

Norfolk Vanguard Offshore Wind Farm

Appendix 5.1

Habitats Regulations Assessment Offshore Screening

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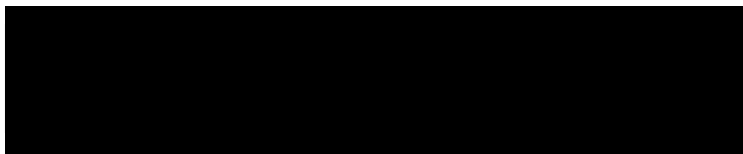
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For and on behalf of Norfolk Vanguard Limited

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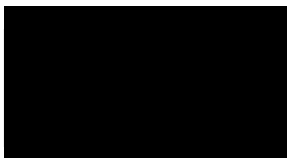
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For and on behalf of Royal HaskoningDHV

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Glossary of acronyms

HRA	Habitats Regulations Assessment
LSE	Likely Significant Effect
PEIR	Preliminary Environmental Information Report
DCO	Development Consent Order
SPA	Special Protection Areas
SAC	Special Area of Conservation
pSAC	Possible SACs
cSAC	Candidate SAC
SCI	Sites of Community Importance
EAOW	East Anglia Offshore Wind
ZDA	Zone Development Agreement
VWPL	Vattenfall Wind Power Ltd
SPR	ScottishPower Renewables (UK) Limited
AfL	Agreement for Lease
OWF	offshore wind farm
NV West	Norfolk Vanguard West
NV East	Norfolk Vanguard East
DCLG	Department for Communities and Local Government
ODPM	Office of the Deputy Prime Minister
Defra	Department for Environment, Food and Rural Affairs
SNCB	Statutory Nature Conservation Bodies
HRGN	Habitats Regulations Guidance Note
NSER	No Significant Effects Report
IROPI	Imperative Reasons of Overriding Public Interest
MU	Management Unit
IAMMWG	Inter-Agency Marine Mammal Working Group
SMRU	Sea Mammal Research Unit
IMARES	Institute of Marine Engineering, Science and Technology

Glossary of Terminology

Natura 2000 site	A network of nature protection areas in the territory of the European Union. It is made up of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) designated under the Habitats Directive and Birds Directive, respectively
Ramsar sites	A Ramsar Site is a wetland site of international importance under the Convention on Wetlands, known as the Ramsar Convention
the OWF sites	Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West)
The offshore project area	Norfolk Vanguard East and Norfolk Vanguard West and the offshore cable corridor

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1 INTRODUCTION

1.1 Purpose of this document

1. This document provides the offshore screening of Natura 2000 sites for Habitats Regulations Assessment (HRA) in relation to the Norfolk Vanguard offshore wind farm. This document covers designated sites for marine mammals, benthic habitats, fish and birds. The document provides the information that was used in stakeholder consultation as part of the Evidence Plan Process, to seek agreement on the designated sites which should be considered further. This also forms stage 1 of the HRA Process (discussed further in Section 1.4). Any updates since screening in Q3/4 of 2017 are discussed in the main Information to Support HRA report. Impacts of the onshore project infrastructure on Natura 2000 sites are screened separately in Appendix 5.2.
2. Designated sites are proposed to be “screened out” where no Likely Significant Effect (LSE) from Norfolk Vanguard is predicted. Where LSE cannot be ruled out at this stage the designated sites will be “screened in” and assessed further. Information to support HRA (both offshore and onshore) will be provided with the Preliminary Environmental Information Report (PEIR) and the Development Consent Order (DCO) application.
3. Note that Natura 2000 sites included in this document include sites in other EU Member States.
4. The classes of Natura 2000 designations considered within this HRA Screening are:
 - Special Protection Areas (SPAs) (some of which are also Ramsar sites)
 - Potential SPA (pSPA)
 - SPAs that are approved by the UK Government but are still in the process of being classified
 - Special Areas of Conservation (SACs)
 - Possible SACs (pSACs)
 - A site which has been identified and approved to go out to formal consultation.
 - Candidate SACs (cSACs)
 - Following consultation on the pSAC, the site is submitted to the European Commission (EC) for designation and at this stage it is called a cSAC.
 - Sites of Community Importance (SCI)

- Once the EC approves the site it becomes a SCI, before the national government then designates it as a SAC.
5. Consideration is also given to impacts on Ramsar sites. Ramsar sites protect wetland areas and extend only to “areas of marine water the depth of which at low tide does not exceed six metres”.
 6. Screening of SPAs and SACs affected by the onshore project elements will be provided separately.

1.2 Project Background

7. In December 2009, as part of the UK Offshore Wind Round 3 tender process, The Crown Estate awarded the joint venture company, East Anglia Offshore Wind (EAOW) Ltd, the rights to develop Zone 5 (later called the ‘East Anglia zone’). These rights were granted through a Zone Development Agreement (ZDA). EAOW Ltd. is a 50:50 joint venture owned by Vattenfall Wind Power Ltd (VWPL) and ScottishPower Renewables (UK) Limited (SPR).
8. Under the ZDA, the joint venture consented East Anglia ONE, and commenced the EIAs for East Anglia THREE (prior to the project being taken forward to submission by SPR) and East Anglia FOUR (up to submission of a request for Scoping Opinion in 2012).
9. In December 2014, a decision was taken to split the zone, with VWPL having development rights within the north of the former East Anglia Zone, and SPR continuing to develop the southern part. In agreement with The Crown Estate, the ZDA was effectively dissolved in 2016. New Agreement for Lease (AfL) areas have been awarded by The Crown Estate within the former Zone, separately to VWPL and its affiliate companies, and SPR and its affiliates.
10. Norfolk Vanguard Ltd (an affiliate company of VWPL) is now undertaking the EIA for Norfolk Vanguard and a Scoping Report was submitted to the Planning Inspectorate in October 2016 (Royal HaskoningDHV, 2016).
11. The offshore wind farm (OWF) comprises two distinct areas, Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West) (‘the OWF sites’), and will be connected to the shore by offshore export cables installed within the offshore cable corridor (Figure 1.1).

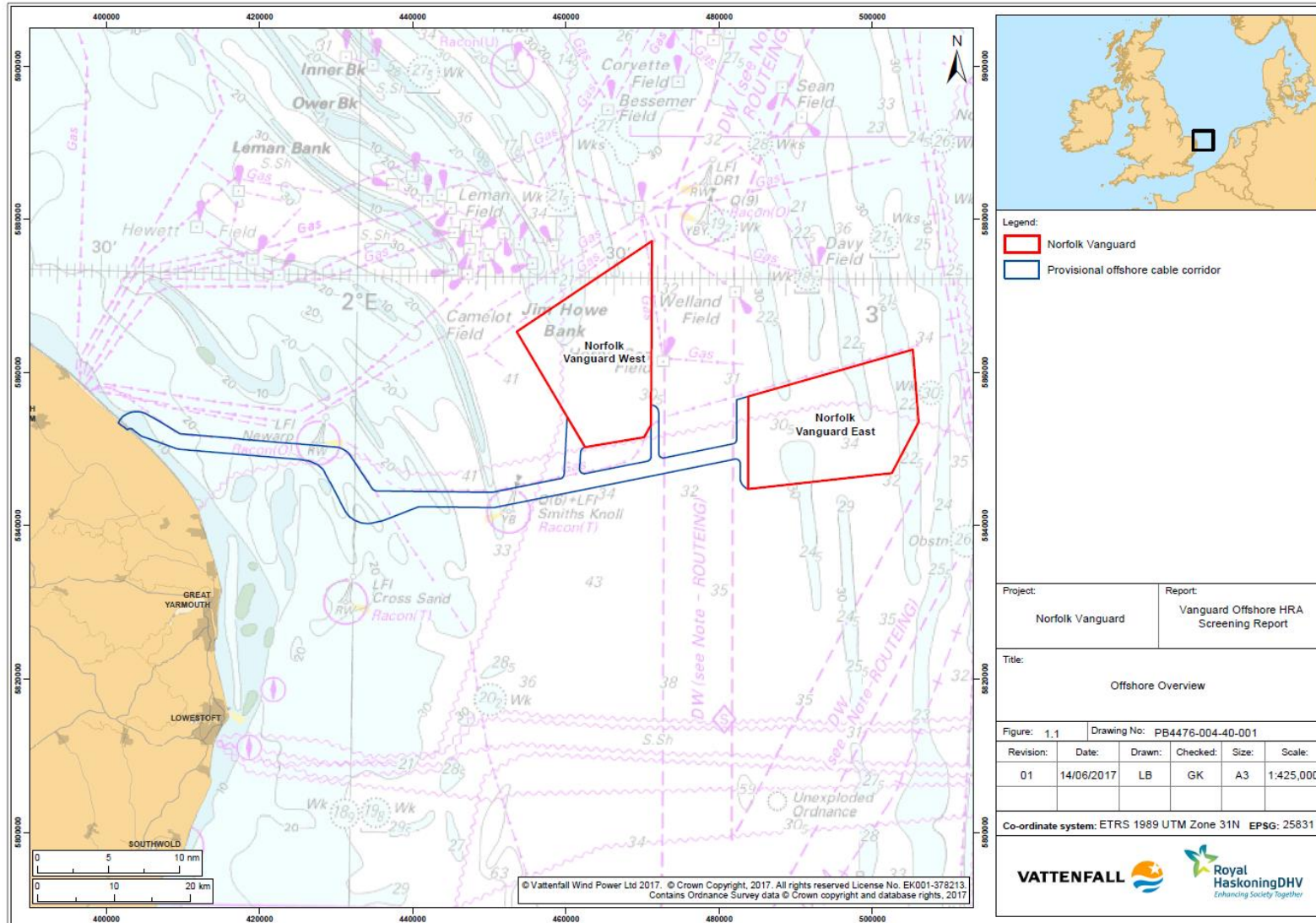


Figure 1.1 Norfolk Vanguard offshore project area

12. The development of the Norfolk Vanguard offshore project area has followed a careful site selection process in order to minimise the impacts on designated sites and where possible sites have been avoided. It has not been possible to avoid the Southern North Sea cSAC which overlaps with the whole of the former East Anglia zone. The requirement to route through the Haisborough, Hammond and Winterton SCI/cSAC followed a detailed site selection exercise and resulted from the need to avoid existing infrastructure and operations, specifically oil and gas pipelines and aggregate dredging areas (see further information in the Norfolk Vanguard Scoping Report, Royal HaskoningDHV, 2016).

1.3 HRA Legislation, Policy and Guidance

1.3.1 Legislation

13. The HRA process derives from the requirements of specific European Directives and the Regulations that implement their requirements in national law.
14. The UK has triggered article 50 of the Treaty on European Union (TEU) and is in a two year process of negotiating a withdrawal agreement for the UK to leave the EU. Following withdrawal from the EU, the UK government plans to enact the Great Repeal Bill. In its white Paper the UK Government has confirmed that it plans to transpose all current European environmental regulation into UK law after Brexit.

1.3.1.1 The Birds Directive

15. The EU Directive on the Conservation of Wild Birds (2009/147/EC) (hereafter called the Birds Directive) provides a framework for the conservation and management of wild birds in Europe. The relevant provisions of the Directive are the identification and classification of SPAs for rare or vulnerable species listed in Annex I of the Directive and for all regularly occurring migratory species (required by Article 4). The Directive requires national Governments to establish SPAs and to have in place mechanisms to protect and manage them. The SPA protection procedures originally set out in Article 4 of the Birds Directive have been replaced by the Article 6 provisions of the Habitats Directive.

1.3.1.2 The Habitats Directive

16. The EU Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (hereafter called the Habitats Directive) provides a framework for the conservation and management of natural habitats, wild fauna (except birds) and flora in Europe. Its aim is to maintain or restore natural habitats and wild species at a favourable conservation status. The relevant provisions of the Directive are the identification and classification of Special Areas of Conservation (SAC) (Article 4) and procedures for the protection of SACs and SPAs (Article 6). SACs are identified based

on the presence of natural habitat types listed in Annex I and populations of the species listed in Annex II. The Directive requires national Governments to establish SACs and to have in place mechanisms to protect and manage them.

1.3.1.3 The Conservation of Habitats and Species Regulations 2010

17. The Conservation of Habitats and Species Regulations 2010, (hereafter called the ‘Habitats Regulations’) transpose the Birds Directive and the Habitats Directive into UK law. The Habitats Regulations place an obligation on ‘competent authorities’ to carry out an appropriate assessment of any proposal likely to affect a SAC or SPA, to seek advice from Natural England and not to approve an application that would have an adverse effect on a SAC or SPA except under very tightly constrained conditions that involve decisions by the Secretary of State. The competent authority in the case of Norfolk Vanguard is the Secretary of State for Business, Energy and Industrial Strategy.

1.3.1.4 The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007

18. The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended), (referred to here as the ‘Offshore Regulations’) transposes the Birds Directive and the Habitats Directive into national law in the offshore environment (from territorial waters to the continental shelf). The Offshore Regulations place an obligation on ‘competent authorities’ to carry out an appropriate assessment of any proposal likely to affect a SAC or SPA, to seek advice from Natural England and / or the joint Nature Conservation Committee (JNCC) and not to approve an application that would have an adverse effect on a SAC or SPA except under very tightly constrained conditions that involve decisions by the Secretary of State. The competent authority in the case of Norfolk Vanguard is the Secretary of State for Business, Energy and Industrial Strategy.

1.3.1.5 Application of the legislation to designated sites

19. As discussed in Section 1.1 the HRA process also applies as a matter of law or policy to the following sites:
 - SCI and cSAC: HRA process applied as a result of Article 4(5) and Article 6(2)(4) of the Habitats Directive.
 - pSPAs: HRA process applied as a result of UK Government policy - paragraph 118 of the National Planning Policy Framework (DCLG, 2012).
 - pSACs: HRA process applied as a result of UK Government policy - paragraph 118 of the National Planning Policy Framework (DCLG, 2012).
 - Listed and proposed Ramsar sites (internationally important wetlands designated under the Ramsar Convention 1971): HRA process applied as a result of UK Government policy (ODPM & Defra, 2005; DCLG, 2012).

1.3.2 Guidance on the HRA Process

20. In preparing this report, consideration has been given to the relevant guidance issued by a number of Governmental, statutory and industry bodies.
21. In relation to guidance from Government bodies this includes:
 - European Commission: Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites.
 - European Commission: EU Guidance on wind energy development in accordance with EU nature directives.
 - Department of Communities and Local Government: Guidance on 'Planning for the Protection of European Sites: Appropriate Assessment'.
 - The Planning Inspectorate Advice Note Nine: Rochdale Envelope.
 - The Planning Inspectorate Advice Note Ten: Habitat Regulations Assessment relevant to nationally significant infrastructure projects.
22. In relation to guidance from the Statutory Nature Conservation Bodies (SNCBs) this includes:
 - English Nature: Habitats Regulations Guidance Note (HRGN 1): The Appropriate Assessment (Regulation 48) The Conservation (Natural Habitats &c) Regulations, 1994.
 - English Nature: Habitats Regulations Guidance Note (HRGN 3): The Determination of Likely Significant Effect under the Conservation (Natural Habitats &c) Regulations, 1994.
 - English Nature: Habitats Regulations Guidance Note (HRGN 4): Alone or in combination.
 - Natural England and JNCC: Interim advice on HRA screening for seabirds in the non-breeding season.
 - Natural England and JNCC: Advice on HRA screening for seabirds in the breeding season.
 - Natural England and JNCC: Interim Advice Note – Presenting information to inform assessment of the potential magnitude and consequences of displacement of seabirds in relation to Offshore Wind farm Developments.

1.4 The HRA Process

23. The HRA process is carried out in a sequential manner and the stages of that sequence are described as follows in Planning Inspectorate Advice Note 10 (Planning Inspectorate, 2016):
 - Stage 1 –Screening (This report);

- European and Ramsar sites are screened for LSE, both effects from the project alone and in combination with other projects. The Planning Inspectorate advises that for those projects where no LSE is predicted then that should be reported in the form of a No Significant Effects Report (NSER) and the Stage 2 assessment is not carried out (the Planning Inspectorate, 2016).
 - Stage 2 - Appropriate Assessment;
 - For those sites where LSE on a European or Ramsar site cannot be excluded in Stage 1 then further information to inform the assessment will be prepared and the test applied to determine whether the project alone or in-combination could adversely affect the integrity of the site in view of its conservation objectives. This assessment stage will be reported in the form of a HRA Report and the results of the assessment summarised in the form of a series of matrices.
24. In those cases where the conclusion of the HRA Report is that an adverse effect on the integrity of a European or Ramsar site has been identified then the assessment proceeds to two further stages:
- Stage 3 - Assessment of Alternatives; and
 - The alternatives that have been considered will be assessed. The Planning Inspectorate advises that alternative solutions can include a proposal of a different scale, a different location and an option of not having the scheme at all – the ‘do nothing’ approach.
 - Stage 4 – Assessment of Imperative Reasons of Overriding Public Interest (IROPI).
 - If it is demonstrated that there are no alternative solutions to the proposal that would have a lesser effect or avoid an adverse effect on the integrity of the site(s), then a justified case will be prepared that the scheme must be carried out for IROPI.
25. If the conclusion of Stages 3 and 4 is that there is no alternative and that the project has demonstrated IROPI then the project may proceed with a requirement that appropriate compensatory measures are delivered.

1.4.1 In-combination Assessment

26. The Habitats Regulations and the Offshore Regulations require the consideration of the potential effects of a project on European sites and Ramsar sites both alone and in-combination with other plans or projects.

27. The identification of plans and projects to include in the in-combination assessment will be based on:
- Approved plans;
 - Constructed projects;
 - Approved but as yet unconstructed projects; and
 - Projects for which an application has been made, are currently under consideration and will be consented before the Norfolk Vanguard consent decision.
28. The classes of projects that could potentially be considered for the in-combination assessment include:
- Offshore wind farms;
 - Marine renewables (wave and tidal);
 - Harbour and port developments
 - Marine aggregate extraction and dredging;
 - Licensed disposal sites;
 - Oil and gas exploration and extraction;
 - Subsea cables and pipelines;
 - Commercial marine fishing activity;
 - Recreational marine fishing activity; and
 - Onshore major residential, commercial and industrial development.
29. The assessment will present relevant in-combination impacts of projects in the following tiered approach (Table 1.1) as advised by Natural England (JNCC and Natural England, 2013a).

Table 1.1 Suggested tiers for undertaking a staged cumulative impact assessment (JNCC and Natural England, 2013a)

Tier Description	Consenting or Construction Phase	Data Availability
Tier 1	Built and operational projects should be included within the cumulative assessment where they have not been included within the environmental characterisation survey, i.e. they were not operational when baseline surveys were undertaken, and/or any residual impact may not have yet fed through to and been captured in estimates of “baseline” conditions e.g. “background” distribution or mortality rate for birds.	Pre-construction (and possibly post-construction) survey data from the built project(s) and environmental characterisation survey data from proposed project (including data analysis and interpretation within the ES for the project).
Tier 2	Tier 1 + projects under construction	As Tier 1 but not including post-construction survey data
Tier 3	Tier 2 + projects that have been consented	Environmental characterisation survey data from proposed project (including

Tier Description	Consenting or Construction Phase	Data Availability
	(but construction has not yet commenced)	data analysis and interpretation within the ES for the project) and possibly pre-construction
Tier 4	Tier 3 + projects that have an application submitted to the appropriate regulatory body that have not yet been determined	Environmental characterisation survey data from proposed project (including data analysis and interpretation within the ES for the project)
Tier 5	Tier 4 + projects that the regulatory body are expecting an application to be submitted for determination (e.g. projects listed under the Planning Inspectorate programme of projects)	Possibly environmental characterisation survey data (but strong likelihood that this data will not be publicly available at this stage).
Tier 6	Tier 5 + projects that have been identified in relevant strategic plans or programmes (e.g. projects identified in Round 3 wind farm zone appraisal and planning (ZAP) documents)	Historic survey data collected for other purposes/by other projects or industries or at a strategic level.

30. Projects will be included in the quantitative assessment where there is sufficient certainty and data confidence that they make a meaningful contribution to the assessment process.

1.5 Process for the Identification of European and Ramsar Sites and Features Potentially Affected by the Project

31. The initial identification of European and Ramsar sites for inclusion in the Stage 1 HRA Screening is primarily based on the location of the site relative to Norfolk Vanguard. The approach for each site interest feature (i.e. marine mammals, benthic habitat, fish and birds) is outlined in Sections 2.1, 3.1, 4.1 and 5.1 as each receptor has different range and therefore different potential for connectivity.

1.6 HRA Stage 1 Screening Process

32. Screening has been based on a conceptual 'source-pathway-receptor' approach. The approach identifies likely environmental impacts resulting from the proposed construction, operation and maintenance (O&M) and decommissioning of the wind farm and its supporting transmission infrastructure. The parameters are defined as follows:
- Source – the origin of a potential impact (noting that one source may have several pathways and receptors).
 - Example: Re-suspension of sediments due to cable laying activity.

- Pathway – the means by which the effect of the activity could impact a receptor.
 - Example: Settlement of re-suspended sediments causing smothering of seabed.
 - Receptor – the element of the receiving environment that is impacted.
 - Example: Smothering has a direct effect on a seabed organism that forms an important part of the food chain for a site interest feature.
33. Where there is no pathway or the pathway is so long that the effect from the source has dissipated to a negligible level before reaching the receptor, there is justification for the screening out of that particular receptor.
34. It only requires one category of site interest feature to be identified in the process below for the European and / or Ramsar site to be screened in, along with all its associated interest features.
35. The approach to screening for each receptor is outlined in Sections 2.2, 3.2, 4.2, and 5.2 based on the known distribution, ecology and sensitivities of each receptor and therefore the potential for being affected by Norfolk Vanguard.
36. Where there is insufficient information available at this stage to screen out a site, it is screened in for further consideration.

2 SCREENING MARINE MAMMAL SAC SITES AND FEATURES

2.1 Identification of Marine Mammal Sites and Features

37. Based on data collected during Norfolk Vanguard aerial surveys and a review of existing data sources, the Annex II species likely to occur in Norfolk Vanguard and therefore considered in the HRA screening are:
- Harbour porpoise *Phocoena phocoena*;
 - Grey seal *Halichoerus grypus*; and
 - Harbour seal *Phoca vitulina*.
38. Bottlenose dolphin *Tursiops truncatus* has not been identified during Norfolk Vanguard aerial surveys and no bottlenose dolphin were positively sighted during the aerial surveys of the adjacent East Anglia THREE site (EATL, 2015). During SCANS III surveys in summer 2016, no bottlenose dolphin were recorded in or around the area of Norfolk Vanguard (Hammond *et al.*, 2016). During the SCANS II surveys, only two bottlenose dolphin groups were sighted within the survey block which encompasses the East Anglia Zone; resulting in an estimated density of 0.0032 (CV 0.74) individuals per km² (Hammond *et al.*, 2013). There are currently seven Management Units (MU) for bottlenose dolphin in UK waters; Norfolk Vanguard is located in the Greater North Sea (GNS) MU, which has an estimated population size of zero (IAMMWG, 2015). Taking into account the very low occurrence of sightings in and around Norfolk Vanguard and the assessment of the GNS MU population size by the IAMMWG, this species will not be considered further.
39. The following sections (2.1.1 – 2.1.3) describe the process used to define the list of sites for which there is theoretical connectivity and therefore potential for a source – pathway – receptor relationship for harbour porpoise, grey seal and harbour seal.

2.1.1 Harbour porpoise

40. For harbour porpoise, connectivity is considered potentially possible between Norfolk Vanguard and any Natura 2000 site within the North Sea Management Unit (MU) (Inter-Agency Marine Mammal Working Group (IAMMWG, 2015) (see Figure 2.1). The extent of the North Sea MU has been agreed during consultation with the Marine Mammals Expert Topic Group¹ (February 2017), as the most appropriate population which any harbour porpoise occurring within Norfolk Vanguard may be part of.

¹ Natural England, Whale and Dolphin Conservation (WDC), Wildlife Trust and Cefas.

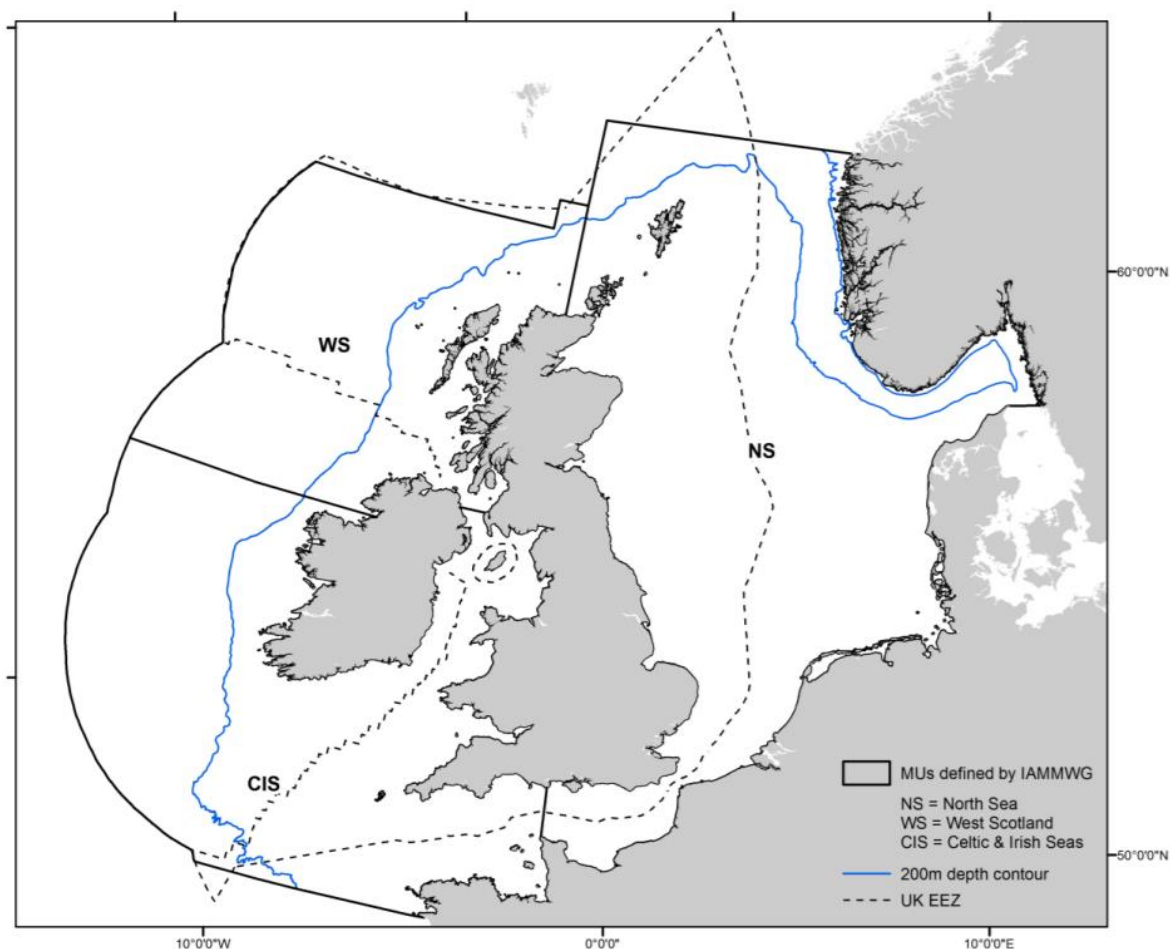


Figure 2.1 Harbour porpoise management units (IAMMWG, 2015)

41. This HRA screening considers any Natura 2000 site within the harbour porpoise North Sea MU, where the species is considered as a grade A, B or C feature. Grade D indicates a non-significant population (JNCC, 2009). All Natura 2000 sites outwith the harbour porpoise North Sea MU area have been screened out from further consideration.
42. Table 2.3 provides the list of sites with harbour porpoise interest features considered for screening.

2.1.2 Grey seal

43. For grey seal, the screening process includes any Natura 2000 site where the species is a grade A, B or C feature. There is potential connectivity with sites that are within 1,000km of Norfolk Vanguard based on studies of regular foraging and dispersal between winter breeding sites, and summer foraging and haul out sites (e.g. McConnell *et al.*, 1992).
44. Table 2.3 provides the list of sites with grey seal interest features considered for screening.

2.1.3 Harbour seal

45. For harbour seal, the screening process considers Natura 2000 sites where the species is a grade A, B or C feature and the site was within 300km of Norfolk Vanguard.
46. The distance of 300km is used as harbour seal exhibit relative short foraging trips from their haul out sites. The range of these trips does vary depending on the surrounding marine habitat (e.g. 25km on the west of Scotland (Cunningham *et al.*, 2009); 30km-45km in the Moray Firth (Tollit *et al.*, 1998; Thompson and Miller, 1990). However, data from The Wash (from 2003- 2005) suggest that harbour seal travel further, and repeatedly forage between 75km and 120km offshore (with one seal travelling 220km; Sharples *et al.*, 2008). Data from the Thames Estuary (from 2006) indicate most animals in this region undertaking short range trips (up to 40km), but one individual did have a range of 660km from the southernmost to the northern most extent of its movements (Sharples *et al.*, 2008). Although occasional longer trips do occur, these are often associated with young animals dispersing from sites, and are therefore not considered to indicate likely repeated connectivity between Natura 2000 sites and Norfolk Vanguard. Telemetry studies of harbour seal have also been completed in German and Danish waters and in the German Bight area of the North Sea (e.g. Tougaard *et al.*, 2008). These data support the screening out of sites beyond 300km from Norfolk Vanguard, as telemetry data suggest a lack of dispersal between German Bight and Danish waters, and seals using Dutch areas of the Wadden Sea, and locations around the Dutch / German border. As such, 300km was chosen as a suitable screening distance for connectivity.
47. Table 2.3 provides the list of sites with harbour seal interest features considered for screening.

2.2 Approach to screening

2.2.1 Potential Effects (Source)

48. The following potential effects during construction, O&M and decommissioning are considered in the HRA process:
 - Indirect impacts through effects on prey species;
 - Underwater noise; and
 - Vessel interactions.

2.2.2 Proximity of source to feature (i.e. SAC) (pathway and receptor)

49. For marine mammals, the approach to HRA screening primarily focuses on the potential for connectivity between individual marine mammals from designated populations and the proposed Norfolk Vanguard project (i.e. demonstration of a

clear source-pathway-receptor relationship). This is based on the distance of Norfolk Vanguard from the designated site, the range of each effect and the potential for animals from a site to be within range of an effect.

50. Therefore sites are screened on the basis of the following:

- The distance between the potential impact range of the proposed project and a site with a marine mammal interest feature is within the range for which there could be an interaction e.g. the pathway is not too long for significant noise propagation.
- The distance between the proposed project and resources on which the interest feature depends (i.e. an indirect effect acting through prey or access to habitat) is within the range for which there could be an interaction i.e. the pathway is not too long.
- The likelihood that a foraging area or a migratory route occurs within the zone of interaction of the proposed project (applies to mobile interest features when outside the SAC).

2.3 Screening

2.3.1 Harbour porpoise

2.3.1.1 Indirect impacts through effects on prey species

51. For indirect effects on prey, results from underwater modelling suggests that noise impacts upon fish will be limited to <50km, for the widest ranging behavioural effects (based on Popper *et al.* (2014) TTS criteria of 186dB SEL). Therefore all sites with the exception of the Southern North Sea cSAC are screened out with regard to indirect effects due to the distance between the potential impact range and other designated sites (see Table 2.3).
52. As there is no discrete population of harbour porpoise associated with designated sites due to their wide ranging nature within the North Sea, it is assumed that at any one time, harbour porpoise foraging in this area are associated with the Southern North Sea cSAC (as they cannot simultaneously be part of the population of multiple designated sites, although all are part of the larger MU population). Therefore connectivity with animals from other designated sites foraging within the impact range of indirect changes to prey resource as a result of Norfolk Vanguard is screened out and the Southern North Sea cSAC is screened in.

2.3.1.2 Underwater noise

53. With regard to underwater noise impacts upon designated sites themselves (or individual animals within them), it is considered that for piling (which is the greatest of the potential noise sources) the potential range of disturbance impact is up to

26km from the source of noise. Based on the effective deterrent radius (EDR) for a single monopile of 26km (Tougaard *et al*, 2013), as suggested in the JNCC discussion paper 'a potential approach to assessing the significance of disturbance against conservation objectives of the harbour porpoise cSAC for the harbour porpoise SACs stakeholder workshop, February 2017. Therefore all sites with the exception of the Southern North Sea cSAC are screened out with regard to noise impacting upon the sites themselves due to being at a greater distance than this impact range.

54. Animals affected by underwater noise from Norfolk Vanguard would be within or in close proximity to the Southern North Sea cSAC. As discussed above, it is considered that during this time, harbour porpoise in this area are associated with the Southern North Sea cSAC and therefore all sites, with the exception of the Southern North Sea cSAC, are screened out with regard to impacts from underwater noise.

2.3.1.3 Vessel interactions

55. For vessel interactions, condensed vessel activity will occur in the vicinity of the Norfolk Vanguard offshore project area and routes to local ports (beyond this, vessel activity will be dispersed and becomes part of the background vessel traffic, using already established vessel routes). Thus, all animals affected would be within or in close proximity to the Southern North Sea cSAC. As discussed above, it is considered that during this time, harbour porpoise in the area are associated with the Southern North Sea cSAC and therefore all sites, with the exception of the Southern North Sea cSAC, are screened out with regard to vessel interactions.

2.3.2 Grey seal

56. A telemetry study by the Sea Mammal Research Unit (SMRU) tagged grey seal at the Berwickshire and North Northumberland Coast (Farnes Island haul out and breeding colony), the Humber Estuary (Donna Nook haul out and breeding colony), the Isle of May (haul out and breeding colony) and within the Firth of Tay and Eden Estuary SAC (Abertay haul out region). Tracks for grey seal pups (Figure 2.2) and adults (Figure 2.3) were assessed for the East Anglia FOUR site (EATL, 2014), which is now NV East. The data indicate that potential use of Norfolk Vanguard, and therefore connectivity with SAC sites in the UK, is low.
57. The track of only one grey seal pup tagged at the Isle of May in 2002 overlapped with the East Anglia FOUR 20km buffer (Figure 2.2) and the edge of NV West. However the extent of overlap is very low with less than 0.3% of locations within the buffer. The track of one adult grey seal also overlaps with NV West.
58. Mixing between the North Sea and West coast of Scotland and Irish Sea sub-populations is not observed; therefore Natura 2000 sites in these locations have been screened out. In addition telemetry data from grey seals in French (Vincent *et*

al., 2002) and Irish (e.g. <http://sealtrack.ucc.ie/>) waters suggest that there is very limited connectivity between haul out sites on the Isles of Scilly or Irish Sea and individuals foraging in the Southern North Sea. As such, Natura 2000 sites in these locations have also been screened out.

59. None of the grey seal tagged in the UK entered Natura 2000 sites in other member states. However, telemetry from Dutch waters (Figure 2.4 and Figure 2.5) supports potential connectivity between grey seal at the Humber Estuary SAC, Isle of May SAC, and the Berwickshire and North Northumberland Coast SAC and shows movement across the southern North Sea and use of NV East by seals which have also used Natura 2000 sites along the Dutch, French and Belgian coasts.
60. Grey seal have been shown to move from the Thames Estuary area to haul out sites in the English Channel and on the French coast as far as Brest (Matthiopoulos *et al.*, 2004).
61. A few grey seal have been tagged in the mouth of the Baltic and Kattegat and Skagerrak but these data (e.g. Dietz *et al.*, 2003) do not provide certainty as to where the boundary lies between the Baltic population and the Northeast Atlantic population. Numbers of grey seals in this region are low (Härkönen *et al.*, 2007). Tagged pups from in the Kattegat-Skagerrak have been shown to originate from the Danish North Sea coast, but the timing of breeding indicated that animals may come from both the Atlantic and Baltic stocks. As such, Natura 2000 sites in the mouth of the Baltic and Kattegat and Skagerrak have been screened out.
62. Grey seal telemetry data show no evidence of connectivity between the German and Danish Natura 2000 sites along the German Bight with movement limited to the Dutch Waddensea and Delta areas, and not extending into the German Waddensea and Helgoland.

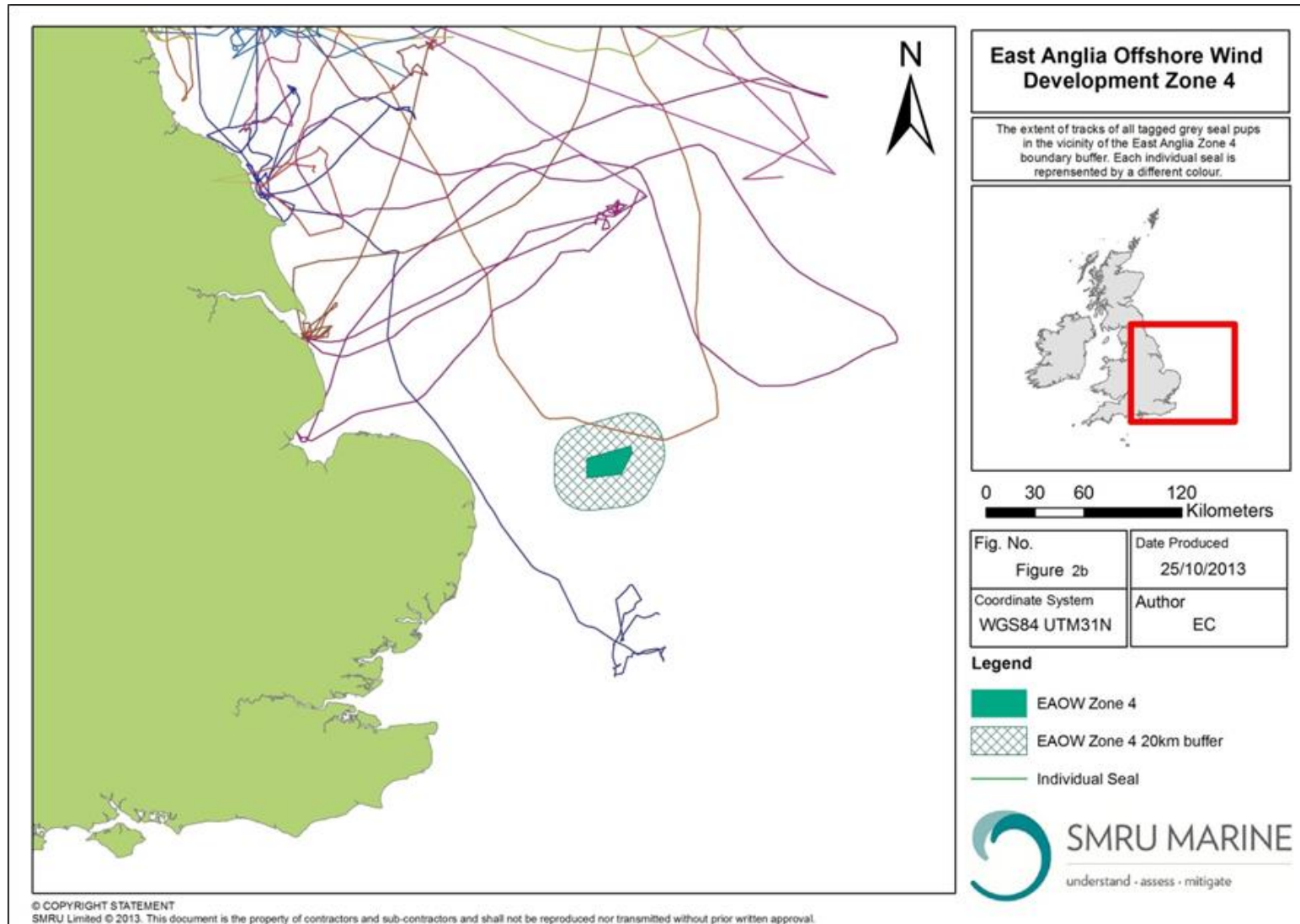


Figure 2.2: Tracks of grey seal pups in the vicinity of the former East Anglia FOUR (now Norfolk Vanguard East) plus buffer from telemetry deployment in the UK

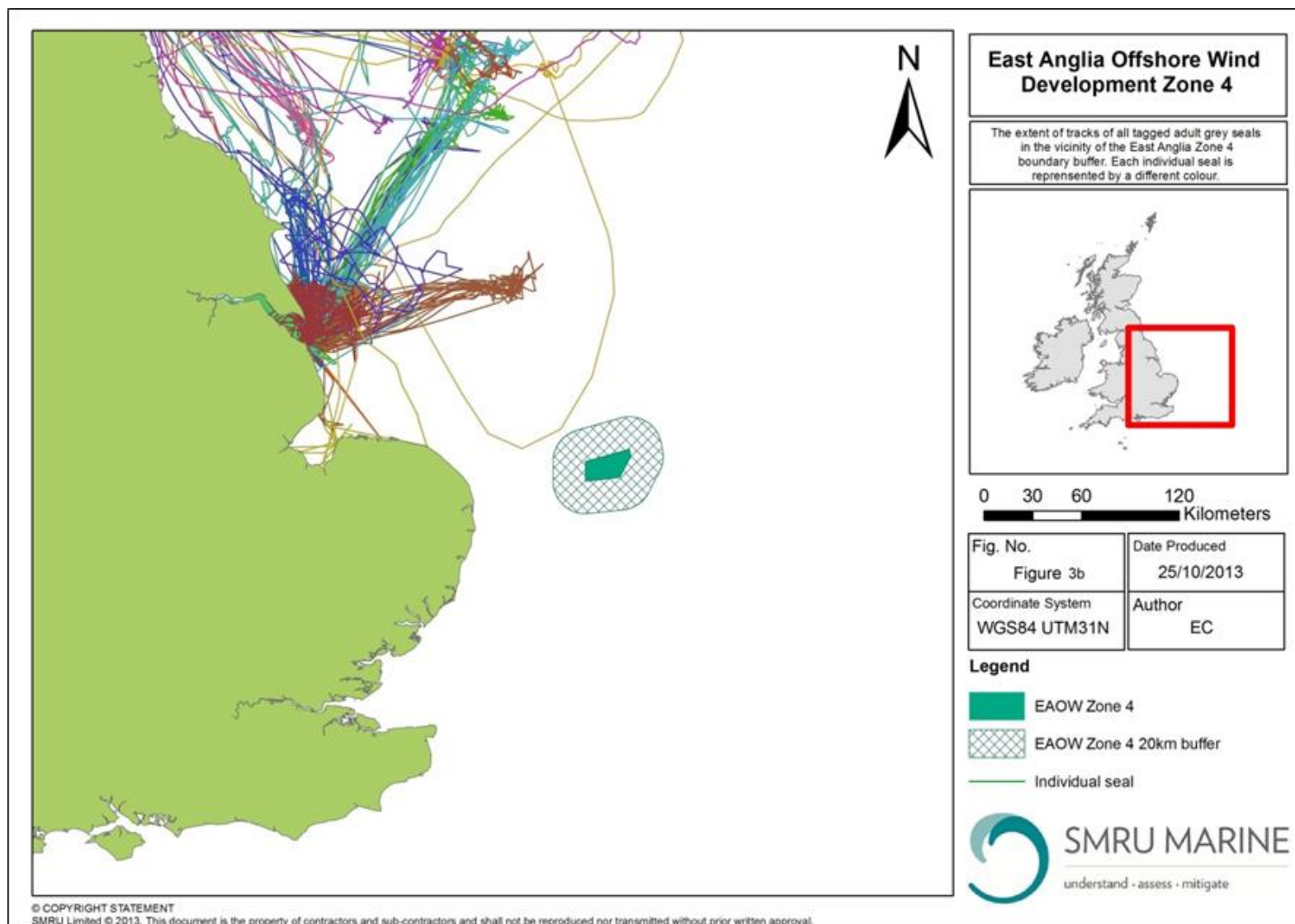


Figure 2.3: Tracks of adult grey seal in the vicinity of the former East Anglia FOUR (now Norfolk Vanguard East) plus buffer from telemetry deployment in the UK

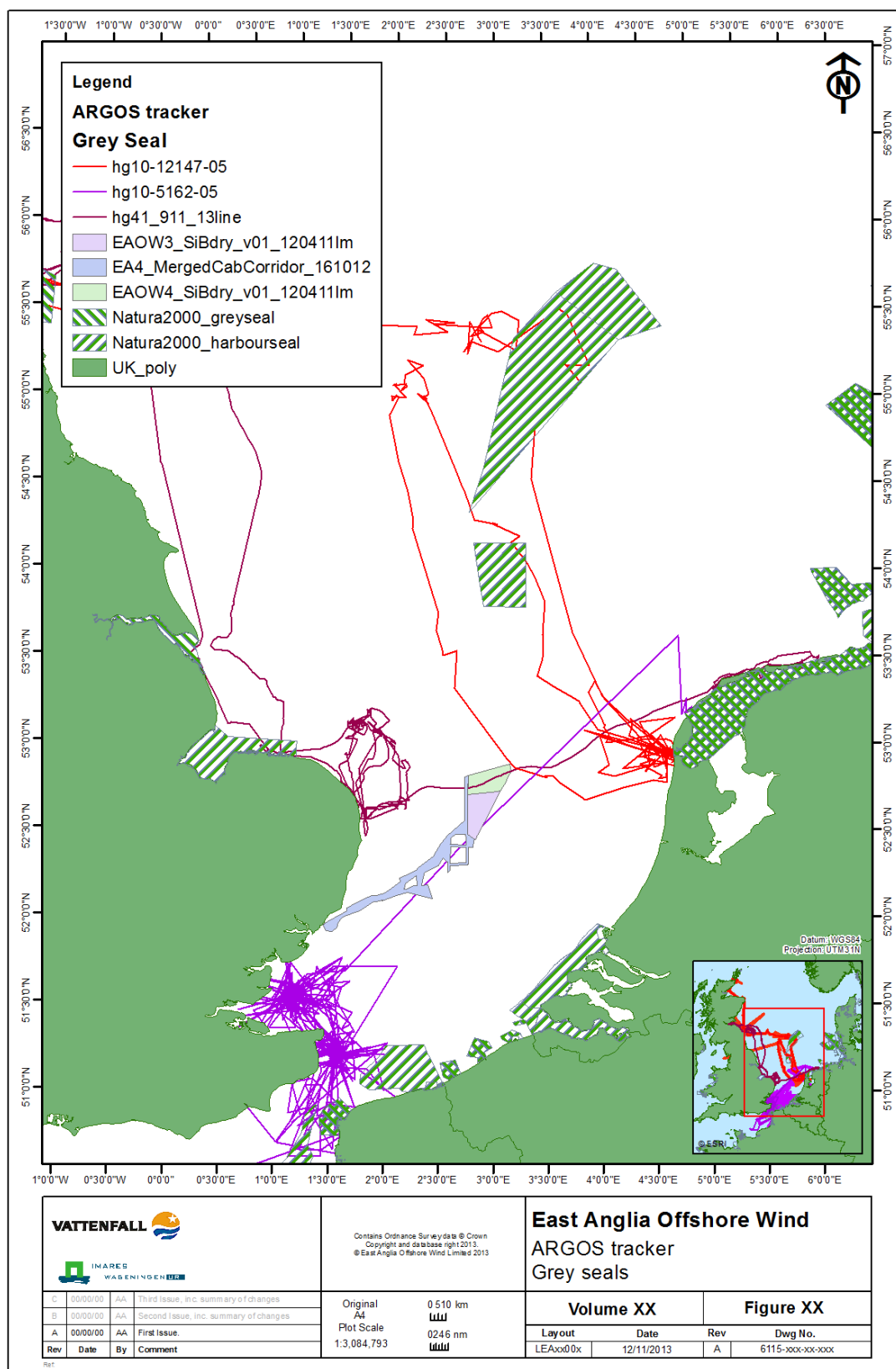


Figure 2.4: Tracks of grey seals tagged in Dutch waters using the Argos location system

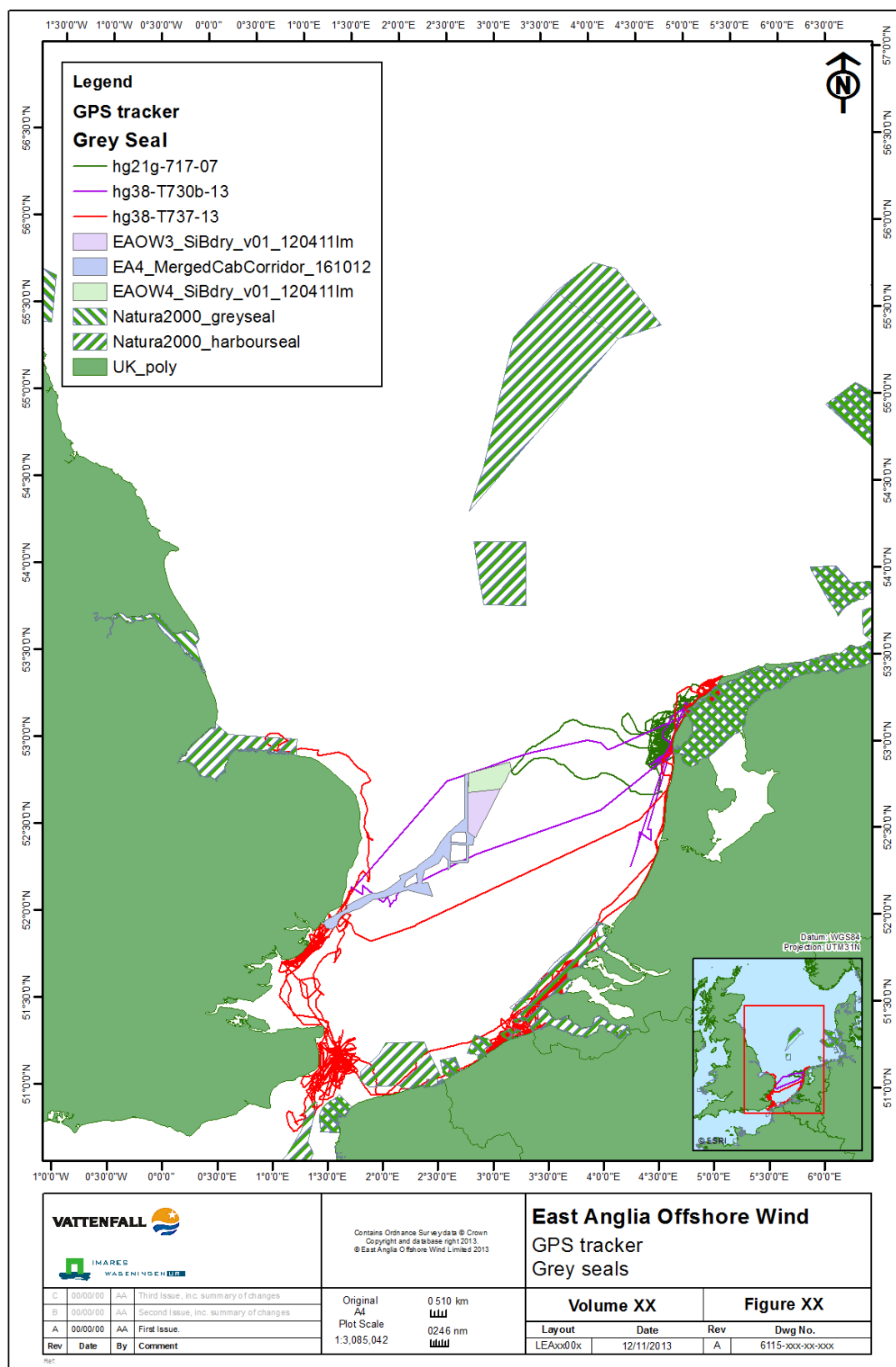


Figure 2.5: Tracks of grey seals tagged in Dutch waters using the GPS-GSM location system

63. Table 2.3 shows the sites considered to have theoretical connectivity to Norfolk Vanguard (i.e. those within 1,000km as discussed in Section 2.1.2). Using the information above, this list has been refined to screen out sites where there is no evidence of potential connectivity. This refined list was then further screened, in relation to the potential effects discussed below.

2.3.2.1 Indirect impacts through effects on prey species

64. For indirect effects on prey, results from underwater modelling suggests that noise impacts upon fish will be limited to <50km, for the widest ranging behavioural effects (based on Popper *et al.* (2014) TTS criteria of 186dB SEL). Therefore all sites are screened out with regard to indirect effects due to the distance between the potential impact range and other designated sites (see Table 2.3). Potential connectivity, and therefore potential for grey seals from designated sites to be foraging in and around Norfolk Vanguard is discussed above.

2.3.2.2 Underwater noise

65. With regard to direct underwater noise impacts upon designated sites (or individual animals within them), it is considered that for piling (which is the greatest of the potential noise sources) the maximum predicted potential range of impact would be up to 5.4km for Temporary Threshold Shift (TTS) and fleeing response based on Southall *et al.*, (2007) criteria of 171db SEL. Therefore all sites are screened out with regard to direct noise impacting upon the designated sites and individual animals located within them.
66. Individuals could come from any of the sites considered to have potential connectivity, given that grey seal are highly mobile and as a result these may be affected within the potential TTS impact range of up to 5km.
67. The number of animals that could be exposed to any potential direct impacts from underwater noise can be estimated based on their density in the potential impact area. In lieu of site specific data for density of grey seal (as sightings data was too low within the Norfolk Vanguard offshore project area) it is proposed that the density used should be the SMRU seals at-sea density data (Jones *et al.* 2016) as agreed for the EIA during the Evidence Plan Process (meeting 15th February 2017). Table 2.1 shows the density estimates for Norfolk Vanguard which have been calculated from the 5 x 5km cells (provided in Jones *et al.*, 2016) based on the area of overlap with Norfolk Vanguard.

Table 2.1 Grey seal density estimates (Jones *et al.* 2016)

Density Estimate	Individuals per km ²				
	Norfolk Vanguard Offshore Cable	Norfolk Vanguard West	Norfolk Vanguard East	Norfolk Vanguard OWF sites	Norfolk Vanguard Offshore Project Area
Lower at-sea	0.0006	0.0005	0.0004	0.0004	0.0005
Mean at-sea	0.001	0.0008	0.0007	0.0008	0.0009
Upper at-sea	0.002	0.001	0.001	0.001	0.001

68. Table 2.1 shows an upper at sea density estimate of 0.001 per km² in the OWF sites. For noise impacts, making the conservative assumption of an impact range for TTS of up to 5.4km, the affected area for a single piling event would be approximately 22.9km² and 45.8km² for concurrent piling at two locations (assuming a worst case scenario of no overlap). Therefore using the conservative upper at-sea density a total of 0.05 individuals would be affected during concurrent piling. At this magnitude of effect it is not considered that there is potential for LSE on any site to which the individual could be attributed. Therefore all sites are screened out with regard to noise impacts.

2.3.2.3 Vessel interactions

69. As discussed in Section 2.3.1.3, condensed vessel activity will occur in the vicinity of the Norfolk Vanguard offshore project area and routes to local ports (beyond this, vessel activity will be dispersed and becomes part of the background vessel traffic).
70. Within the offshore wind farm sites (592km²) the upper at-sea density of grey seal is estimated to be 0.001/km²) and therefore the potential number of individuals which could interact with vessels in this area is 0.6.
71. Within the offshore cable corridor area (237km²) the upper at-sea density of grey seal is estimated to be 0.002/km²) and therefore the potential number of individuals which could interact with vessels in this area is 0.5.
72. The total number of seals that could interact with vessels associated with the project is therefore estimated to be one.
73. Latest grey seal counts from the north east England and south east England in August 2015 were 6,942 and 5637, respectively (SCOS, 2016). One seal therefore represents 0.01% of the north east count and 0.02% of the south east count. At this magnitude of effect it is not considered that there is potential for LSE on grey seals from designated sites within this MU.

74. There is little information on collision rates or avoidance behaviour in seals, however it should be noted that the majority of vessels within the offshore project area will be slow moving or stationary. It is also highly unlikely that every grey seal in the offshore project area will be at risk of vessel collision.
75. Given the low numbers of affected individuals even on an unrealistic and highly precautionary worst case, at this magnitude of effect it is not considered that there is potential for LSE on any site to which the individual could be attributed. Therefore all sites are screened out with regard to any LSE from vessel interactions.
76. The port location is not confirmed at this stage, however if a port to the north (e.g. Hull) is selected there is potential for impact on the Humber Estuary SAC due to the proximity of this site to Hull port. If a port to the south is used (e.g. Great Yarmouth or Lowestoft) there will be no impact on grey seal SACs due to the distance of this site and the route vessels would be required to take from designated sites.

2.3.3 Harbour seal

77. A telemetry study by the SMRU tagged harbour seal at the Wash and North Norfolk SAC, the Firth of Tay and Eden Estuary SAC and the Thames Estuary. No harbour seal tagged in these locations entered NV East (former East Anglia FOUR) (Figure 2.6), although the site is within the potential foraging range of seals using the Wash and North Norfolk SAC. The location of NV West (shown in Figure 1.1) is on the edge the tracks of one individual from the SAC.

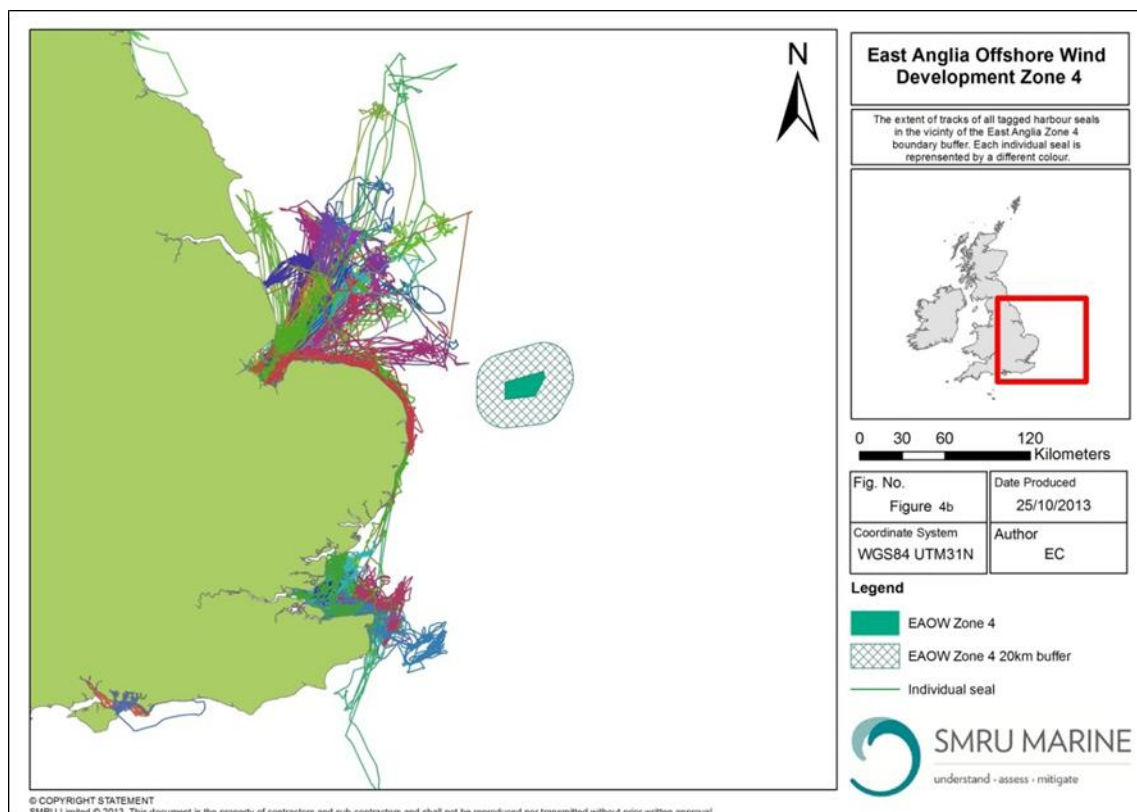


Figure 2.6: Tracks of adult harbour seal in the vicinity of the former East Anglia Zone 4 plus buffer (now Norfolk Vanguard East) from telemetry deployment in the UK

78. Figure 2.7 and Figure 2.8 show tracks from seals tagged in Dutch waters. These indicate that seals in the vicinity of Norfolk Vanguard have used the Wash and North Norfolk SAC, as well as haul-out sites and at-sea areas near Dutch and Belgian designated sites.
79. Data from seals tagged in UK and Dutch waters suggest very limited dispersal or mixing between seals within the southern North Sea and seals using the English Channel. Tagging studies in French waters in 2006 and 2007 (Vincent *et al.*, 2010) also suggest that no seals ranged from the waters of the English Channel beyond the Straits of Dover. Although this lack of movement by tagged animals between the southern North Sea and English Channel does not completely exclude mixing between these subpopulations, it does support the conclusion that there is little or no potential for connectivity between harbour seal using Norfolk Vanguard, and any Natura 2000 sites along the south of the English Channel and along the French coast, and therefore no potential for LSE.

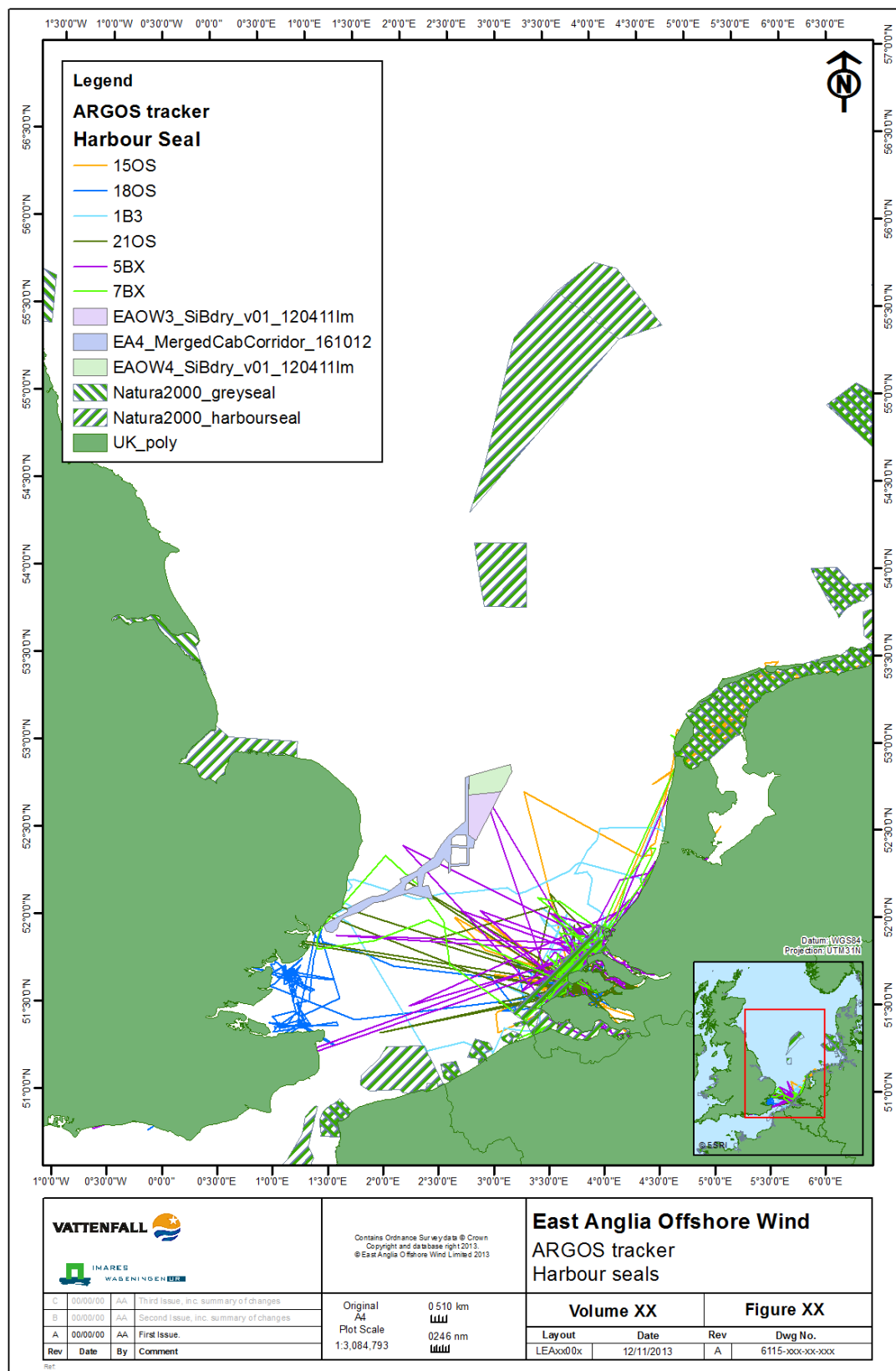


Figure 2.7: Tracks of harbour seals tagged in Dutch waters using the Argos location system

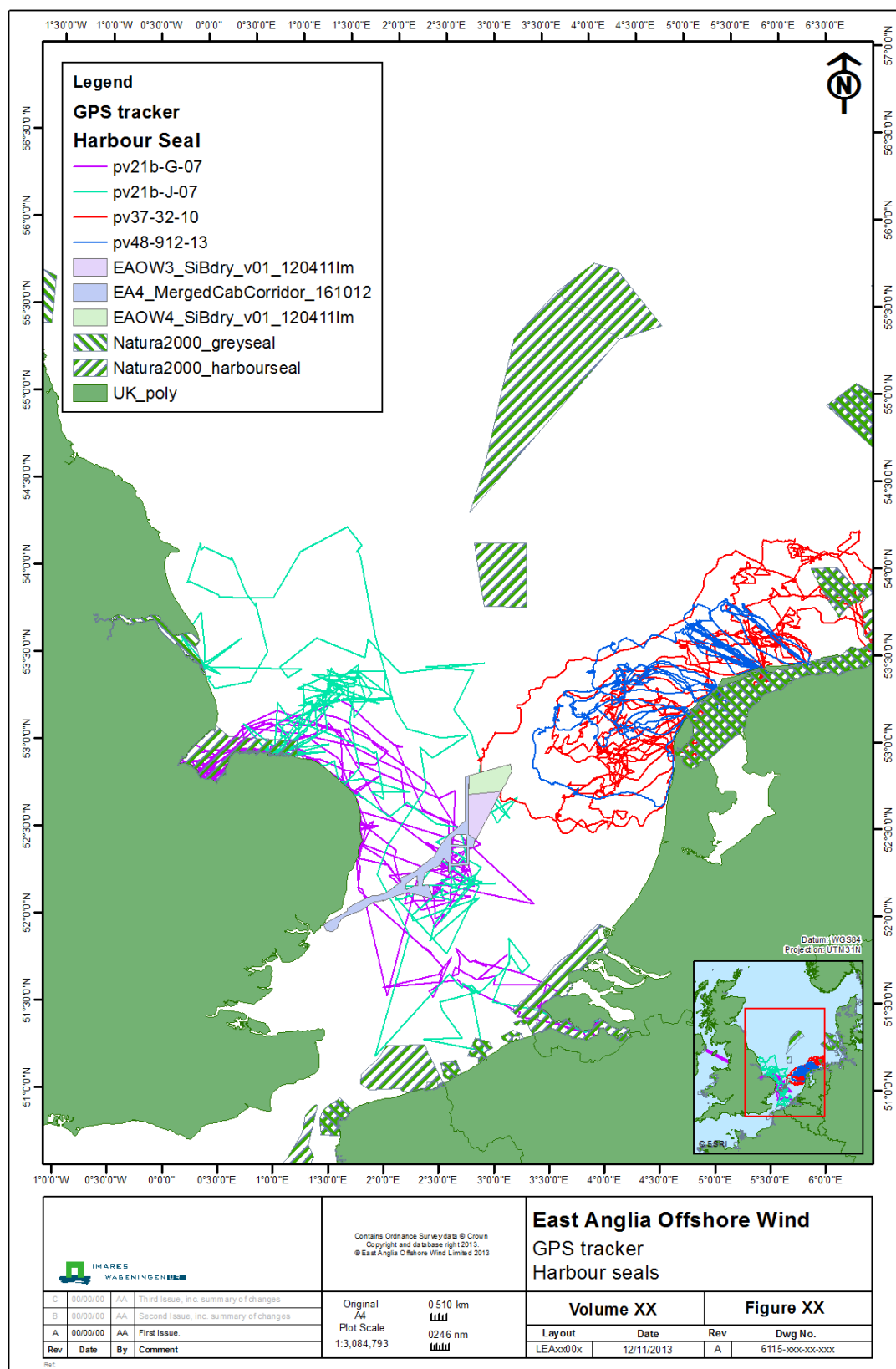


Figure 2.8: Tracks of harbour seals tagged in Dutch waters using the GPS-GSM location system

80. Table 2.3 shows the sites considered to have theoretical connectivity to Norfolk Vanguard (i.e. those within 300km as discussed in Section 2.1.3). Using the information above, this list has been refined to screen out sites where there is no evidence of potential connectivity. This refined list was then further screened, in relation to the potential effects discussed below.

2.3.3.1 Indirect impacts through effects on prey species

81. As previously discussed, results from underwater modelling suggests that noise impacts upon fish will be limited to <50km, for the widest ranging behavioural effects (based on Popper *et al.* (2014) TTS criteria of 186dB SEL). Therefore all sites are screened out with regard to indirect effects due to the distance between the potential impact range and other designated sites (see Table 2.3). Potential connectivity, and therefore potential for animals from designated sites to be foraging in and around Norfolk Vanguard is discussed above.

2.3.3.2 Underwater noise

82. With regard to direct underwater noise impacts upon designated sites (or individual animals within them), it is considered that for piling (which is the greatest of the potential noise sources) the maximum predicted potential range of impact would be up to 5.4km for TTS and fleeing response based on Southall *et al.*, (2007) criteria of 171db SEL. Therefore all sites are screened out with regard to direct noise impacting upon the designated sites and individual animals located within them. Individuals could come from any of the sites considered to have potential connectivity given that harbour seal are mobile and as a result these may be affected within the potential TTS impact range of up to 5.4km.
83. The number of animals that could be exposed to any potential direct the impacts from underwater noise can be estimated based on their density in the potential impact area. In lieu of site specific data for density of harbour seal (as sightings data was too low within the Norfolk Vanguard offshore project area) it is proposed that the density used should be the SMRU seals at-sea density data (Jones *et al.* 2016; shown in Table 2.2) for harbour seal as agreed for the EIA during the Evidence Plan Process (meeting 15th February 2017). Table 2.2 shows the density estimates for Norfolk Vanguard which have been calculated from the 5 x 5km cells (provided in Jones *et al.*, 2016) based on the area of overlap with Norfolk Vanguard.

Table 2.2 Harbour seal density estimates (Jones *et al.* 2016)

Density Estimate	Individuals per km ²				
	Norfolk Vanguard Offshore Cable	Norfolk Vanguard West	Norfolk Vanguard East	Norfolk Vanguard OWF sites	Norfolk Vanguard Offshore Project Area
Lower at-sea	0.0001	4×10^{-7}	2×10^{-7}	3×10^{-7}	5×10^{-5}
Mean at-sea	0.004	7×10^{-6}	4×10^{-6}	5×10^{-6}	0.001
Upper at-sea	0.008	1.4×10^{-6}	7×10^{-6}	1×10^{-5}	0.002

84. Table 2.2 shows an upper at sea density estimate of 1×10^{-5} per km² in the OWF sites. For noise impacts, making the conservative assumption of an impact range for TTS of up to 5.4km, the affected area for a single piling event would be approximately 22.9km² and 45.8km² for concurrent piling at two locations (assuming a worst case scenario of no overlap). Therefore using the conservative upper at-sea density a total of 0.0005 individuals would be affected during concurrent piling. At this magnitude of effect it is not considered that there is potential for LSE on any site to which the individual could be attributed. Therefore all sites are screened out with regard to noise impacts.

2.3.3.3 Vessel interactions

85. As discussed previously, condensed vessel activity will occur in the vicinity of the Norfolk Vanguard offshore project area and routes to local ports (beyond this, vessel activity will be dispersed and becomes part of the background vessel traffic within established vessel routes).
86. Within the offshore wind farm sites (592km²) the upper at-sea density of harbour seal is estimated to be 1×10^{-5} km²) and therefore the potential number of individuals which could interact with vessels in this area is 0.006.
87. Within the offshore cable corridor area (237km²) the upper at-sea density of harbour seal is estimated to be 0.008/km²) and therefore the potential number of individuals which could interact with vessels in this area is 1.9.
88. The total number of seals that could interact with vessels associated with the project is therefore estimated to be 2. The mean harbour seal count for the Wash in 2015 was 3336 (SCOS, 2016), therefore 2 seals would represent 0.06% of the 2015 count. This represents the most conservative population to assess the effect against. The south east England harbour seal count (based on surveys from 2008 to 2015) is 4740 (SCOS, 2016). At this magnitude of effect it is not considered that there is potential for LSE on the Wash and North Norfolk SAC if all individuals with potential vessel interactions were from this SAC.

89. There is little information on collision rates or avoidance behaviour in seals, however as previously discussed, the majority of vessels within the offshore project area will be slow moving or stationary. It is also highly unlikely that every harbour seal potentially in the offshore project area will be at risk of vessel collision.
90. Given the low numbers of individuals even on an unrealistic and highly precautionary worst case, at this magnitude of effect it is not considered that there is potential for LSE on any site to which the individual could be attributed. Therefore all sites are screened out with regard to vessel interactions.
91. The port location is not confirmed at this stage, however if a port to the north (e.g. Hull) is selected there is potential for impact on the Wash and North Norfolk Coast SAC. If a port to the south is used (e.g. Great Yarmouth or Lowestoft) there will be no impact on harbour seal SACs.

2.3.4 Screening summary

92. Table 2.3 provides a list of sites for which there is theoretical connectivity to Norfolk Vanguard for harbour porpoise, grey seal and harbour seal, as outlined in Sections 2.1.1, 2.1.2 and 2.1.3, respectively.
93. In summary, a total of 41 sites were initially considered in the screening process for harbour porpoise and these sites were then assessed for the potential effects listed in Section 2.3.1. Shaded rows have been screened out from further consideration in the HRA and the Southern North Sea cSAC site will be assessed further.
94. A total of 42 sites were initially considered in relation to grey seal. Based on the potential impacts outlined in Section 2.3.2, all sites for grey seal, with the exception of the Humber Estuary SAC, have been screened out from further consideration in the HRA.
95. A total of 40 sites were initially considered in the screening for harbour seal. Based on the potential impacts outline in Section 2.3.3, all sites for harbour seal, with the exception of the Wash and North Norfolk Coast SAC, have been screened out from further consideration in the HRA.

Table 2.3 Screening list of SACs and SCIs for harbour porpoise, grey seal and harbour seal (screened out sites are shown in grey).

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
BEMNZ0001	Belgium	Vlaamse Banken	Harbour porpoise Harbour seal	SAC	138	No No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
BEMNZ0002	Belgium	SBZ 1 / ZPS 1	Harbour porpoise Grey seal Harbour seal	SPA	170	No Yes No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
BEMNZ0003	Belgium	SBZ 2 / ZPS 2	Harbour porpoise Grey seal Harbour seal	SPA	156	No Yes No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
BEMNZ0004	Belgium	SBZ 3 / ZPS 3	Harbour porpoise Grey Seal Harbour seal	SPA	153	No Yes No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
BEMNZ0005	Belgium	Vlakte van de Raan	Harbour porpoise Grey seal Harbour seal	SCI	147	No Yes No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
DK00FX112	Denmark	Skagens Gren og Skagerrak	Harbour porpoise	SAC	680	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DK00VA347	Denmark	Sydlig Nordsø	Harbour porpoise Grey seal	SAC	367	No No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
DK00VA259	Denmark	Gule Rev	Harbour porpoise	SCI	571	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DK00VA258	Denmark	Store Rev	Harbour porpoise	SCI	654	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DK00AY176	Denmark	Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde	Harbour porpoise	SAC	418	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Grey seal			No		
dk00va302	Denmark	Knudegrund	Harbour porpoise	SAC	675	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
dk00va301	Denmark	Lønstrup Rødgrund	Harbour porpoise	SAC	648	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
dk00va340	Denmark	Sandbanker ud for Thyboron	Harbour porpoise	SAC	523	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
dk00va348	Denmark	Thyboron Stenvolde	Harbour porpoise	SCI	506	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
dk00va341	Denmark	Sandbanker ud for Thorsminde	Harbour porpoise	SAC	492	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE1003301	Denmark	Doggerbank	Harbour seal	SCI	281	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE1209301	Denmark	Sylter Aussenriff	Harbour seal	SCI	311	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
DE1011401	Denmark	SPA Ostliche Deutsche Bucht	Harbour seal	SPA	345	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE0916391	Denmark	NTP S-H Wattenmeer und angrenzende Kustengebiete	Harbour seal	SAC	365	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE1813391	Denmark	Helgoland mit Helgolander Felssockel	Harbour seal	SAC	343	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE1714391	Denmark	Steingrund	Harbour seal	SAC	353	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2016301	Denmark	Hamburgisches Wattenmeer	Harbour seal	SCI	361	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2323392	Denmark	Schleswig-Holsteinisches Elbastuar und angrenzende Flächen	Harbour seal	SAC	388	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2018331	Denmark	Untere Elbe	Harbour seal	SCI	388	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2424302	Denmark	Muhlenberger Loch/Nesssand	Harbour seal	SCI	448	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2507331	Denmark	Unterems und Aussenems	Harbour seal	SCI	263	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2507301	Denmark	Hund und Paapsand	Harbour seal	SCI	261	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
DE2306301	Denmark	Nationalpark Niedersächsisches Wattenmeer	Harbour seal	SAC	246	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2104301	Denmark	Borkum-Riffgrund	Harbour seal	SCI	234	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
FR2200346	France	Estuaires et littoral picards (baies de Somme et d'Authie)	Harbour porpoise	SAC	275	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Harbour seal			No		
FR2300121	France	Estuaire de la Seine	Harbour porpoise	SCI	394	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
FR2300139	France	Littoral Cauchois	Harbour porpoise	SAC	314	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
FR2502020	France	Baie de Seine occidentale	Harbour porpoise	SAC	429	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
FR2502021	France	Baie de Seine orientale	Harbour porpoise	SAC	408	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
FR3100478	France	Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant	Harbour porpoise	SAC	217	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Grey seal			Yes		The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
			Harbour seal			No		No potential connectivity based on information in Annexes 1 and 2

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
FR3102002	France	Bancs des Flandres	Harbour porpoise	SAC	162	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		
FR3102003	France	Recifs Gris-Nez Blanc-Nez	Harbour porpoise	SAC	209	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		
FR3102004	France	Ridens et dunes hydrauliques du detroit du Pas-de-Calais	Harbour porpoise	SAC	217	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Harbour seal			No		
FR3102005	France	Baie de Canche et couloir des trois estuaires	Harbour porpoise	SAC	254	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		
FR5300017	France	Abers - Côtes Des Legendes	Grey seal	SAC	667	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
FR5300023	France	Archipel Des Glenan	Grey seal	SAC	713	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
FR5300015	France	Baie De Morlaix	Grey seal	SAC	622	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
FR5300020	France	Cap Sizun	Grey seal	SAC	711	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
FR2500079	France	Chausey	Grey seal	SAC	509	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
FR5300009	France	Cote De Granit Rose-Sept-Iles	Grey seal	SAC	583	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
FR5300018	France	Ouessant-Molene	Grey seal	SAC	698	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
FR7200811	France	Panache De La Gironde Et Plateau Rocheux De Cordouan (Système Pertuis Gironde)	Grey seal	SAC	837	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
FR5400469	France	Pertuis Charentais	Grey seal	SAC	767	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
FR5300019	France	Presqu'île De Crozon	Grey seal	SAC	700	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
FR5300010	France	Tregor Goëlo	Grey seal	SAC	571	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
FR3100474	France	Dunes De La Plaine Maritime Flamande	Harbour seal	SAC	185	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
FR3100480	France	Estuaire De La Canche, Dunes Picardes Plaquees Sur L'ancienne Falaise, Foret D'hardelot Et Falaise D'equihen	Harbour seal	SAC	241	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE0916391	Germany	NTP S-H Wattenmeer und angrenzende Küstengebiete	Harbour porpoise	SAC	365	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Grey seal			No		
DE1011401	Germany	SPA Östliche Deutsche Bucht	Harbour porpoise	SPA	345	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Grey seal			No		
DE1209301	Germany	Sylter Außenriff	Harbour porpoise	SCI	311	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Grey seal			No		
DE1003301	Germany	Doggerbank	Harbour porpoise	SCI	281	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2104301	Germany	Borkum-Riffgrund	Harbour porpoise	SCI	234	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		
DE1813391	Germany	Helgoland mit Helgoländer Felssockel	Harbour porpoise	SAC	343	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Grey seal			No		

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
DE1714391	Germany	Steingrund	Harbour porpoise	SAC	353	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
			Grey seal			No		
DE2016301	Germany	Hamburgisches Wattenmeer	Harbour porpoise	SCI	361	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result in no potential for LSE
			Grey seal			Yes		
DE2018331	Germany	Untereelbe	Harbour porpoise	SCI	388	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2306301	Germany	Nationalpark Niedersächsisches Wattenmeer	Harbour porpoise	SAC	246	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		
DE1115391	Germany	Dünenlandschaft Süd-Sylt	Grey seal	SAC	399	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE1315391	Germany	Küsten- und Dünenlandschaften Amrums	Grey seal	SAC	395	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2507301	Germany	Hund und Paapsand	Harbour seal	SCI	261	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
DE2507331	Germany	Unterems und Außenems	Harbour seal	SCI	263	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
NL2008001	Netherlands	Doggersbank	Harbour porpoise	SAC	149	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
NL2008002	Netherlands	Klaverbank	Harbour porpoise	SAC	93	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		
NL9802001	Netherlands	Noordzeekustzone	Harbour porpoise	SAC	98	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		
NL2008003	Netherlands	Vlakte van de Raan	Harbour porpoise	SAC	135	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
			Grey seal			Yes		
			Harbour seal			No		
NL4000017	Netherlands	Voordelta	Grey seal	SAC and SPA	106	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
			Harbour seal			No		
NL1000001	Netherlands	Waddenzee	Grey seal	SAC	111	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
			Harbour seal			No		
BEMNZ0001	Netherlands	Vlaamse Banken	Grey seal	SAC	138	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result in no potential for LSE.
NL9803061	Netherlands	Westerschelde & Saeftinghe	Harbour seal	SAC	141	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.

Site code	Country	Site name	Interest Feature	Designation	Distance (km)*	Potential connectivity	Screening decision	Reason for screening decision
NL3009016	Netherlands	Oosterschelde	Harbour seal	SAC	130	No	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
SE0520170	Sweden	Kosterfjorden-Väderöfjorden	Harbour porpoise	SAC	800	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
	UK	Southern North Sea	Harbour porpoise	cSAC	0	Yes	In	Norfolk Vanguard is within the cSAC. Assumed that all harbour porpoise in this area are associated with this cSAC.
UK0017072	UK	Berwickshire and North Northumberland Coast	Grey seal	SAC	368	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result are negligible and would result in no potential for LSE.
UK0017096	UK	Faray and Holm of Faray	Grey seal	SAC	762	No	Out	The distance between the potential impact range of the proposed project and the site is beyond that of potential for direct or indirect effects
UK0030170	UK	Humber Estuary	Grey seal	SAC	149	Yes	In	Potential for vessel interactions if a port to the north of Norfolk Vanguard is selected.
UK0030172	UK	Isle of May	Grey seal	SAC	478	Yes	Out	The distance between the potential impact range of the proposed project and the extent of any impact on individuals from this site result in no potential for LSE.
UK0017075	UK	The Wash and North Norfolk Coast	Harbour seal	SAC	80	Yes	In	Potential for vessel interactions if a port to the north of Norfolk Vanguard is selected.

*Distance measured from the closest point of Norfolk Vanguard (i.e. the wind turbine array) to the closest point of the SAC/cSAC/SCI rounded to the nearest kilometre

3 SCREENING BENTHIC ECOLOGY SAC SITES AND FEATURES

3.1 Identification of Benthic Sites and Features

96. Natura 2000 sites in the southern North Sea, which have benthic habitats (Habitats Directive Annex I) as an interest feature, have been considered for HRA Screening. Table 3.1 provides the list of sites considered for screening.

3.2 Approach to Screening

97. The sites which could potentially be affected by the proposed project have been screened in to the HRA on the basis of the following:
- A component of the proposed project directly overlaps a site whose interest features includes a particular habitat.
 - The distance between the proposed project and the offshore habitat interest feature is within the range for which there could be an interaction e.g. the pathway is not too long for sediment deposition.

3.2.1 Potential effects (Source)

98. The conservation objectives for offshore Annex I habitats are to “maintain or restore the habitat in Favourable Condition”.
99. The formal advice associated with the Haisborough, Hammond and Winterton cSAC (JNCC and Natural England, 2013) identifies six pressure categories which may cause deterioration of natural habitats within SACs, either alone or in combination (and thus affect Favourable Condition), have been identified as:
- Physical loss;
 - Physical damage;
 - Non-physical disturbance;
 - Toxic contamination;
 - Non-toxic contamination²; and
 - Biological disturbance³
100. The potential effects on offshore habitats from Norfolk Vanguard have been identified as follows based on the Norfolk Vanguard scoping report (Royal HaskoningDHV, 2016) and scoping opinion (the Planning Inspectorate, 2016b):
- Construction
 - Permanent habitat loss⁴;

² For some sites this includes changes in nutrient and / or organic enrichment and / or in salinity.

³ For some sites this includes the introduction of non-native species and / or the selective extraction of species.

- Temporary physical disturbance;
 - Smothering due to increased suspended sediment;
 - Re-mobilisation of contaminated sediments; and
 - Underwater noise and vibration.
- Operation
 - Permanent habitat loss;
 - Physical disturbance through maintenance activities;
 - Smothering through increased suspended sediment; and
 - Introduction of new substrate.
 - Decommissioning
 - Temporary physical disturbance;
 - Smothering due to increased suspended sediment;
 - Re-mobilisation of contaminated sediments; and
 - Underwater noise and vibration.
101. Within the Norfolk Vanguard offshore project area (the offshore wind farm (OWF) sites and offshore cable corridor), construction activities such as the installation of foundations, cables and ancillary structures and the placement of jack-up vessel legs, will cause physical disturbance and indirect disturbance.
102. Operation of Norfolk Vanguard would create more permanent impacts (i.e. for the 25 year predicted lifespan of the proposed project) through the loss of existing habitat and introduction of new substrate.
103. Other temporary impacts identified during operation will be caused by maintenance activities such as the use of jack up vessels and the replacement and repair of any cables or through potential scour associated with the installed infrastructure.
104. Decommissioning impacts will be primarily caused by the removal of structures from the seabed. Decommissioning would cause similar impacts to that identified during construction.
- 3.2.2 Proximity of source to feature (i.e. SAC) (pathway and receptor)**
105. The significance of such impacts would be dependent on the characteristics of the habitats and communities (receptors) present within the footprint of the impact and, in particular, the capacity of the affected communities to recover from those impacts identified.

⁴ The installation of turbine foundations will result in a permanent loss of habitat. As the loss of habitat is an on-going impact this is considered under operation rather than construction to avoid double counting.

106. Impacts to offshore habitats will be small scale when put in the context of the wider environment, being localised to Norfolk Vanguard and in many cases to individual elements of the proposed project.
107. Some benthic species may react to episodic noise such as that from pile driving (Lovell *et al*, 2005, Heinisch and Weise, 1987) however any impact is likely to be localised and temporary (i.e. occurring only during piling). Annex 1 habitats, for which Natura 2000 sites are designated, are not known to have any noise sensitivity. These include:
- Sandbanks which are slightly covered by sea water all the time;
 - Estuaries;
 - Mudflats and sandflats not covered by seawater at low tide;
 - Coastal lagoons;
 - Reefs;
 - Large shallow inlets and bays;
 - Submarine structures made by leaking gases; and
 - Submerged or partially submerged sea caves.

3.3 Screening

108. Table 3.1 provides the list of 30 sites within the southern North Sea which have benthic features as a primary or secondary reason for designation. In summary, all sites have been screened out with the exception of the Haisborough, Hammond and Winterton SCI.
109. The Haisborough, Hammond and Winterton SCI overlaps with the cable corridor, and therefore there is potential for its designated features, Sandbanks which are slightly covered by sea water all the time and Reefs to be impacted during construction, O&M or decommissioning of Norfolk Vanguard. The following impacts will be considered further during the HRA:
- Temporary physical disturbance;
 - Increased suspended sediment and smothering;
 - Permanent habitat loss; and
 - Introduction of new substrate.
110. Based on the draft Marine Physical Process impact assessment the majority of suspended sediments are predicted to be deposited locally to the area of disturbance, with only a very small proportion of mud becoming more widely dispersed before settling on the seabed. Based on comparable plume modelling studies for East Anglia ONE (ABPmer, 2012), the range of indirect effects associated with the deposition of suspended sediments is predicted to extend to approximately

50km within a band of a few hundred metres in the direction of the tidal flow (north to south). This deposited sediment is likely to become rapidly incorporated into the existing mobile seabed sediment layer. The North Norfolk Sandbanks and Saturn Reef SCI and Inner Dowsing, Race Bank and North Ridge SCI lie outside the area of direct impact but within the area of suspended sediment deposition. Within the predicted deposition area, the deposited sediment layer is predicted to be generally less than 0.2mm with a maximum of 2mm in some locations. No LSE on the sandbank or *Sabellaria* features of the North Norfolk Sandbanks and Saturn Reef SCI is predicted in relation to a potential for up to 2mm of deposited sediment.

111. All other sites are beyond the range of any potential direct or indirect effects from Norfolk Vanguard.

Table 3.1: List of SACs in the southern North Sea with their respective categories of Annex 1 habitat interest feature and screening decisions (screened out sites are shown in grey).

Site Code	Country	SAC name	Category of interest feature	Distance* (km)	Screening decision	Reason for screening decision
BEMNZ0001	Belgium	Vlaamse Banken SAC	H1170 Reefs H1110 Sandbanks which are slightly covered by sea water all the time	138	Out	Beyond the range of potential impact
BEMNZ0005	Belgium	Vlakte Van de Raan SAC	H1110 Sandbanks which are slightly covered by sea water all the time	147	Out	Beyond the range of potential impact
FR3102002	France	Bancs Des Flandres SAC	H1110 Sandbanks which are slightly covered by sea water all the time	162	Out	Beyond the range of potential impact
FR3100474	France	Dunes De La Plaine Maritime Flamande SAC	H1110 Sandbanks which are slightly covered by sea water all the time H1140 Mudflats and sandflats not covered by seawater at low tide	185	Out	Beyond the range of potential impact
FR3100478	France	Falaises Du Cran Aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardingen et Dunes de Wissant SAC	H1110 Sandbanks which are slightly covered by sea water all the time H1140 Mudflats and sandflats not covered by seawater at low tide H1170 Reefs	217	Out	Beyond the range of potential impact
FR3100479	France	Falaises et Dunes de Wimereux, Estuaire de la Slack, Garennes et Communaux d'Ambleteuse-Audresselles SAC	H1130 Estuaries H1140 Mudflats and sandflats not covered by seawater at low tide H1170 Reefs	228	Out	Beyond the range of potential impact
FR3100477	France	Falaises et Pelouses du Cap Blanc Nez, du Mont d'Hubert, des Noires Mottes, du Fond de la Forge et du Mont de couple SAC	H1140 Mudflats and sandflats not covered by seawater at low tide H1170 Reefs	212	Out	Beyond the range of potential impact

Site Code	Country	SAC name	Category of interest feature	Distance* (km)	Screening decision	Reason for screening decision
FR3102003	France	Récifs Gris-Nez Blanc-Nez SAC	H1110 Sandbanks which are slightly covered by sea water all the time H1170 Reefs	209	Out	Beyond the range of potential impact
FR3102004	France	Ridens Et Dunes Hydrauliques Du Detroit Du Pas-De-Calais SAC	H1110 Sandbanks which are slightly covered by sea water all the time	217	Out	Beyond the range of potential impact
FR3102004	France	Ridens Et Dunes Hydrauliques Du Detroit Du Pas-De-Calais SAC	H1170 Reefs	217	Out	Beyond the range of potential impact
NL2008003	Netherlands	Vlakte Van de Raan SAC	H1110 Sandbanks which are slightly covered by sea water all the time	135	Out	Beyond the range of potential impact
NL1000001	Netherlands	Waddenzee SAC	H1110 Sandbanks which are slightly covered by sea water all the time H1130 Estuaries 1140 Mudflats and sandflats not covered by seawater at low tide	111	Out	Beyond the range of potential impact
NL9802001	Netherlands	Noordzeekustzone SAC	H1110 Sandbanks which are slightly covered by sea water all the time H1140 Mudflats and sandflats not covered by seawater at low tide	98	Out	Beyond the range of potential impact
NL2008001	Netherlands	Doggersbank SAC	H1110 Sandbanks which are slightly covered by sea water all the time	149	Out	Beyond the range of potential impact
NL4000017	Netherlands	Voordelta SAC	H1110 Sandbanks which are slightly covered by sea water all the time 1140 Mudflats and sandflats not covered by seawater at low tide	106	Out	Beyond the range of potential impact
UK0030076	UK	Alde, Ore and Butley Estuaries SAC	H1130 Estuaries H1140 Mudflats and sandflats not covered by seawater at low tide	68	Out	Beyond the range of potential impact
UK0030368	UK	Bassurelle Sandbank SAC	H1110 Sandbanks which are slightly covered	235	Out	Beyond the range of

Site Code	Country	SAC name	Category of interest feature	Distance* (km)	Screening decision	Reason for screening decision
			by sea water all the time			potential impact
UK0017072	UK	Berwickshire and North Northumberland Coast SAC	H1150 Coastal lagoons H8330 Submerged or partially submerged sea caves	341	Out	Beyond the range of potential impact
UK0030357	UK	Braemar Pockmarks SAC	H1180 Submarine structures made by leaking gases	663	Out	Beyond the range of potential impact
UK0013690	UK	Essex Estuaries SAC	H1130 Estuaries H1140 Mudflats and sandflats not covered by seawater at low tide	114	Out	Beyond the range of potential impact
UK0013036	UK	Flamborough Head SAC	H8330 Submerged or partially submerged sea caves	199	Out	Beyond the range of potential impact
UK0013107	UK	Thanet Coast SAC	H1110 Sandbanks which are slightly covered by sea water all the time H1140 Mudflats and sandflats not covered by seawater at low tide H1170 Reefs	170	Out	Beyond the range of potential impact
UK0030369	UK	Haisborough, Hammond and Winterton SCI	H1110 Sandbanks which are slightly covered by sea water all the time H1170 Reefs	0	In	Overlaps with the offshore cable corridor
UK0030170	UK	Humber Estuary SAC	H1130 Estuaries H1140 Mudflats and sandflats not covered by seawater at low tide H1110 Sandbanks which are slightly covered by sea water all the time H1150 Coastal lagoons	104	Out	Beyond the range of potential impact
UK0030370	UK	Inner Dowsing, Race Bank and North Ridge SCI	H1110 Sandbanks which are slightly covered by sea water all the time H1170 Reefs	44	Out	The magnitude of any impact on the features of this site result is negligible and would result in no

Site Code	Country	SAC name	Category of interest feature	Distance* (km)	Screening decision	Reason for screening decision
						potential for LSE.
UK0030371	UK	Margate and Long Sands SCI	H1110 Sandbanks which are slightly covered by sea water all the time	99	Out	Beyond the range of potential impact
UK0030358	UK	North Norfolk Sandbanks and Saturn Reef SCI	H1110 Sandbanks which are slightly covered by sea water all the time H1170 Reefs	2	Out	The magnitude of any impact on the features of this site result is negligible and would result in no potential for LSE.
UK0014780	UK	Orfordness - Shingle Street SAC	H1150 Coastal lagoons	70	Out	Beyond the range of potential impact
UK0030354	UK	Scanner Pockmark SAC	H1180 Submarine structures made by leaking gases	591	Out	Beyond the range of potential impact
UK0017075	UK	The Wash and North Norfolk Coast SAC	H1110 Sandbanks which are slightly covered by sea water all the time H1140 Mudflats and sandflats not covered by seawater at low tide H1160 Large shallow inlets and bays	26	Out	Beyond the range of potential impact

* Distance measured from the closest point of Norfolk Vanguard offshore project area to the closest point of the SAC site rounded to the nearest kilometre

4 SCREENING FISH SAC SITES AND FEATURES

4.1 Identification of Fish Sites and Features

112. Natura 2000 sites in the southern North Sea, which have migratory fish species as an interest feature, are considered for HRA Screening. Table 4.1 provides the list of sites considered for screening.

4.2 Approach to Screening

113. The sites which could potentially be affected by the proposed project will be screened in to the HRA on the basis of the following:
- A component of the proposed project directly overlaps a site whose interest features includes a species of fish.
 - The distance between the proposed project and a site with a fish interest feature is within the range for which there could be an interaction e.g. the pathway is not too long for sediment deposition.
 - The distance between the proposed project and resources on which the interest feature depends (i.e. an indirect effect acting through prey or access to habitat) is within the range for which there could be an interaction i.e. the pathway is not too long.
 - The likelihood that a foraging area or a migratory route occurs within the zone of interaction of the proposed project.
114. The key factors that will be applied during the HRA screening process are:
- Potential effects (source); and
 - Proximity of source to feature (distance between the proposed development and SACs, migration routes) (pathway and receptor).

4.2.1 Potential effects (source)

115. Example conservation objectives for sites with migratory fish are listed below based on the Humber Estuary SAC (Natural England undated):
- Avoid the deterioration of the qualifying natural habitats and the habitats of qualifying species, and the significant disturbance of those qualifying species, ensuring the integrity of the site is maintained and the site makes a full contribution to achieving Favourable Conservation Status of each of the qualifying features.
 - Subject to natural change, to maintain or restore:
 - The extent and distribution of qualifying natural habitats and habitats of qualifying species;

- The structure and function (including typical species) of qualifying natural habitats and habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and habitats of qualifying species rely;
- The populations of qualifying species; and
- The distribution of qualifying species within the site.

116. The key effects of development on migratory fish comprise the following:

- Construction
 - Temporary physical disturbance;
 - Smothering due to increased suspended sediment;
 - Re-mobilisation of contaminated sediments; and
 - Underwater noise and vibration.
- Operation
 - Permanent habitat loss;
 - Physical disturbance through maintenance activities;
 - Smothering through increased suspended sediment;
 - Introduction of new substrate/ fish aggregation;
 - Underwater noise and vibration; and
 - Electromagnetic fields (EMF).
- Decommissioning
 - Temporary physical disturbance;
 - Smothering due to increased suspended sediment; and
 - Underwater noise and vibration.

4.2.2 Proximity of source to feature (pathway)

117. Direct impacts associated with Norfolk Vanguard (e.g. from loss of habitat, physical disturbance and potential smothering) will be localised to Norfolk Vanguard. As discussed in Section 3.2.2, based on the draft Marine Physical Process impact assessment, there is a potential for 0.2 to 2mm of deposited sediment to a distance of approximately 50km within a band of a few hundred metres in the direction of the tidal flow (north to south).
118. Based on underwater noise modelling of potential fish disturbance impact ranges associated with pile driving, all sites greater than 50km from Norfolk Vanguard are proposed to be screened out of the HRA.

119. Consideration is also given to the potential for migratory fish associated with SACs and Ramsar sites to be present in the waters in and around Norfolk Vanguard.

4.2.3 Annex 2 fish species (receptor)

120. Atlantic salmon, allis shad, twaite shad, and sea lamprey migrate through or spend time in the North Sea at particular stages through their lifecycle. Subject to the location and distance from Norfolk Vanguard, these species could potentially be indirectly affected by the effects identified above, during the construction, operation, or decommissioning of the proposed project. Brook lamprey are fully estuarine or freshwater species and do not undertake migration through marine waters and therefore no pathway exists for impact upon designated populations of this species.
121. The nearest SAC/SCI designated for Annex II fish features (Noordzeekustzone SAC in The Netherlands) is located 98km from Norfolk Vanguard. Given the distance of the sites listed in Table 4.1, from Norfolk Vanguard and the potential impact ranges discussed in Section 4.2.2, it is considered that there will be no pathway for impacts upon the supporting habitats and processes of any sites designated for migratory fish.
122. There is potential for migratory fish to be present in the waters in and around the proposed project to be affected by the effects listed above. However, given the distances to designated sites and to the coast from Norfolk Vanguard, it is considered that there would be no significant barrier effects to migratory fish reaching the designated sites and therefore no potential LSE.

4.3 Screening

123. Table 4.1 provides a list of 13 sites for which there is theoretical connectivity to Norfolk Vanguard for fish receptors, as outlined in Section 4.1. Based on the approach outlined in Section 4.2, it was concluded that there is no potential for LSE from Norfolk Vanguard for any of the sites considered and therefore it is proposed that these will not be considered further in the HRA.

Table 4.1 List of SACs in the southern North Sea with their respective Annex 2 migratory fish species interest feature and screening decisions (screened out sites are shown in grey).

Site Code	Country	SAC name	Category of interest feature	Distance* (km)	Screening decision	Reason for screening decision
BEMNZ0001	Belgium	Vlaamse Benken SAC	1095 Sea Lamprey 1103 Twaite Shad*	138	Out	The distance between the proposed project and the site is beyond that of potential impacts on the fish features or the supporting habitat and processes and no barrier impacts are predicted.
BEMNZ0005	Belgium	Vlakte Van der Raan SCI	1095 Sea Lamprey 1099 River lamprey* 1103 Twaite Shad*	147	Out	
FR3102005	France	Baie De Canche et Couloir Des Trois Estuaires SAC	1106 Salmon 1095 Sea Lamprey 1099 River lamprey 1102 Allis Shads	254	Out	
FR2200346	France	Estuaires et littoral Picards SAC	1099 River lamprey	275	Out	
FR3100479	France	Falaises et Dunes de Wimereux, Estuaire de la Slack, Garennes et Communaux d'Ambleteuse-Audresselles SAC	1099 River lamprey	228	Out	
DE2104301	Germany	Borkum-Riffgrund (Borkum Reef Ground) SCI	1103 Twaite Shad	234	Out	
DE1209301	Germany	Sylter Außenriff (Sylt Outer Reef) SAC	1099 River lamprey* 1103 Twaite Shad	311	Out	
NL9802001	Netherlands	Noordzeekustzone SAC	1095 Sea Lamprey 1102 Allis Shad 1103 Twaite Shad	98	Out	
NL2008003	Netherlands	Vlakte Van der Raan SAC	1103 Twaite Shad*	135	Out	
NL4000017	Netherlands	Voordelta SAC	1095 Sea Lamprey 1099 River lamprey 1102 Allis Shad 1103 Twaite Shad	106	Out	
NL9803061	Netherlands	Westerschelde SAC	1099 River lamprey* 1103 Twaite Shad*	141	Out	

Site Code	Country	SAC name	Category of interest feature	Distance [*] (km)	Screening decision	Reason for screening decision
UK0030170	UK	Humber Estuary SAC	1095 Sea Lamprey** 1099 River lamprey**	104	Out	
UK0030253	UK	River Derwent SAC	1099 River lamprey*	234	Out	

* Distance measured from the closest point of Norfolk Vanguard OWF sites to the closest point of the SAC site rounded to the nearest kilometre

5 SCREENING SPA SITES AND FEATURES

5.1 Identification of Ornithology Sites and Features

124. SPA and Ramsar sites around the North Sea basin, in the northern North Sea and around the coast of the British Isles for which there is the potential for connectivity are considered for HRA Screening (see Table 5.1).

5.2 Approach to Screening

125. Following the same principles as used in assessments for previous developments such as East Anglia ONE and East Anglia THREE (APEM 2012, EAOL 2013, Planning Inspectorate 2013, DECC 2014), SPAs and Ramsar sites will be screened related to birds potentially affected by the offshore components of the proposed project as follows:
- A component of the proposed project directly overlaps a site whose interest features includes a species of bird (applies to SPAs and Ramsar sites).
 - The distance between the proposed project and a site with a bird interest feature is within the range for which there could be an interaction. For seabirds in the breeding season this element of the screening process will be informed by published information on maximum foraging range (especially the data presented in Thaxter *et al.*, 2012a).
 - Assessment of species-specific risk which informs the extent to which populations of particular species may be vulnerable to collision mortality, displacement or barrier effects (Garthe & Hüppop 2004, Cook *et al.* 2012, Furness *et al.* 2013, Bradbury *et al.* 2014).
 - The distance between the proposed project and resources on which the interest feature depends (i.e. an indirect effect acting through prey or access to habitat) is within the range for which there could be an interaction i.e. the pathway is not too long (applies to SPAs and Ramsar sites).
 - Evidence that a migratory route passes through the proposed project wind turbine array for bird species migrating to and / or from protected sites (applies to SPAs and Ramsar sites). This will be informed by published information on migration routes, principally Wright *et al.* (2012), but also Wernham *et al.* (2002), Brown and Grice (2005) and Furness (2015).

5.2.1 Potential effects (source)

126. The following potential effects, related to specific stages of the offshore components of the Project, will be considered in the HRA process.
- Construction

- Disturbance / displacement; and
- Indirect impacts through effects on habitats and prey species.
- Operation
 - Disturbance / displacement (e.g. see Schwemmer *et al.* 2011, Dierschke *et al.* 2016);
 - Indirect impacts through effects on habitats and prey species (e.g. see Carter *et al.* 2017);
 - Collision risk (e.g. Band 2000, 2012); and
 - Barrier effect (e.g. see Carter *et al.* 2017).
- Decommissioning
 - Disturbance / displacement; and
 - Indirect impacts through effects on habitats and prey species.

5.2.2 Proximity of source to receptors/ pathway for effect

5.2.2.1 Migratory birds and transboundary considerations

127. Many SPA sites within the UK and in neighbouring Member States can be screened out of HRA because there is no connectivity between the SPA site and the proposed project area in terms of populations of birds that are features of the SPAs. Therefore, LSE can be ruled out. This applies to most SPAs that are distant from the proposed project. However, some bird species are highly mobile and may interact with projects because they range over considerable distances. This applies especially to seabirds.
128. Migratory birds may move into areas where there are projects and so may interact during their migration. From an initial consideration of all SPAs in the UK and in neighbouring Member States that were listed in APEM and Royal HaskoningDHV (2014), we have scoped out those for which connectivity with the proposed East Anglia THREE project can be ruled out or assessed as negligible. This applies to most of the SPAs in those territories, including all SPAs in Member States on the European mainland designated for coastal birds / waterbirds / seabirds (Table 5.1).
129. Birds of some species that are SPA features, such as shorebirds, may migrate from the mainland of Europe to eastern England (for example from SPAs in Netherlands to the Wash or Thames estuaries) so these birds need to be considered. Migrating shorebirds and other coastal birds tend to fly high when weather conditions are favourable for migration, and normally set off on a migratory flight under such weather conditions, and so are rarely recorded to be collision victims at offshore wind farms, where passerines are the group most at risk of collision (Hüppop *et al.* 2006). Indeed, Hüppop *et al.* (2006) reported that only six out of 442 collision carcasses in their study were non-passerine birds. Assessments of collision risk of

migrating coastal birds at offshore wind farms in UK waters also indicate that risk is low and for most species does not represent a hazard that would require HRA assessment (Wright *et al.* 2012; WWT 2013).

130. The Netherlands Ministry of Infrastructure and the Environment stated in a letter of 7 July 2014 that they had a concern that the proposed projects in the East Anglia zone could have an effect on the seabirds of Bruine Bank pSPA. The non-breeding seabirds that are the interest feature of the Bruine Bank (Brown Ridge) pSPA are primarily auks. An assessment of potential impacts on auks has been conducted as part of the East Anglia THREE EIA (MacArthur Green 2015, sections 13.7.1.1 and 13.7.2.1) in relation to construction and operational disturbance and displacement. In all cases impacts were found to be minor or negligible (based on BDMPS populations in UK North Sea waters, Furness 2015). Assessment of impacts over the whole North Sea (i.e. including non UK waters) would greatly increase the estimated seabird population sizes and only slightly increase cumulative impacts (because most offshore wind farms are in UK waters). Accordingly a likely significant effect on the Bruine Bank (Brown Ridge) pSPA can be screened out.
131. The Netherlands Ministry of Infrastructure and the Environment also stated in their letter of 7 July 2014 'on-shore bird colonies in the Netherlands are all situated more than 100km from the Dutch-UK border, so no effects are to be expected there'. We agree with that interpretation (with one exception discussed below), particularly since the seabirds that breed in the Netherlands are predominantly species with coastal and relatively short foraging ranges, such as terns, cormorants and gulls, and there is no evidence that breeding birds from those populations cross into the UK while they are breeding. However, lesser black-backed gulls breed in large numbers in The Netherlands. Between 32,000 and 57,000 pairs were estimated to breed in The Netherlands in 1992-97 (Mitchell *et al.* 2004) and the numbers subsequently increased to a peak of over 90,000 pairs in 2005 (Camphuysen 2013). With a maximum foraging range of 181km from breeding colonies (Thaxter *et al.* 2012a), there is theoretical potential for connectivity between some colonies in The Netherlands and Norfolk Vanguard. However, extensive colour ringing and tracking of breeding lesser black-backed gulls from multiple colonies in The Netherlands has found no evidence for connectivity during the breeding season between birds breeding in those colonies and the UK, and also that there is remarkably little migration of birds from the colonies in The Netherlands through UK waters outside the breeding season (Camphuysen 2013). Not only do breeding adult lesser black-backed gulls from colonies in The Netherlands normally remain on the continental side of the North Sea while breeding, but 95% of their foraging trips are less than 135km from those colonies (Camphuysen 1995, 2013), so would be very unlikely to

reach Norfolk Vanguard. These studies therefore rule out any transboundary impacts of Norfolk Vanguard on any of these breeding lesser black-backed gull populations.

132. Similarly, impacts on seabird breeding populations in Germany, Belgium and France can be screened out due to the distance of colonies in those countries from the proposed project (Table 5.1), which, with two exceptions discussed in the next paragraph, exceeds maximum foraging ranges of breeding seabirds (Thaxter *et al.* 2012a).
133. There are breeding gannets at colonies where Norfolk Vanguard lies within the reported maximum foraging range of breeding gannets (590km, Thaxter *et al.* 2012a). These colonies are at Seevogelschutzgebiet Helgoland SPA (Germany) and Littoral Seino-Marin SPA (France). However, tracking studies of breeding adults at each of these colonies show that birds from those colonies do not travel into Norfolk Vanguard but forage relatively close to their breeding colonies (Stefan Garthe, pers. comm., Wakefield *et al.* 2013).
134. Therefore, no trans-boundary issues are screened in to this assessment.

5.2.3 Receptors

135. Based on the data collected from site specific surveys for Norfolk Vanguard and a review of existing data sources, the bird species likely to occur in Norfolk Vanguard can be grouped into a series of categories for this high level screening process. This categorisation is based on biological relationships related to breeding biology, feeding, habitat use and migratory pathways. The categories are:

- Breeding seabirds;
- Breeding waterbirds;
- Non-breeding seabirds
- Passage waterbirds; and
- Wintering waterbirds.

5.3 Screening

136. Table 5.1 provides a list of SPAs and Ramsar sites in the North Sea and around the British Isles, along with whether they are proposed to be screened in or out based on whether LSE is deemed to be possible (summarised in Table 5.1 and discussed where relevant in greater detail in paragraphs 137 to 140).

Table 5.1: List of SPA and Ramsar sites with their respective categories of bird interest feature and screening decisions (screened out sites are shown in grey)

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
#N/A	Netherlands	Bruine Bank (Brown Ridge) pSPA	Non-breeding seabirds	c. 20 (estimate as no detailed maps available)	Out	Migrations of birds from this SPA are likely to result in negligible numbers passing through Norfolk Vanguard during migration relative to the size of BDMPS regional populations.
UK9020309	UK	Outer Thames Estuary SPA and pSPA extension	Wintering marine birds and breeding terns	21	Out	SPA is beyond maximum foraging range of designated breeding seabird species (terns) and tern foraging tends to be coastal so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are likely to be small as these species are thought to remain close to shore during much of their migration through UK waters. Migrations of non-breeding seabirds from this pSPA are likely to result in only very small numbers passing through the site during migration, as the migration of divers and sea ducks from SE England tends to be to German Bight and northeastwards to breeding areas, and not therefore in the direction of Norfolk Vanguard.
	UK	Greater Wash pSPA	Non-breeding seabirds and breeding terns	c. 35 (estimate as no detailed maps available)	IN	SPA is beyond maximum foraging range of designated seabird species (terns) and tern foraging tends to be coastal so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are likely to be small as these species are thought to remain close to shore during much of their migration through UK waters. Migrations of non-breeding seabirds from this pSPA are likely to result in small numbers passing through the site during migration, but given the proximity of the site to this pSPA further more detailed assessment of that is appropriate.
UK9009271	UK	Great Yarmouth and North Denes SPA	Breeding seabirds	49	Out	SPA is beyond maximum foraging range of designated seabird species (little tern) and little tern foraging tends to be coastal so has no breeding season connectivity. Proportions of this populations migrating through Norfolk Vanguard are likely to be small as the species is thought to remain close to shore during much of its migration through UK waters.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
UK9009181	UK	Breydon Water SPA and Ramsar	Wintering and passage waterbirds	53	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009253	UK	Broadland SPA and Ramsar	Wintering and passage waterbirds	53	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009101	UK	Minsmere - Walberswick SPA and Ramsar	Breeding, wintering and passage waterbirds	75	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009031	UK	North Norfolk Coast SPA and Ramsar	Wintering and passage waterbirds	80	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009112	UK	Alde-Ore Estuary SPA and Ramsar	Breeding seabirds and breeding, wintering and passage waterbirds	92	IN	Lesser black-backed gull and herring gull populations may have connectivity with Norfolk Vanguard. This SPA holds the closest large colony of these species to Norfolk Vanguard, and some birds from that SPA may pass through Norfolk Vanguard during migration.
#N/A	Netherlands	Frisian Front pSPA	Non-breeding seabirds	c. 100	Out	Migrations of birds from this SPA are likely to result in negligible numbers passing through Norfolk Vanguard during migration relative to the size of BDMPS regional populations.
NL4000017	NL	Voordelta SPA	Wintering and passage waterbirds	106	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009261	UK	Deben Estuary SPA and Ramsar	Wintering and passage waterbirds	107	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
NL9801001	NL	Waddenzee (Wadden Sea) SPA	Wintering and passage waterbirds	111	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
UK9009121	UK	Stour & Orwell Estuaries SPA and Ramsar	Wintering and passage waterbirds	119	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9008021	UK	The Wash SPA and Ramsar	Wintering and passage waterbirds	120	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009131	UK	Hamford Water SPA and Ramsar	Wintering and passage waterbirds	127	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9008022	UK	Gibraltar Point SPA and Ramsar	Wintering and passage waterbirds	133	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009243	UK	Colne Estuary SPA and Ramsar	Wintering and passage waterbirds	144	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK0030170	UK	Humber Estuary SPA and Ramsar	Wintering and passage waterbirds	149	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009141	UK	Abberton Reservoir SPA and Ramsar	Wintering and passage waterbirds	150	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009245	UK	Blackwater Estuary SPA and Ramsar	Wintering and passage waterbirds	152	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
BEMNZ0004	Belgium	SBZ 3 / ZPS 3[GK9] (off Molenhoek)	Non-breeding seabirds	153	Out	Migrations of birds from this SPA are likely to result in negligible numbers passing through Norfolk Vanguard during migration relative to the size of BDMPS regional populations.
UK9009242	UK	Dengie SPA and Ramsar	Wintering and passage waterbirds	155	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
BEMNZ0003	Belgium	SBZ 2 / ZPS 2 (off Ostend)	Non-breeding seabirds	156	Out	Migrations of birds from this SPA are likely to result in negligible numbers passing through Norfolk Vanguard during migration relative to the size of BDMPS regional populations.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
UK9009246	UK	Foulness SPA and Ramsar	Wintering and passage waterbirds	158	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009244	UK	Crouch & Roach Estuaries SPA and Ramsar	Wintering and passage waterbirds	167	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
BEMNZ0002	Belgium	SBZ 1 / ZPS 1 (off Nieuwpoort)	Non-breeding seabirds	170	Out	Migrations of birds from this SPA are likely to result in negligible numbers passing through Norfolk Vanguard during migration relative to the size of BDMPS regional populations.
UK9012071	UK	Thanet Coast and Sandwich Bay SPA and Ramsar	Wintering and passage waterbirds	171	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9009171	UK	Benfleet & Southend Marshes SPA and Ramsar	Wintering and passage waterbirds	182	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9012011	UK	The Swale SPA	Wintering and passage waterbirds	187	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9012021	UK	Thames Estuary and Marshes SPA and Ramsar	Wintering and passage waterbirds	188	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9012031	UK	Medway Estuary & Marshes SPA and Ramsar	Wintering and passage waterbirds	190	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9006171	UK	Hornsea Mere SPA	Wintering and passage waterbirds	197	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
	UK	Flamborough and Filey Coast pSPA	Breeding seabirds	c. 200	IN	Uncertain proportions of the kittiwake, gannet, common guillemot, razorbill and puffin populations most likely migrate through Norfolk Vanguard. Only gannet has potential for connectivity during the breeding season based on maximum foraging range but tracking data indicate no connectivity of breeding gannets.
DE2104301	Germany	Borkum-Riffgrund SPA	Non-breeding seabirds	234	Out	Migrations of birds from this SPA are likely to result in negligible numbers passing through Norfolk Vanguard during migration relative to the size of Biologically Defined Minimum Population Scale (BDMPS) regional populations.
UK9006061	UK	Teesmouth and Cleveland Coast SPA and Ramsar	Wintering and passage waterbirds	289	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9006131	UK	Northumbria Coast SPA and Ramsar	Wintering and passage waterbirds	308	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
DE1209301	Germany	Sylter Außenriff SPA	Non-breeding seabirds	311	Out	Migrations of birds from this SPA are likely to result in negligible numbers passing through Norfolk Vanguard during migration relative to the size of BDMPS regional populations.
UK9011011	UK	Chichester & Langstone Harbours SPA	Migratory waterbirds	313	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
FR2310045	France	Littoral Seine-Marine SPA	Breeding seabirds	315	Out	Norfolk Vanguard is within the theoretical maximum foraging range of breeding gannets from this SPA, but tracking data show that breeding gannets from the SPA do not reach Norfolk Vanguard. The SPA is far beyond maximum foraging range of other designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are likely to be extremely small relative to BDMPS.
UK9011051	UK	Portsmouth Harbour SPA	Migratory waterbirds	326	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
UK9011061	UK	Solent & Southampton Water SPA	Migratory waterbirds	331	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
DE1813491	Germany	Seevogelschutzgebiet Helgoland SPA	Breeding seabirds	343	Out	Tracking data from gannets breeding on Helgoland show these birds do not travel in the direction of or as far as Norfolk Vanguard despite this site being within theoretical maximum foraging range of gannet. The site is beyond the maximum foraging range of other seabird species at Helgoland. Proportions of these populations migrating through Norfolk Vanguard are likely to be very small relative to BDMPS regional populations.
DE1011401	Germany	Östliche Deutsche Bucht SPA	Non-breeding seabirds	345	Out	Migrations of birds from this SPA are likely to result in negligible numbers passing through Norfolk Vanguard during migration relative to the size of BDMPS regional populations.
DE0916491	Germany	Ramsar-Gebiet S-H Wattenmeer und angrenzende Küstengebiet e SPA	Breeding, wintering and passage waterbirds	365	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9006031	UK	Coquet Island SPA	Breeding seabirds	366	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9006021	UK	Farne Islands SPA	Breeding seabirds	393	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9006011	UK	Lindisfarne SPA and Ramsar	Wintering and passage waterbirds	398	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9010091	UK	Chesil Beach & The Fleet SPA	Migratory waterbirds	420	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
FR2502020	France	Baie de Seine Occidentale SPA	Breeding, wintering and passage waterbirds	429	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK0030281	UK	St Abbbs Head to Fast Castle SPA	Breeding seabirds	438	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
FR2510099	France	Falaise du Bessin Occidental SPA	Breeding seabirds	445	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9004411	UK	Firth of Forth SPA	Wintering and passage waterbirds	463	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9010081	UK	Exe Estuary SPA	Migratory waterbirds	470	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9004171	UK	Forth Islands SPA	Breeding seabirds	471	Out	Tracking data show breeding gannets from Bass Rock do not commute to Norfolk Vanguard although the site is just within maximum foraging range. Except for gannet, SPA is far beyond maximum foraging range of other designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9004451	UK	Imperial Dock Lock, Leith SPA	Breeding seabirds	491	Out	SPA is far beyond maximum foraging range of designated seabird species (common tern) so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9004121	UK	Firth of Tay & Eden Estuary SPA	Wintering and passage waterbirds	503	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9004031	UK	Montrose Basin SPA	Wintering and passage waterbirds	520	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
UK9002271	UK	Fowlsheugh SPA	Breeding seabirds	525	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002491	UK	Buchan Ness to Collieston Coast SPA	Breeding seabirds	556	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002221	UK	Ythan Estuary, Sands of Forvie and Meikle Loch SPA	Wintering and passage waterbirds	556	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9002211	UK	Loch of Strathbeg SPA	Wintering and passage waterbirds	581	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9002471	UK	Troup, Pennan and Lion's Heads SPA	Breeding seabirds	597	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9001625	UK	Moray and Nairn Coast SPA	Wintering and passage waterbirds	624	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9001624	UK	Inner Moray Firth SPA	Wintering and passage waterbirds	652	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9001623	UK	Cromarty Firth SPA	Wintering and passage waterbirds	664	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.
UK9001622	UK	Dornoch Firth and Loch Fleet SPA	Wintering and passage waterbirds	669	Out	Survey data show little or no evidence of SPA features occurring in Norfolk Vanguard and migrations of birds from this SPA are likely to result in negligible numbers passing through the site during migration.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
UK9001182	UK	East Caithness Cliffs SPA	Breeding seabirds	685	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9001181	UK	North Caithness Cliffs SPA	Breeding seabirds	708	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9001131	UK	Pentland Firth Islands SPA	Breeding seabirds	716	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002151	UK	Copinsay SPA	Breeding seabirds	725	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002141	UK	Hoy SPA	Breeding seabirds	733	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002431	UK	Calf of Eday SPA	Breeding seabirds	760	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002091	UK	Fair Isle SPA	Breeding seabirds	762	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002371	UK	Rousay SPA	Breeding seabirds	763	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
UK9002121	UK	Marwick Head SPA	Breeding seabirds	767	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002101	UK	West Westray SPA	Breeding seabirds	773	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002111	UK	Papa Westray (North Hill and Holm) SPA	Breeding seabirds	778	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002511	UK	Sumburgh Head SPA	Breeding seabirds	791	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002361	UK	Mousa SPA	Breeding seabirds	807	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002081	UK	Noss SPA	Breeding seabirds	816	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002061	UK	Foula SPA	Breeding seabirds	833	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002051	UK	Papa Stour SPA	Breeding seabirds	851	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.

Site code	Country	SPA/ Ramsar site name	Category of interest feature	Distance (km)*	Screening decision	Reason for screening decision
UK9002031	UK	Fetlar SPA	Breeding seabirds	859	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002041	UK	Ronas Hill - North Roe and Tingon SPA	Breeding seabirds	866	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.
UK9002011	UK	Hermaness, Saxa Vord and Valla Field SPA	Breeding seabirds	881	Out	SPA is far beyond maximum foraging range of designated seabird species so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are small relative to BDMPS.

*Distance measured from the closest point of Norfolk Vanguard OWF sites (i.e. the wind turbine array) to the closest point of the SPA site rounded to the nearest kilometre

137. Many protected sites can be scoped out as having negligible connectivity with Norfolk Vanguard. Three sites were scoped in for further detailed assessment: Alde-Ore Estuary SPA, Flamborough & Filey pSPA and Greater Wash pSPA.
138. Thaxter *et al.* (2012a) report a maximum foraging range of 181km for lesser black-backed gull, a mean maximum across studies of 141km and a mean foraging range of 71.9km. The Alde-Ore Estuary SPA is a minimum of 92km from Norfolk Vanguard, so is beyond the mean foraging range but well within the maximum foraging range of this species, so some breeding birds from the Alde-Ore Estuary SPA may forage within Norfolk Vanguard. Thaxter *et al.* (2012a) report a maximum foraging range of 92km for herring gull, a mean maximum across studies of 61.1km and a mean foraging range of 10.5km. Therefore, it is unlikely that any herring gulls breeding at the Alde-Ore Estuary SPA forage within Norfolk Vanguard during the breeding season. Further consideration therefore needs to focus on evidence regarding the foraging of lesser black-backed gulls from the Alde-Ore Estuary SPA, especially in relation to tracking work (Thaxter *et al.* 2012b, 2015), and the extent to which connectivity with Norfolk Vanguard may occur.
139. The Flamborough and Filey Coast pSPA is a minimum of 200km from Norfolk Vanguard. Thaxter *et al.* (2012a) report a maximum foraging range of breeding gannets as 590km, puffins as 200km, common guillemots as 135km, kittiwakes as 120km, and razorbills as 95km. RSPB tracking data from gannets breeding at Flamborough and Filey Coast pSPA suggest low connectivity with Norfolk Vanguard (RSPB 2012). However, Carroll *et al.* (2017) present tracking data from breeding kittiwakes at Flamborough and Filey Coast pSPA showing that these birds may travel particularly far out into the Dogger Bank area to forage while breeding. Therefore, Flamborough and Filey Coast pSPA is potentially within the maximum foraging range of gannet from that pSPA. Some of the birds from that colony are also likely to pass through Norfolk Vanguard during migrations. Assessed impacts on these populations need also to consider the conservation status of the designated populations (e.g. increases in gannet numbers (Trinder 2012, WWT 2012, Murray *et al.* 2015) but declines in kittiwake and many other seabird breeding numbers, and other factors driving population change, such as breeding success (Coulson 2017), and the influences on this of changes in fish stocks and fisheries (ICES 2013, Carroll *et al.* 2017), and winter distributions of birds (Frederiksen *et al.* 2012).
140. The Greater Wash pSPA is approximately 35km from Norfolk Vanguard. Although this is less than the mean max foraging range of Sandwich tern, the breeding colonies themselves (already designated as North Norfolk Coast SPA) are beyond foraging range of Norfolk Vanguard. This means that there will be little or no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are likely to be small as these species are thought to remain close

to shore during much of their migration through UK waters. Migrations of non-breeding seabirds (red-throated divers, little gulls and common scoters; Lawson *et al.* 2016) from this pSPA are likely to result in small numbers passing through the site during migration, but given the proximity of the site to this pSPA further more detailed assessment of that is appropriate.

6 OVERALL SUMMARY

141. Following the screening process, seven sites will be considered further within the HRA to determine any LSE.
142. Three sites will be considered for marine mammals:
 - Southern North Sea cSAC will be further assessed for harbour porpoise, as Norfolk Vanguard lies within the footprint of the cSAC;
 - Humber Estuary SAC will be further assessed for grey seal as there is potential for vessel interactions if a port to the north of Norfolk Vanguard is selected; and
 - Wash and North Norfolk Coast SAC will be further assessed for harbour seal, as there is potential for vessel interactions if a port to the north of Norfolk Vanguard is selected.
143. One site will be considered for benthic:
 - Haisborough, Hammond and Winterton SCI will be further assessed for Sandbanks which are slightly covered by sea water all the time and Reefs, as it overlaps with the cable corridor.
144. Three sites will be considered further for birds:
 - Greater Wash pSPA will be further assessed for non breeding seabirds and breeding terns. The SPA is beyond maximum foraging range of designated seabird species (terns) and tern foraging tends to be coastal so has no breeding season connectivity. Proportions of these populations migrating through Norfolk Vanguard are likely to be small as these species are thought to remain close to shore during much of their migration through UK waters. Migrations of non-breeding seabirds from this pSPA are likely to result in small numbers passing through the site during migration, but given the proximity of the site to this pSPA further more detailed assessment of that is appropriate;
 - Alde-Ore Estuary SPA and Ramsar will be further assessed for Breeding seabirds and breeding, wintering and passage waterbirds. Lesser black-backed gull and herring gull populations may have connectivity with Norfolk Vanguard. This SPA holds the closest large colony of these species to Norfolk Vanguard, and some birds from that SPA may pass through Norfolk Vanguard during migration; and
 - Flamborough and Filey Coast pSPA will be further assessed for breeding seabirds. Uncertain proportions of the kittiwake, gannet, common guillemot, razorbill and

puffin populations most likely migrate through Norfolk Vanguard. Only gannet has potential for connectivity during the breeding season based on maximum foraging range but tracking data indicate no connectivity of breeding gannets.

145. No sites will be considered further for impacts to designated fish features as there will be no connectivity.

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