the application
VMS Pelagic trawling	Yes	Yes
EMODnet Preferred herring sediment	No (based on BGS data)	No (based on BGS data)
EMODnet Marginal herring sediment	No (based on BGS data)	No (based on BGS data)
International Herring Larvae Survey (IHLS) interpolated layer	Yes	Yes
ESFJC Herring and sprat fishing layer	Yes	Omitted

39. The outputs of the heat map using the 2024 methodology (Reach *et al*, 2024) are illustrated for sandeels and herring in Figure 5.1 and Figure 5.2.
40. As shown, the updated methodology uses a different scoring system to that presented in Marine Space (2013a and 2013b). The updated methodologies no longer rank scores into categories of “low”, “medium”, “high” and “very high” habitat confidence, but simply rank the layers in the map. It is therefore difficult to make direct comparisons with the outputs of the heat maps produced following the Marine Space (2013a and 2013b) method and those submitted with the Application. The Applicant notes that according to the updated methodology, areas of “low”, “medium”, “high” and “very high” potential spawning habitat should be inferred by professional judgement.
41. The Applicant notes that in the case of the sandeel heat map, the inclusion in the updated 2024 methodology of the MMO UK VMS data for demersal trawlers continues to misrepresent potential sandeel habitat in the area of the Project, as previously identified with regards to Marine Space (2013a) method. The updated heat map for sandeels around the area of the Project is further misrepresented by the use of an interpolated layer based on OneBenthic Sandeel Presence data. This is illustrated in Figure 5.3. This data layer is based on the presence of sandeels recorded from grab samples undertaken by up to 38 data providers including aggregate extraction companies, offshore wind farm developers, DEFRA, Cefas, The Crown Estate and National Research Institutes.
42. Within the fish and shellfish study area, there were 51,581 grab and box core samples taken between 1986 – 2023, of which a total of 13 sandeels were recorded between 2002 and 2018. Within the Project, 1,274 grab samples have been recorded, with only one sandeel reported. The interpolation of this data results in a wide area being assumed as sandeel presence and fed into the heatmap.
43. The inclusion of the MMO UK VMS demersal trawl fishing data and of the OneBenthic sandeel presence interpolated data layer are responsible for the apparent increased sandeel suitability of the area of the Project in the heat map produced using the 2024 methodology (Figure 5.1) compared to that presented in the heat map produced in support of the Application<sup>[OBJ]</sup>.

44. The addition of the Wright *et al.* (2019) sandeel fishing grounds data layer, does not result in any material change to the sandeel heat map. As shown in Figure 3.6, these grounds do not overlap with the area of the Project or the study area.
45. In the case of herring, the data layers used in the 2024 methodology have remained consistent with those previously used and the outputs of the heat map are consistent with those in the heat map included in support of the Application.



**Figure 5.1 Sandeel Heat Map (Reach et al., 2024)**

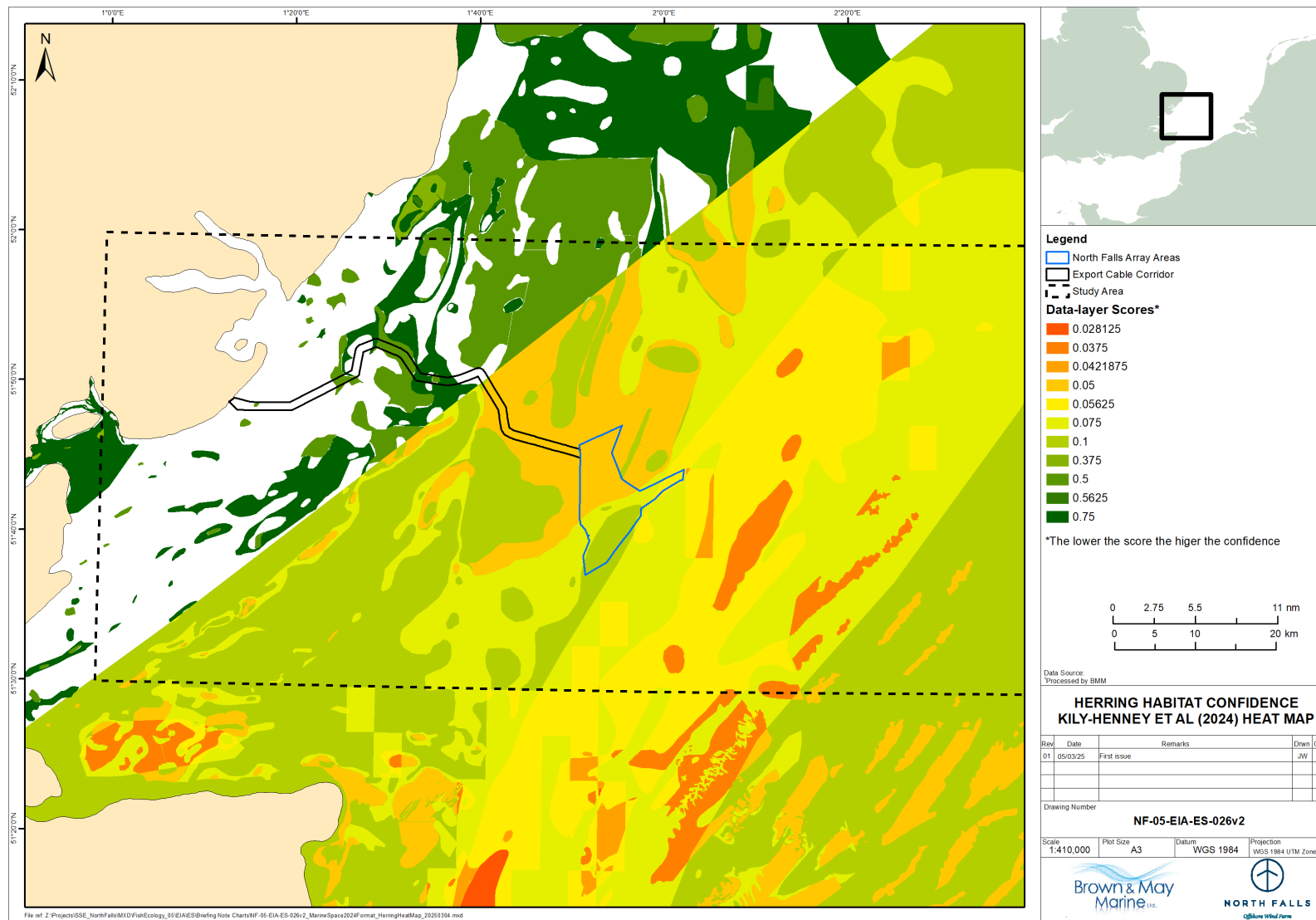


Figure 5.2 Herring Heat Map (Kily-Henney et al., 2024)



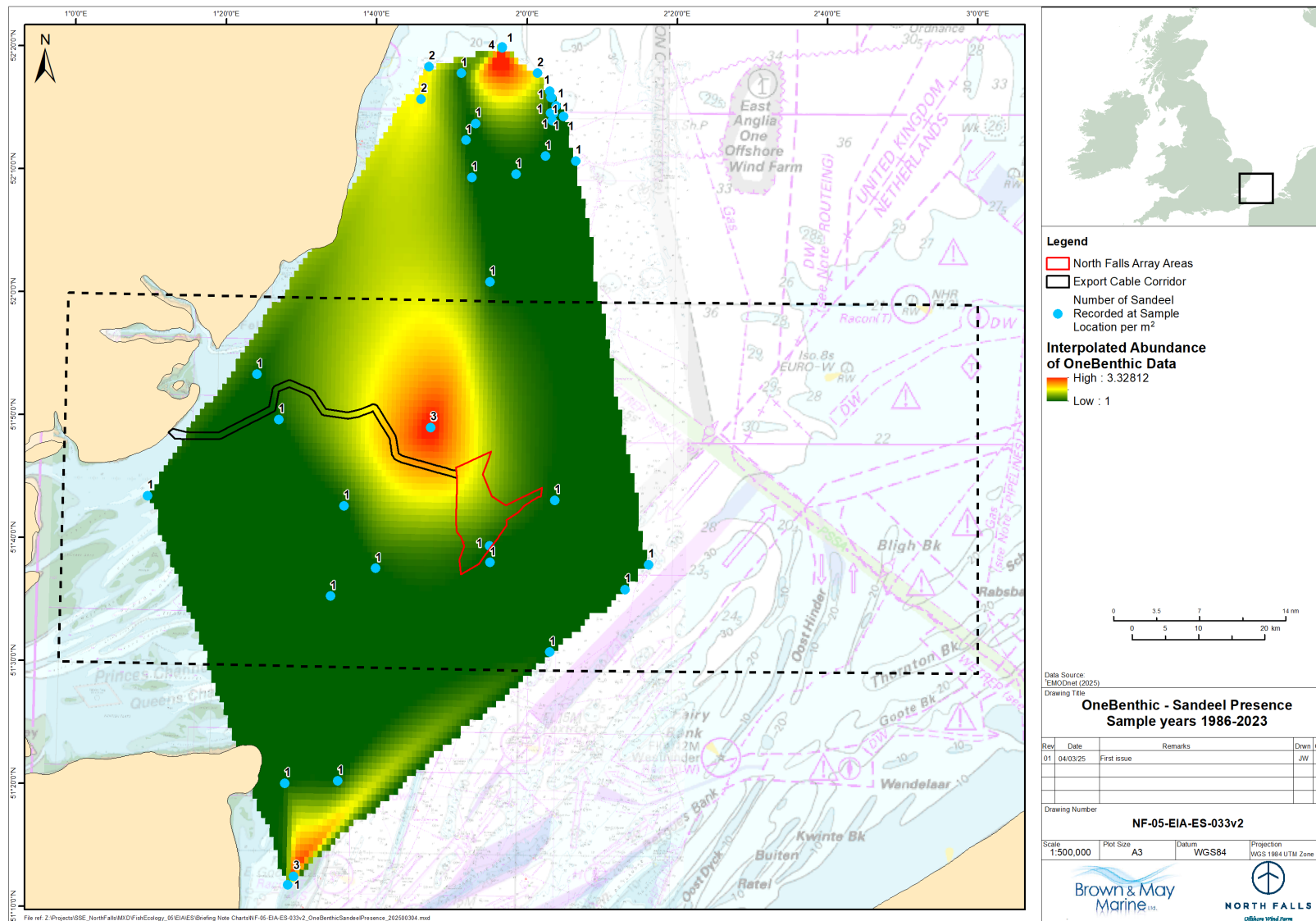



Figure 5.3 OneBenthic Sandeel Presence Interpolated Data Layer

## 6 Discussion

46. As described above, despite minor differences, the heat maps produced in support of the Application are broadly consistent with those produced strictly following Marine Space (2013a and 2013b) and the updated 2024 methodologies.
47. In the case of sandeels, the Applicant notes that the inclusion of some layers, particularly the UK VMS demersal trawling data layer (Marine Space 2013a and Reach et al., 2024) and the OneBenthic sandeel presence data layer (Reach et al., 2024) result in heat maps that misrepresent and overstate the importance of the area of the Project with regards to its suitability as sandeel habitat. The Applicant welcomes the updates proposed with regards to the scoring system used in the 2024 methodologies (Reach et al., 2024 and Kyle-Henney et al., 2024), particularly the encouragement of expert judgement for definition of areas of “low”, “medium”, and “very high” potential spawning habitat.
48. Based on the best available data and information, regardless of the approach and the scoring system used for heat mapping it is clear that the area of the Project does not constitute a key sandeel area, as identified throughout ES Chapter 11 Fish and Shellfish Ecology [APP-025].

## 7 References

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**NORTH FALLS**

*Offshore Wind Farm*



## **HARNESSING THE POWER OF NORTH SEA WIND**

*North Falls Offshore Wind Farm Limited*

*A joint venture company owned equally by SSE Renewables and RWE.*

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