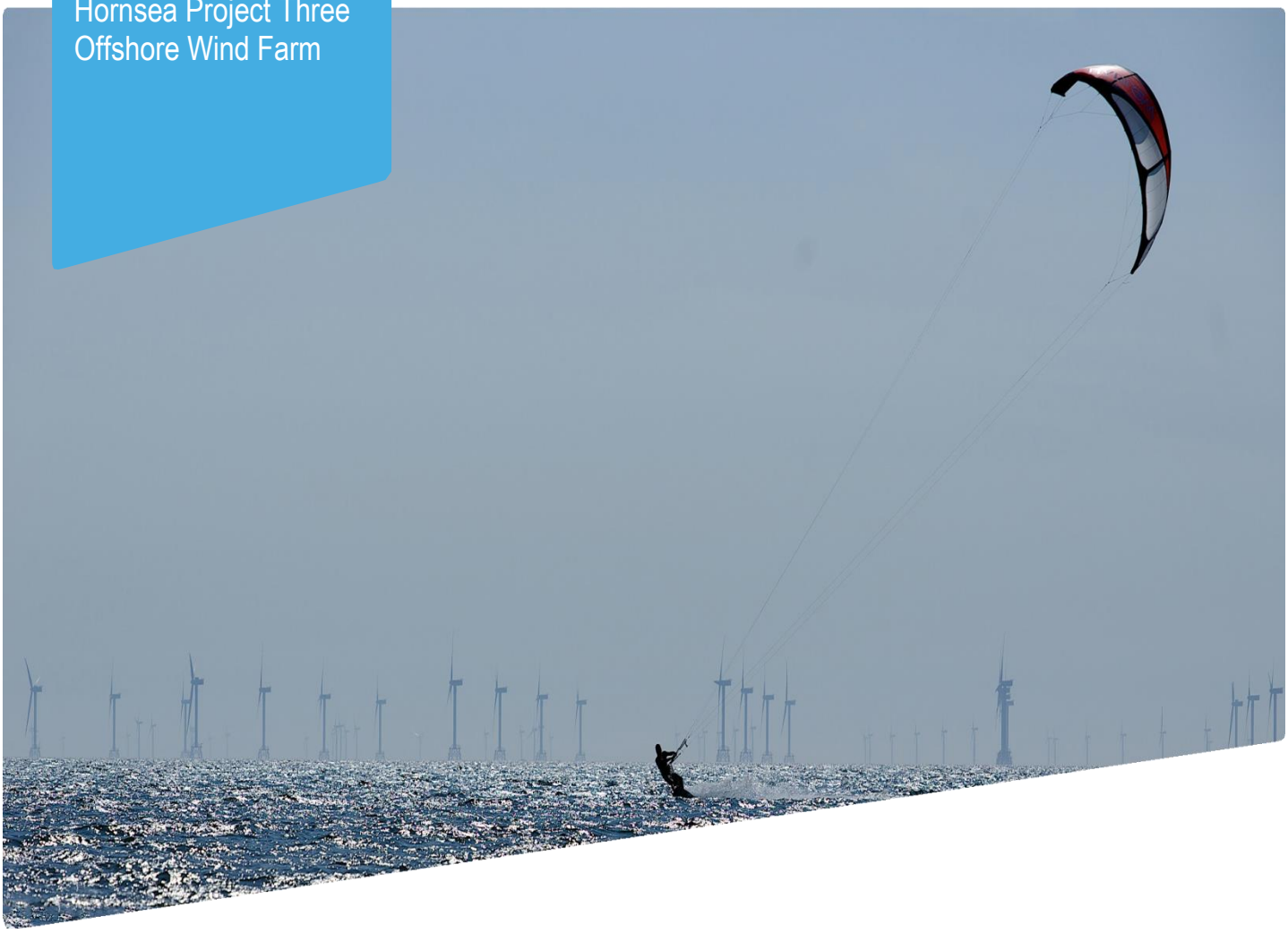
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Appendix 5 to Deadline 7 submission - Clarification of Biotope Classification within North Norfolk Sandbanks and Saturn Reef SAC

Date: 14th March 2019

Hornsea 3
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Front cover picture: Kite surfer near a UK offshore wind farm © Ørsted Hornsea Project Three (UK) Ltd., 2019.

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1. Introduction

1.1 As outlined in Natural England/JNCC's comments on the Applicant's response to Ex.A question Q1.2.15, Natural England and JNCC retain concerns regarding the benthic data analysis and biotope allocation process that was undertaken to inform the benthic ecology characterisation presented in Volume 5, Annex 2.1: Benthic Ecology Technical Report of the Environmental Statement (APP-102) and Volume 2, Chapter 2: Benthic Ecology of the Environmental Statement (APP-062). The Applicant understands from the Natural England Deadline 3 response (REP3-077) that there is sufficient information for characterisation of The Wash and North Norfolk Coast Special Area of Conservation, but JNCC disagree that there is adequate characterisation for the North Norfolk Sandbanks and Saturn Reef SAC. Natural England have provided further comments on the Applicant's comments to the Ex.A's Written Questions to Interested Parties (REP2-005), in a document entitled *Benthic Annex 2.2A – Review of Applicant's response to IP response to ExA Questions – Benthic Ecology*[1].

1.2 In response to these comments, the Applicant has prepared this note to provide clarity and transparency on the benthic characterisation for the North Norfolk Sandbanks and Saturn Reef SAC that underpins the assessment presented in Volume 2, Chapter 2: Benthic Ecology of the Environmental Statement and the Report to Inform Appropriate Assessment (RIAA; APP-052). The purpose of this document is to demonstrate that the characterisation of the SAC is robust and consistent with the results of previous surveys undertaken in the SAC by JNCC and Cefas in 2013 and therefore adequate for the purposes of the Environmental Impact Assessment and Report to Inform Appropriate Assessment.

1.3 As outlined in paragraph 4.1.4.16 of Volume 5, Annex 2.1: Benthic Ecology Technical Report of the Environmental Statement, the biotope map produced from the Hornsea Three site-specific survey data for the area of the Hornsea Three offshore cable corridor coinciding with the North Norfolk Sandbanks and Saturn Reef SAC was compared to, and informed, by the data provided in the 2013 Cefas/JNCC survey report for the SAC (Jenkins *et al*., 2015). Two of the six survey boxes (boxes A and C) described in the Jenkins *et al*. (2015) report coincided with the Hornsea Three offshore cable corridor. This is shown in Figure 2.1 of Volume 5, Annex 2.1: Benthic Ecology Technical Report of the Environmental Statement where the sample locations from the 2013 Cefas/JNCC are shown in relation to the Hornsea Three offshore cable corridor. The following sections of this note consider, in detail, the benthic characterisation for the part of the Hornsea Three offshore cable corridor that coincides with the North Norfolk Sandbanks and Saturn Reef SAC, taking first the northern intersection and then the southern intersection (see Figure 1.1 below).

[1] The Applicant notes that this document was provided to the Applicant by Natural England as part of their Deadline 3 response, although it is not included within the Examination Library and therefore does not have an Examination reference for inclusion here.

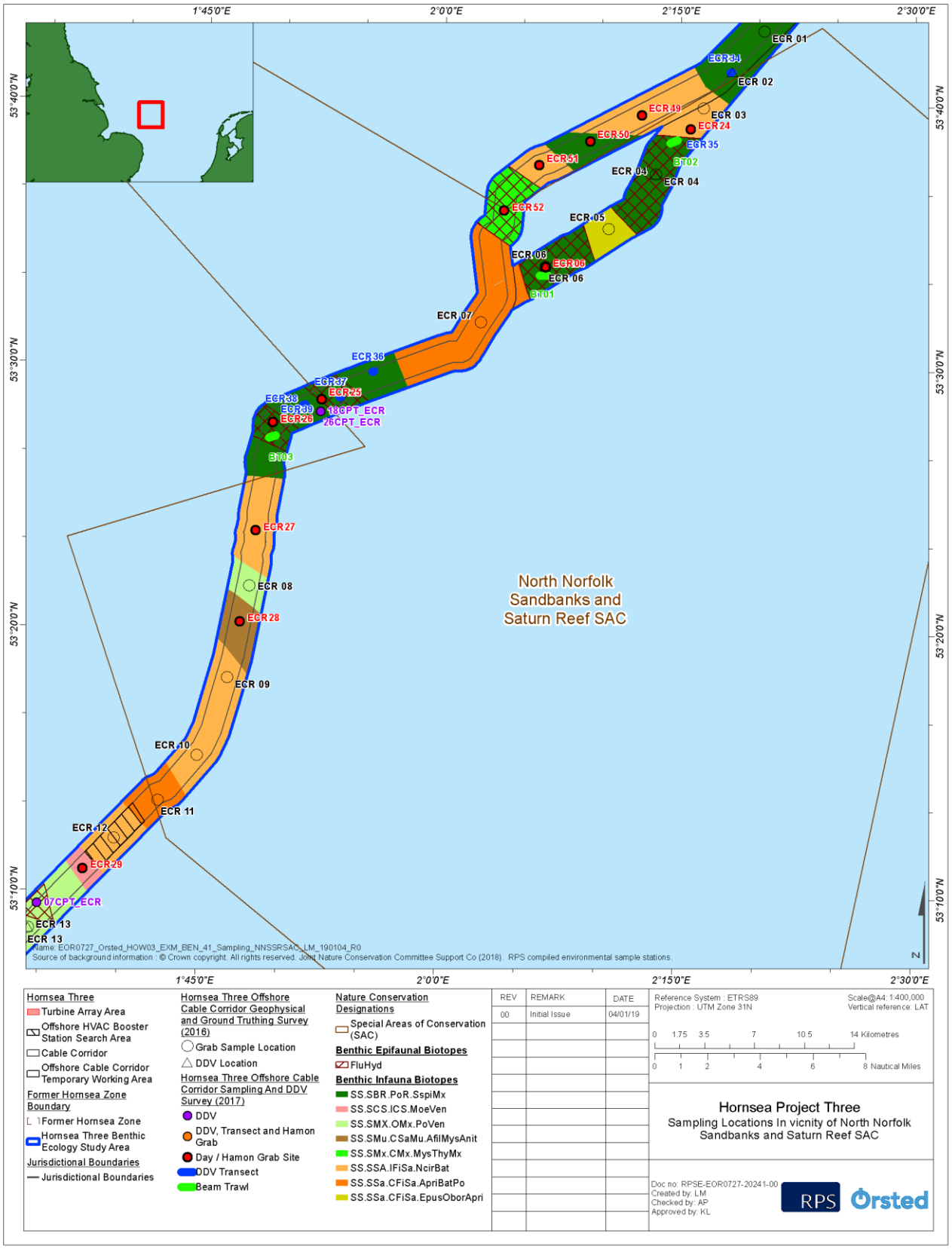

Figure 1.1: Sampling Locations within North Norfolk Sandbanks and Saturn Reef SAC. Biotopes as shown in Figure 2.5 of Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement.

2. Benthic characterisation of the North Norfolk Sandbanks and Saturn Reef SAC

Northern intersection

2.1 With regard to the northern intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC, the SS.SBR.PoR.SspiMx '*Sabellaria spinulosa* on stable circalittoral mixed sediment' biotope (hereafter referred to as SspiMx) was mapped in the western part of this area (see Figure 1.1 above; reproduced from Figure 2.5 in Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement). This biotope was allocated on the basis of a combination of the results of the benthic grab and drop down video sampling undertaken by the Applicant in this area (sample locations ECR36 and ECR37), the results of which are described in paragraph 2.7.1.13 *et seq*. of Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement, and the results of the 2013 JNCC/Cefas survey (Jenkins *et al*., 2015). The site-specific surveys and results of the Annex I reef assessments in this area concluded that these areas constituted 'not reef' on the basis of the sparse distribution of *S. spinulosa* tubes across the seafloor, however in acknowledgement of the historic mapping of *S. spinulosa* reef in this area previously during the 2013 JNCC/Cefas survey, it was deemed appropriate and precautionary to assign this area to the SspiMx biotope. The grab sample collected from within the area mapped as SspiMx biotope, ECR25, confirmed the sediment type as mixed as would be expected for this biotope and identified *S. spinulosa* as the second most abundant species (270 individuals per m^2) after the tube worm *Spirobranchus lamarcki* (1,070 individuals per m^2), the presence of this species which encrusts stones, rocks and shells reflecting and confirming the mixed nature of the sediments at this site (see Table 1 below).

2.2 In the central part of the northern intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC, sandy sediments characterised by the SS.SSa.CFiSa.ApriBatPo '*Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand' biotope (hereafter referred to as ApriBatPo) were mapped (see Figure 1.1 above). Summary statistics for the grab sample collected from location ECR7 within this area are presented in Table 1 below. Although the sediments at this site were classified as coarse sediment on the basis of the particle size analysis (PSA) data, the most abundant species at this location were more typical of sandy sediments. For example, the amphipods *Bathyporeia guilliamsoniana* and *Bathyporeia elegans* were the most abundant species followed by the polychaetes *Ophelia borealis* and *Nephtys cirrosa*. The ApriBatPo biotope was assigned to this area during the EIA characterisation, but it is possible on just the basis of the species list (i.e. without any multivariate community analysis) that the SS.SSa.IFiSa.NcirBat '*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand' biotope (hereafter referred to as NcirBat) could also be an applicable biotope to assign to this location. This may be related to the size of the dataset used in the EIA compared to looking at the sample in isolation as has been undertaken for this note. Within the wider Hornsea Three dataset, the community at ECR7 would have shown similarities to other sites with communities more typical of the ApriBatPo biotope. The Applicant would highlight that the ApriBatPo/NcirBat biotopes were recorded in this part of the SAC by Cefas/JNCC during the 2013 survey (in the area coinciding with box A; Jenkins et al., 2015) and similarly in areas of coarse sediment as well as sandy sediment. As such, classification to of the ApriBatPo biotope in this area is in line with previous surveys of the area undertaken by Cefas and JNCC.

2.3 The northernmost intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC was characterised by mixed sediments and communities typical of the SS.SMx.CMx.MysThyMx '*Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment' biotope (hereafter referred to as MysThyMx; see Figure 1.1 above). The summary statistics for the grab sample collected from location ECR52 within this area are presented in Table 1 below and demonstrate that most abundant species at this location were the polychaete *Lumbrineris cingulata* (260 individuals per m^2) and the mollusc *Kurtiella bidentata* (230 individuals per m^2). The abundances of both of these species are consistent with the indicative abundances provided on the JNCC website and in Conner *et al*. (2004) for this biotope description. The Applicant would also highlight that the Jenkins *et al*. (2015) report also identified the MysThyMx biotope in areas of coarse/mixed sediment in this part of the SAC (see box B and box C in Jenkins *et al*. 2015).

Table 1: Summary statistics for Hornsea Three grab sample locations in the northernmost intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC. Note: abundances of <3 individuals per 0.1 m^2 are not shown, although raw data have previously been provided to JNCC during pre-application consultation.

Sample	%gravel	%sand	%mud	Simplified Folk Classification Category	Annelids (N)	Crustaceans (N)	Echinoderms (N)	Molluscs (N)	Other (N)	Top most abundant taxa (abundance per 0.1m^2)	Hornsea Three biotope allocation
ECR52	28.76	54.42	16.81	Mixed	15	1	2	6	3	*Lumbrineris cingulata (26)* *Kurtiella bidentata (23)* *Magelona alleni (11)* *Abra alba (6)* *Hydroides norvegica (5)* *Pholoe inornata (3)* *Sabellidae (3)* *Malmgrenia (3)*	MysThyMx
ECR7	38.37	58.2	3.4	Coarse	5	3	4	1	3	*Bathyporeia guilliamsoniana (18)* *Bathyporeia elegans (15)* *Ophelia borealis (4)* *Nephtys cirrosa (3)* *Ophiuridae (juv) (3)* *Nototropis swammerdamei (3)*	ApriBatPo
ECR25	48.52	45.83	5.64	Mixed	19	7	0	4	3	*Spirobranchus lamarcki (107)* *Sabellaria spinulosa (27)* *Pholoe inornata (16)* *Timoclea ovata (3)* *NEMATODA (3)*	SspiMx

Southern intersection

2.4 As shown in Figure 2.3 of Volume 5, Annex 2.1: Benthic Ecology Technical Report of the Environmental Statement (and Figure 1.1 above), six site-specific grab/combined grab and drop down video sample locations coincided with the southernmost intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC. Summary statistics for these sample locations are summarised in Table 2.

2.5 As shown in see Figure 1.1 above (and Figure 2.5 of Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement), the majority of this area (coinciding with grab sample locations ECR27, ECR9 and ECR10) was shown to be characterised by sandy sediments which were assigned the NcirBat biotope. As discussed previously and in Jenkins *et al*. (2015), the NcirBat biotope was also recorded within the SAC during the 2013 Cefas/JNCC survey. Smaller, discrete areas of the Hornsea Three offshore cable corridor in this area were assigned to another sandy sediment biotope, ApriBatPo (ECR11) and the SS.SMu.CSaMu.AfilMysAnit '*Amphiura filiformis, Mysella bidentata* and *Abra nitida* in circalittoral sandy mud' biotope (hereafter referred to as AfilMysAnit) typical of sandy mud communities (ECR28). A small area of coarse sediment within the central part of this area (ECR8) was assigned the SS.SMx.OMx.PoVen 'Polychaete-rich deep Venus community in offshore mixed sediments' biotope (hereafter referred to as PoVen) although it should be noted that the majority of the southernmost intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC was characterised by sandy sediments and sandy sediment biotopes.

2.6 As discussed in paragraph 2.6.2.1 of in Volume 5, Annex 2.1: Benthic Ecology Technical Report of the Environmental Statement, the statistical analysis undertaken for the benthic characterisation considered all of the Hornsea Three infaunal samples together in a single holistic assessment. For transparency and to assist with JNCC's understanding of the characterisation of the part of the Hornsea Three offshore cable corridor coinciding with the North Norfolk Sandbanks and Saturn Reef SAC, the Applicant has however re-run the statistical analysis using the PRIMER software for just the six grab samples within the southern intersection of the SAC. The methodology for this analysis is the same as undertaken for the EIA as described in paragraph 2.6.2.7 *et seq*. of Volume 5, Annex 2.1: Benthic Ecology Technical Report of the Environmental Statement. The benthic infaunal dataset was square root transformed for multivariate community analysis using the PRIMER v6 software. Community structure was investigated using CLUSTER analysis (hierarchical agglomerative clustering) and Similarity Percentages (SIMPER) analyses were subsequently undertaken to identify which species best explained the similarity within groups and the dissimilarity between groups identified in the cluster analysis. The results of this re-analysis are presented below.

2.7 The MDS plot for all six samples and the dendrogram are shown in Figure 2.1 and Figure 2.2 below. Together they show that three samples (ECR9, ECR10 and ECR11) cluster closely together (Simprof group 3; green triangles) with the remaining samples from locations ECR8, ECR27 and ECR28 showing looser aggregation and lower similarity with this cluster. Similarity Profile (SIMPROF) was used to test whether these groupings were significantly different and Figure 2.1 and Figure 2.2 also show the allocated SIMPROF groupings. This revealed that the ECR8 community was not significantly different from that at ECR9, ECR10 and ECR11 but that the communities at ECR27 and ECR28 were statistically significantly different from each other and all other samples.

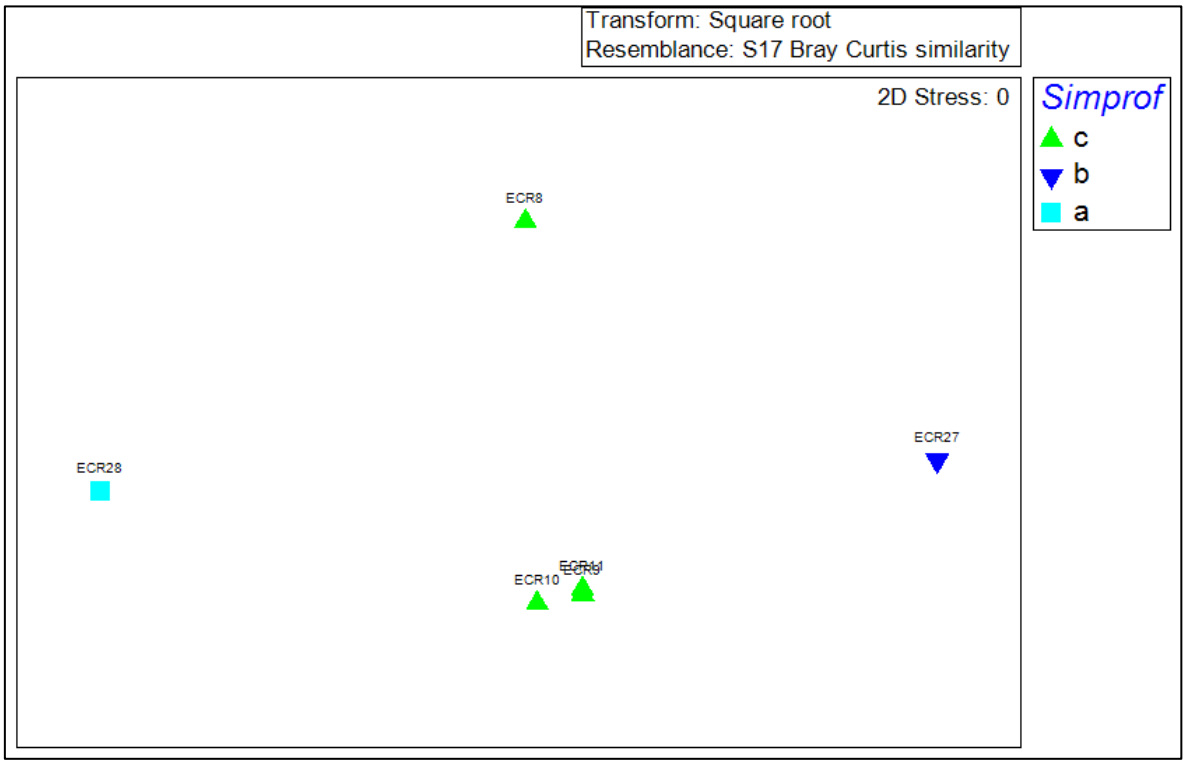

Figure 2.1: 2-D MDS plot (with Simprof groups) for infaunal communities for the six grab samples within the southernmost intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC.

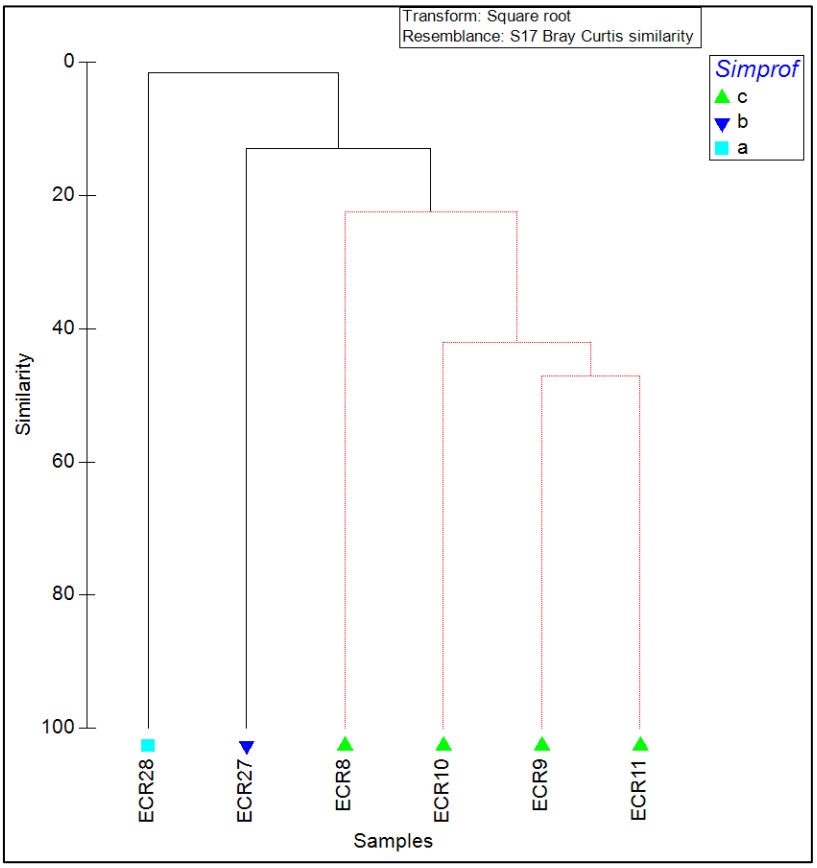

Figure 2.2: Dendrogram (with Simprof groups) of infaunal communities for the six grab samples within the southernmost intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC.

2.8 The SIMPER analysis for these datasets identified that ECR8, ECR9, ECR10 and ECR11 were characterised by the amphipod *B. elegans* and the polychaetes *N. cirrosa* and *Spiophanes bombyx*. The Applicant considers that these communities to be characteristic of the NcirBat biotope. This does not represent a change in the biotope allocation made within the EIA for ECR9 or ECR10 but is a change in biotope allocation for ECR8, from the PoVen predicted in the EIA (discussed below, with implications for the impact assessment discussed in Section 3).

2.9 With respect to ECR11, the ApriBatPo biotope was assigned in the EIA characterisation and although the re-analysis of the smaller dataset has shown that this has similarly with the sites assigned to NcirBat, the level of similarity is less than 50% (see Figure 2.2). On inspection of the full species list for this site, the ApriBatPo biotope may still be applicable as the Applicant considers that, although the bivalve *Abra prismatica* is absent, the community present at the location is also reasonable match for this biotope. Therefore, the biotope may be considered to be ApriBatPo or NcirBat.

2.10 Potentially different allocation of biotopes at locations ECR8 and ECR11 from the EIA compared to this small subset analysis, may be related to the size of the dataset used in the EIA compared to this small subset. Within the wider Hornsea Three dataset, ECR8 would have shown similarities to other sites with communities more typical of the PoVen biotope and combined with the coarse sediment classification (based on the PSA data) this would have led to this site being allocated as PoVen, as opposed to NcirBat.

2.11 Upon inspection of the SIMPER outputs for ECR27 and the full species list, the dissimilarity of this sample from those within Simprof group c assigned to the NcirBat biotope, was due to the fact that species richness and abundance were very low at this site with only three infaunal species recorded; the crustacean *Gastrosaccus spinifer*, the polychaete *Nephtys cirrosa* and the bivalve *Timoclea ovata*. Therefore, whilst the Applicant does not consider that the allocated biotope from this re-analysis is different from the NcirBat identified for the EIA characterisation, it is noted that this is a particularly impoverished version of this biotope in this area.

2.12 For the community at ECR28, which was also statistically significantly different from the communities present at the other five locations, inspection of the SIMPER outputs (dissimilarity with other Simprof groupings) and the full species list for this site confirms the AfilMysAnit biotope allocation made within the EIA. Whilst the Applicant notes that the brittlestar *Amphiura filiformis* was absent from the community, *Ophiura albida* was in the list of top most abundant species (see Table 2) and may therefore contribute to a similar ecological functionality at this site.

Table 2: Summary statistics for Hornsea Three grab sample locations in the southernmost intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC. Note: abundances of <3 individuals per 0.1 m2 are not shown, although raw data have previously been provided to JNCC during pre-application consultation.

Sample	%gravel	%sand	%mud	Simplified Folk Classification Category	Annelids (N)	Crustaceans (N)	Echinoderms (N)	Molluscs (N)	Other (N)	Top most abundant taxa (abundance per 0.1m^2)	Hornsea Three biotope allocation in ES	Revised biotope allocation
ECR27	0.75	97.06	2.19	sand and muddy sand	1	1	0	1	1	*Gastrosaccus spinifer (7)* *Nephtys cirrosa (3)*	NcirBat	NcirBat (no change although impoverished variant)
ECR8	26.17	72.7	1.1	coarse	9	5	0	2	1	*Urothoe marina (56)* *Bathyporeia guilliamsoniana (18)* *Bathyporeia elegans (12)* *Polycirrus (3)*	PoVen	NcirBat

Sample	%gravel	%sand	%mud	Simplified Folk Classification Category	Annelids (N)	Crustaceans (N)	Echinoderms (N)	Molluscs (N)	Other (N)	Top most abundant taxa (abundance per 0.1m²)	Hornsea Three biotope allocation in ES	Revised biotope allocation
ECR28	3.21	86.6	10.2	sand and muddy sand	14	12	3	5	4	*Urothoe elegans (7)* *Kurtiella bidentata (6)* *Lumbrineris cingulata (5)* *Polydora cornuta (4)* *Ophiura albida (3)* *Bathyporeia tenuipes (3)* *Nephasoma minutum (3)*	AfilMysAnit	AfilMysAnit (no change)

Sample	%gravel	%sand	%mud	Simplified Folk Classification Category	Annelids (N)	Crustaceans (N)	Echinoderms (N)	Molluscs (N)	Other (N)	Top most abundant taxa (abundance per 0.1m²)	Hornsea Three biotope allocation in ES	Revised biotope allocation
ECR9	0.02	100.0	0.0	sand and muddy sand	7	3	0	0	1	*Ophelia borealis (6)* *Nephtys cirrosa (6)* *Bathyporeia elegans (4)* *Urothoe brevicornis (4)* *Spio goniocephala (4)* *Diastylis bradyi (3)*	NcirBat	NcirBat (no change)

Sample	%gravel	%sand	%mud	Simplified Folk Classification Category	Annelids (N)	Crustaceans (N)	Echinoderms (N)	Molluscs (N)	Other (N)	Top most abundant taxa (abundance per 0.1m²)	Hornsea Three biotope allocation in ES	Revised biotope allocation
ECR10	1.09	96.1	2.8	sand and muddy sand	4	6	2	1	1	*Urothoe poseidonis (15)* *Nephtys cirrosa (5)* *Bathyporeia guilliamsoniana (4)* *Ophiura albida (4)* *Urothoe brevicornis (3)* *Spiophanes bombyx (3)*	NcirBat	NcirBat (no change)
ECR11	6.98	92.3	0.7	coarse	7	5	0	1	0	*Bathyporeia elegans (11)* *Nephtys cirrosa (9)* *Scoloplos armiger (9)* *Ophelia borealis (3)*	ApriBatPo	ApriBatPo (possibly NcirBat)

3. Discussion and Conclusions

3.1 On the basis of the information presented within this note, the Applicant considers that for the northern intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC, the EIA characterisation and allocation of infaunal biotopes (predominantly SspiMx and ApriBatPo) to the sediments present in this area is entirely consistent with the results of the previous 2013 JNCC/Cefas sampling in this area. Although the reinspection of the data undertaken for this note indicated that the NcirBat biotope may be equally applicable to the community at location ECR7 as the assigned ApriBatPo biotope, the Applicant notes that ApriBatPo/NcirBat biotopes were recorded in this part of the SAC by Cefas/JNCC during the 2013 survey. As such, classification to of the ApriBatPo biotope in this area is in line with previous surveys of the area undertaken by Cefas and JNCC. This difference is likely due to the size of the dataset used in the EIA compared to looking at the sample in isolation as has been undertaken for this note. Within the wider Hornsea Three dataset, the community at ECR7 would have shown similarities to other sites with communities more typical of the ApriBatPo biotope.

3.2 On this basis, the Applicant is confident that the characterisation of this northern intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC is robust and, as such, that the assessment of impacts presented within Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement is similarly robust. Particularly, in view of the assessment that was undertaken within paragraph 2.11.1.43 *et seq*. of Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement to assess the prospect of impacts to potential future Annex I *S. spinulosa* reef should it develop in this area prior to construction, and the designed-in measures adopted as part of Hornsea Three to avoid direct impacts on Annex I reefs, where possible, based on the results of a detailed pre-construction geophysical and seabed imagery survey.

3.3 With respect to the southern intersection of the Hornsea Three offshore cable corridor and the North Norfolk Sandbanks and Saturn Reef SAC, the Applicant has presented a re-analysis of the infaunal data associated with a small subset (six grab samples) of the Hornsea Three dataset within this area. This re-analysis, together with a re-inspection of the raw data, broadly aligns with the benthic characterisation for this area presented within Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement. Notably it characterises the area as predominantly sandy sediments with associated communities representative of the NcirBat (or ApriBatPo at the southern extreme) biotope and a small area of muddier sediment characterised by the AfilMysAnit biotope in the central section of this area. The Applicant would highlight that, as discussed in section 3.1.2 of Volume 5, Annex 2.1: Benthic Ecology Technical Report of the Environmental Statement, these biotopes are common and widespread within this part of the southern North Sea.

3.4 As discussed in paragraphs 2.8 to 2.12 above, the re-analysis presented within this note confirms the infaunal biotope map produced for this part of the SAC as presented in Figure 2.5 of Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement (see Figure 1.1 above). One minor amendment to this being the reallocation of the community at a single sample location ECR8 from the coarse sediment biotope PoVen to the sandy sediment biotope NcirBat. The Applicant would however highlight that, as discussed in paragraph 2.11.1.28 of Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement, the PoVen biotope has the potential for longer recovery times from impacts associated with disturbance from cable installation, compared with the NcirBat biotope. On the basis that the NcirBat biotope has the potential for faster recovery rates, the characterisation of this small section of the offshore cable corridor within the North Norfolk Sandbanks and Saturn Reef SAC and the consequent impact assessment based on this characterisation is likely to be over conservative, with recovery following cable installation in this section of the offshore cable corridor occurring faster than predicted in the Environmental Statement.

3.5 The Applicant can therefore also confirm that this minor adjustment to the biotope classification as a result of the re-analysis of a small subset of the data within the SAC, has no implications on the conclusions presented in Volume 2, Chapter 2: Chapter Benthic Ecology of the Environmental Statement or the RIAA and that the characterisation of the benthic ecology within this part of the SAC is adequately robust and overly conservative.

References

Jenkins, C., Eggleton, J. Albrecht, J., Barry, J., Duncan, G., Golding, N. and O'Connor, J. (2015). North Norfolk Sandbanks and Saturn Reef cSAC/SCI management investigation report. JNCC/Cefas Partnership Report, No. 7