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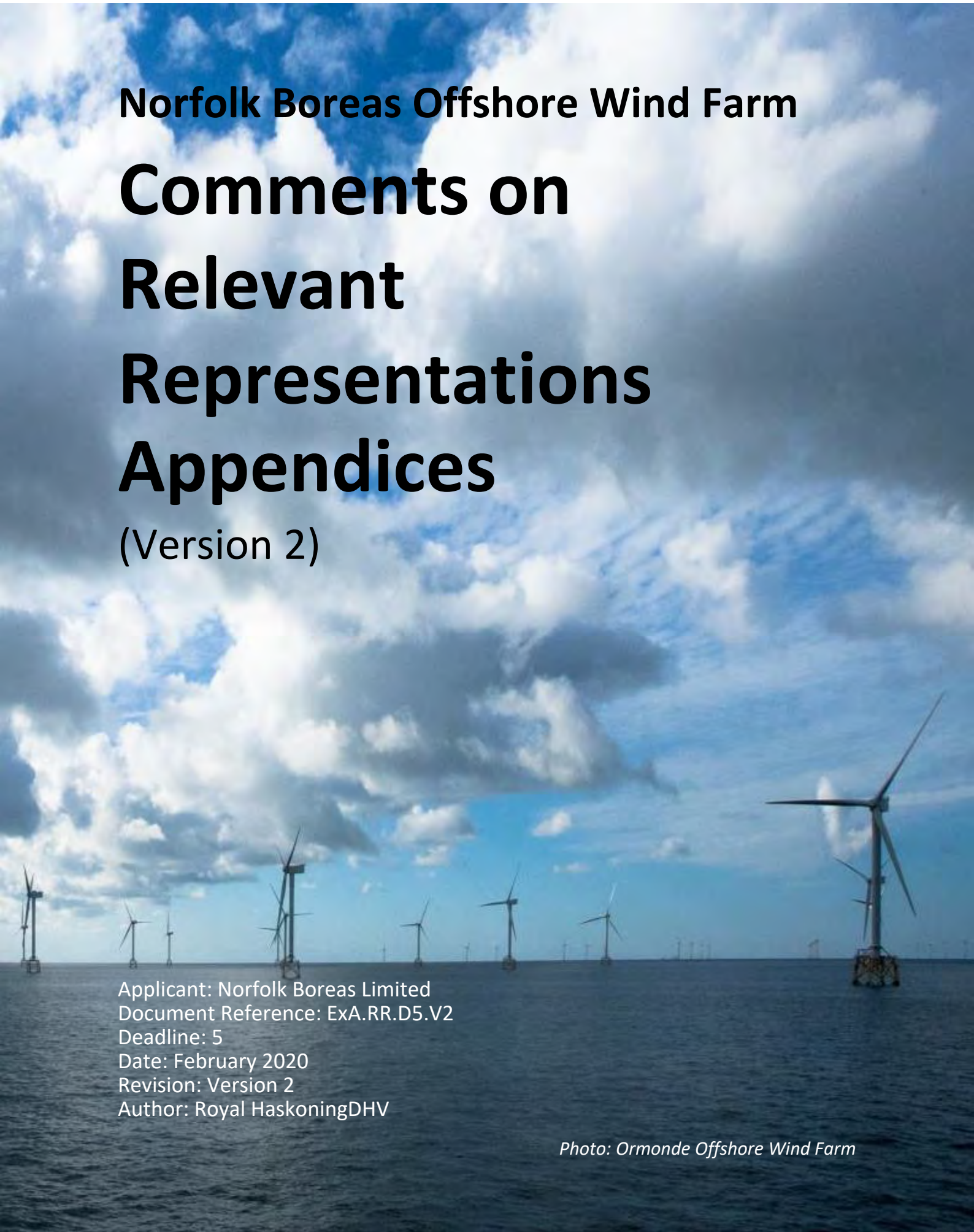
Norfolk Boreas Offshore Wind Farm

Comments on Relevant Representations Appendices

(Version 2)



Applicant: Norfolk Boreas Limited
Document Reference: ExA.RR.D5.V2
Deadline: 5
Date: February 2020
Revision: Version 2
Author: Royal HaskoningDHV

Photo: Ormonde Offshore Wind Farm

This document contains the Appendices to the Comments on Relevant Representations document comprising the following:

- Appendix 1 Vattenfall Project Information Sheets
- Appendix 2 Norfolk Vanguard Onshore Ecology Clarification Notes
- Appendix 3 Norfolk Vanguard Limited and Marine Management Organisation Joint Position Statement - Arbitration and Appeal Mechanisms
- Appendix 4 Integrated Offshore Transmission Project Conclusions and Recommendations

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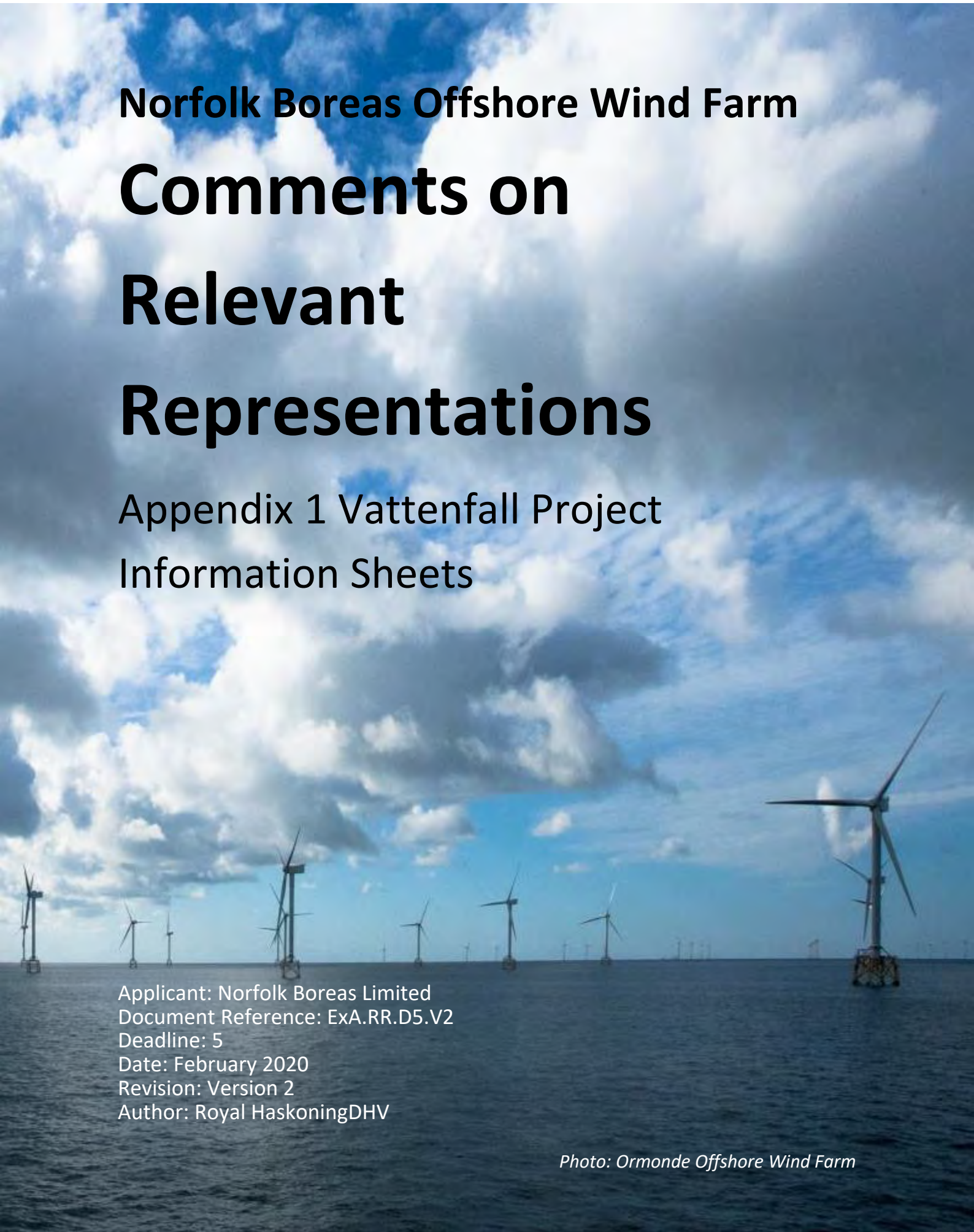
Norfolk Boreas Offshore Wind Farm

Comments on Relevant Representations

Appendix 1 Vattenfall Project Information Sheets



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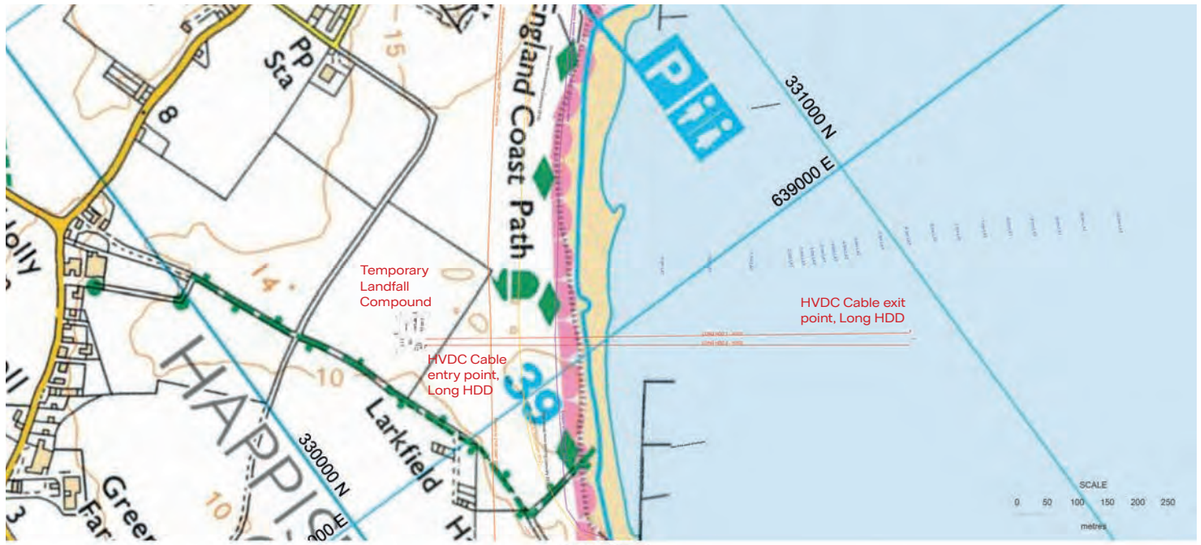
Appendix 1 Vattenfall Project Information Sheets

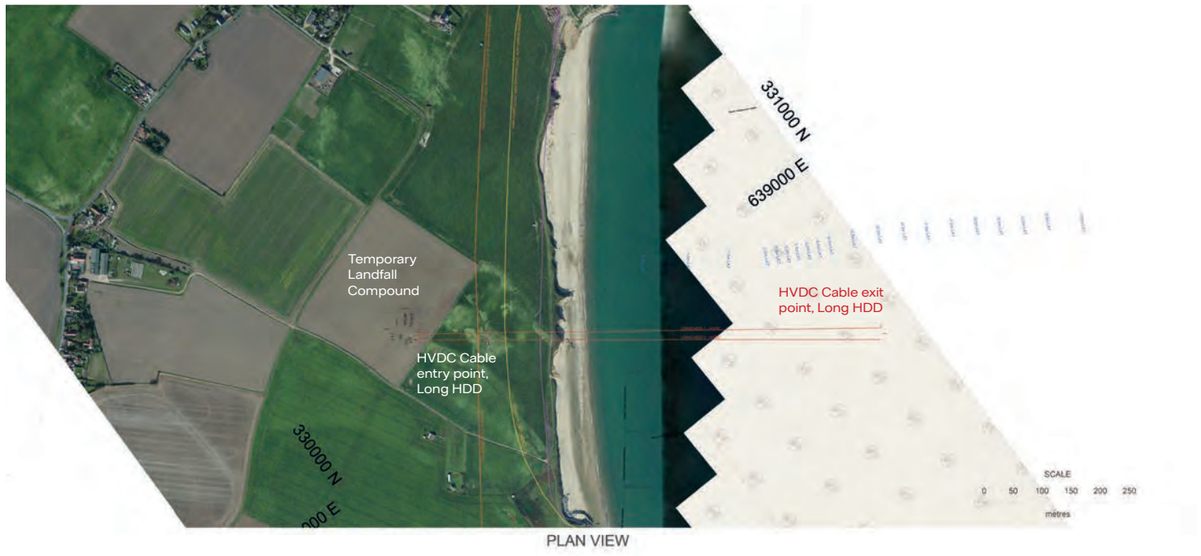
This appendix contains the following documents:

- Landfall Information sheet
- Onshore Cable Route Information sheet
- Onshore Project Substation Information sheet
- Vattenfall EMF Information sheet
- Vattenfall and Ørsted EMF Information sheet

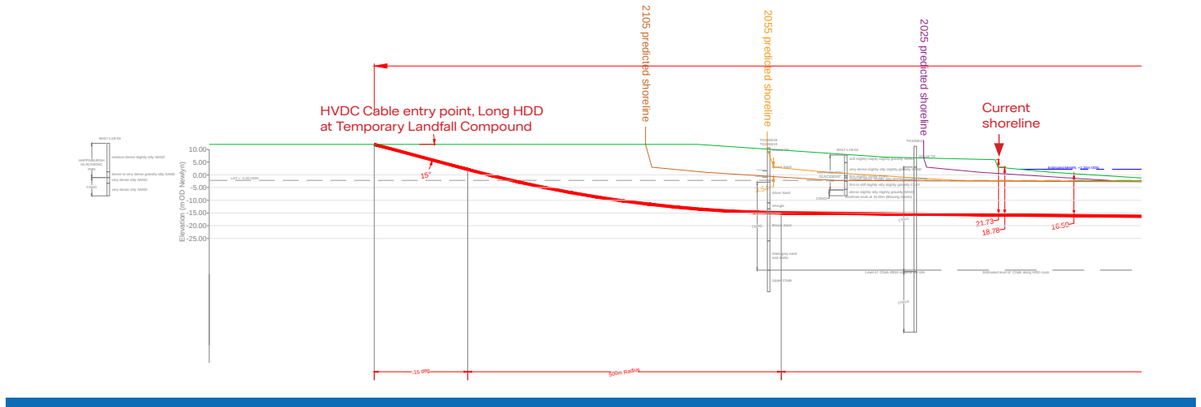
Indicative Landfall cross sections



PLAN VIEW



PLAN VIEW



Geological Cross section based on site investigation drilling at Happisburgh in Summer 2017. The Cromer Forest Bed was not encountered in these bore holes.

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Landfall

Autumn 2018

What is landfall?

Landfall is the location along the project cable route where the offshore transmission cables carrying power from the wind turbines are brought ashore and link to the onshore cables. Following an extensive site selection process[1], the landfall for Norfolk Vanguard and Norfolk Boreas will be south of Happisburgh.

Summary Information:

Location – South of Happisburgh

Timescale – 20 weeks duct installation, currently predicted to occur in 2024/25. Up to 16 weeks cable installation (up to two phases 2026/27)

Access to landfall compound – using temporary running track from the junction of the onshore cable route with Whimpwell Street

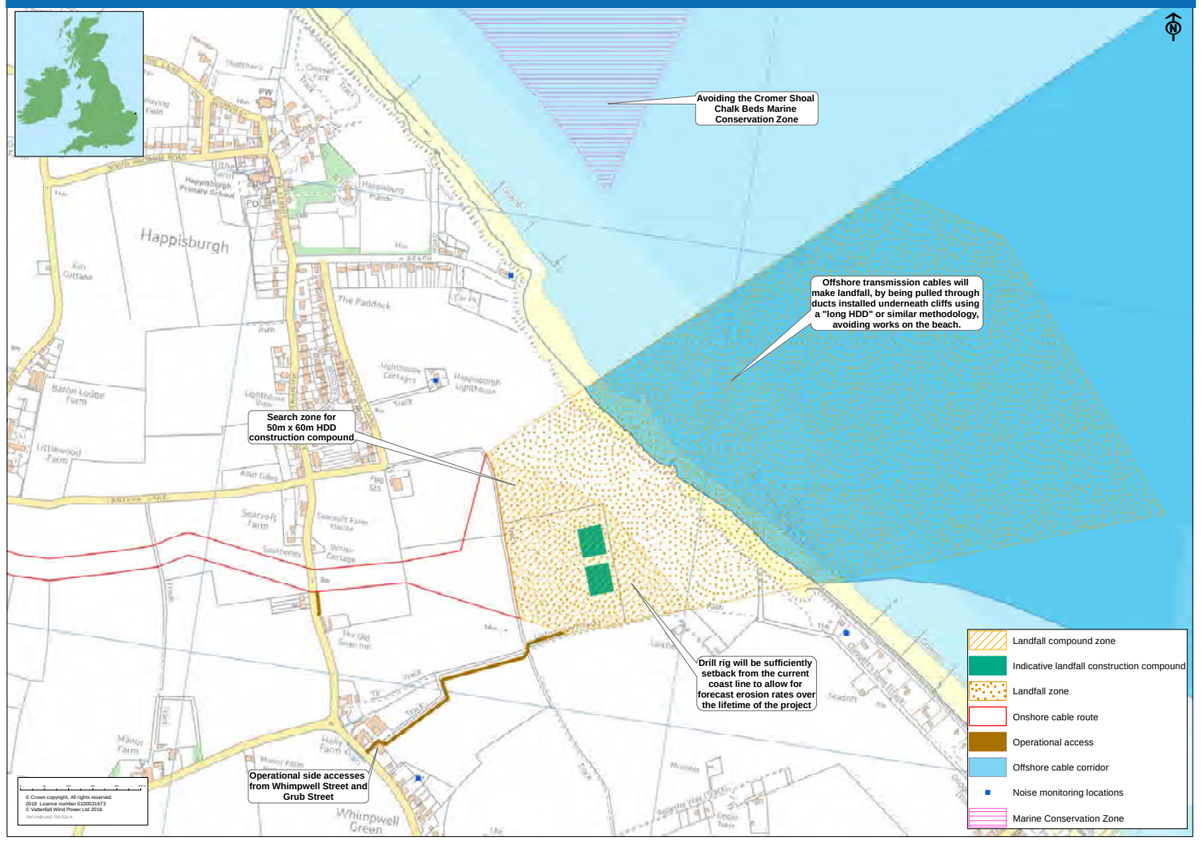
Traffic – Approximately 3 HGVs per hour in the first and last week to allow for site setup and demobilisation, reducing to 0.3 HGV's per hour for the remaining 18 weeks. Approximately 10-20 personnel.

Example Horizontal Directional Drilling (HDD) Rig

Activity	Year					
	2023	2024	2025	2026	2027	2028
Landfall						
Duct Installation						
Cable Pull, Joint and Commission						
Phase 1						
Phase 2						

[1] https://corporate.vattenfall.co.uk/contentassets/e7459d533c9243caa561d739402300e7/volume-1-peir-chapters/peir-chapter-04-site-selection-and-assessment-of-alternatives.pdf

Landfall Zone



Method of Installation

Landfall will be facilitated through the use of horizontal directional drilling (HDD) to install ducts within which the offshore power cables can be installed and joined to the onshore cables at a transition pit onshore. This method is a proven technique and has been applied as common practice throughout the industry for landfall of offshore wind projects amongst other applications. The HDD works will be undertaken from behind the cliffs, within the search area on the map, and have a footprint as indicated, and extend out to sea beyond the intertidal area, thus avoiding impacts on the beach. The decision to adopt a long HDD was taken as a result of consultation with local stakeholders.

The landfall has two phases, the duct installation (achieved through HDD) in 2024/2025 and the subsequent cable installation in 2026 and 2027.

Duct Installation 2024/2025

1. A new temporary access will be created within the onshore cable route, from the public highway at the crossing of the onshore cable route and Whimpwell Street, to the landfall compound zone where a temporary landfall construction compound will be instated of dimensions 50m x 60m.
2. The HDD method involves:
   a. A pilot hole of small diameter to be drilled from the landfall compound to the exit point.
   b. The pilot hole being enlarged through multiple passes with reamers until the necessary diameter for duct installation is achieved.
   c. The duct being pulled into the reamed drill hole (maximum duct size of 750mm per circuit).
3. The site will then be reinstated to its pre-construction state and all materials removed.

The entire duct installation process for Norfolk Boreas, described above (1 - 3) is expected to be completed within 20 weeks.

Cable pull and jointing 2026/2027

1. Temporary access will again be taken from the public highway at the crossing of the onshore cable route and Whimpwell Street, to the landfall site.
2. The pre-installed ducts will be exposed through excavation of a transition pit (15m x 10m x 5m per circuit) and a concrete floor laid to allow a stable surface for winching and jointing of the cables.
3. The offshore cables will be positioned into the pre-installed ducts offshore and pulled through the duct to the onshore transition pit, where they will be jointed with the onshore cables.
4. The site will then be reinstated to its pre-construction state and all materials removed.

The cable installation process is expected to require up to 16 weeks to complete per circuit and will be repeated as necessary for the second Norfolk Boreas circuit which will be programmed for the following year.

Coastal Erosion

The landfall is located along a section of Norfolk coastline which is fronted by unprotected cliffs which are subject to dynamic natural processes. This area of the coastline is considered within the Kelling to Lowestoft Shoreline Management Plan (SMP) published and adopted by North Norfolk District Council (NNDC) in 2012. The shoreline policy is 'Managed Realignment' at the landfall and as such, forecast erosion rates presented by the SMP, and further analysis as part of a coastal erosion study[2] have been, and will continue to be, considered in the design of the landfall.

The landfall design will mitigate against impacts to or from coastal erosion processes over the lifetime of the project. Our methodology is underpinned by the following principles and decisions, which ensure the landfall will have no significant impact on either the cliffs or the beach:

- Landfall compound zone (and location of HDD entry and subsequent transition pit) is setback from the current cliff edge by at least 125m to allow for forecast coastal processes. Furthermore, the landfall compound zone currently extends a further 200m inland to allow flexibility in the siting of the landfall post consent, during detailed design, using the most up to date information and forecasts.
- Use of long HDD method prevents the requirement for surface excavations on the beach or at the existing cliff face which could act as weak points during storm events.
- Ground investigations (boreholes) within the landfall compound zone, conducted in 2017, to a depth of 20m below ground level, have shown that the land is primarily dense sands and clay soils, which are suitable for the HDD installation method.[3] Research into the stability of HDD installations has found the integrity of the annular space is maintained with little evidence of voids and the strength properties increased over time through consolidation, or equalization, with the native soil.
- Drill profile is proposed to be sufficiently far back from the cliff face and deep enough below the beach to ensure the ducts will not become exposed during the operational lifetime of the wind farm as a result of coastal processes and will not impact on the stability of the cliff or beach as a result of vibration or fracturing.

Figure 32. HDD installed 200mm diameter duct excavated 1 year after installation. Ariaratnam & Beljan (2005).

[2] https://corporate.vattenfall.co.uk/contentassets/e7459d533c9243caa561d739402300e7/volume-3-appendices/chapter-4-appx/peir-appendix-4.05-norfolk-vanguard-and-norfolk-boreas-coastal-erosion-study.pdf

[3] No signs of the Cromer Forest Bed geological layer were seen in the borehole surveys. This layer is typically associated with the recent discoveries of early man in Norfolk and therefore no impact on this geoarchaeological feature is anticipated.

Commitment to minimising impacts and responding to local concerns

Commitment to HVDC technology -

This commitment has resulted in:

- The number of cable circuits (and ducts to be installed at the landfall) for Norfolk Boreas being reduced from six to two.
- Reduced duct installation construction time at the landfall from up to nine months to five months.
- Removed the previous requirement for a cable relay station (CRS) in the coastal area.
- Reduced the onshore cable route working width from 50m to 35m.
- Reduces the maximum number of cable installation phases from three to two.

Commitment to Long HDD

- Removes any requirement for construction works on the beach.

Commitment to not using Happisburgh public car parks for construction

- All construction traffic will use the temporary compound and temporary access during construction of the landfall.

Commitment to avoid Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ)

- The landfall location allows the offshore cables to avoid this environmentally designated site.

Cable pulling preparation

Further Information

Further detailed information about Landfall, including installation methods and coastal erosion can be found in the Norfolk Boreas Preliminary Environmental Information Report. This can be downloaded from **https://corporate.vattenfall.co.uk/projects/wind-energy-projects/vattenfall-in-norfolk/norfolkboreas/documents/preliminary-environmental-information-report/**

Commitment to minimising impacts and responding to local concerns

Commitment to HVDC technology - This commitment has resulted in:

- The number of cable circuits to be installed throughout the cable route (including trenchless crossings and landfall) being reduced from six to two.
- Removed the previous requirement for a cable relay station (CRS) near the North Norfolk coast.
- Reduced the onshore cable route working width from 50m to 35m.
- Reduces the maximum number of cable installation phases from three to two.
- Reduces the total number of jointing bays for Norfolk Boreas from 450 to 150.
- Reduces materials and subsequent traffic requirements.
- Reduces number of link boxes from approximately every 1-3 km to every 5km, if required.

Strategic approach to delivering Norfolk Vanguard and Norfolk Boreas

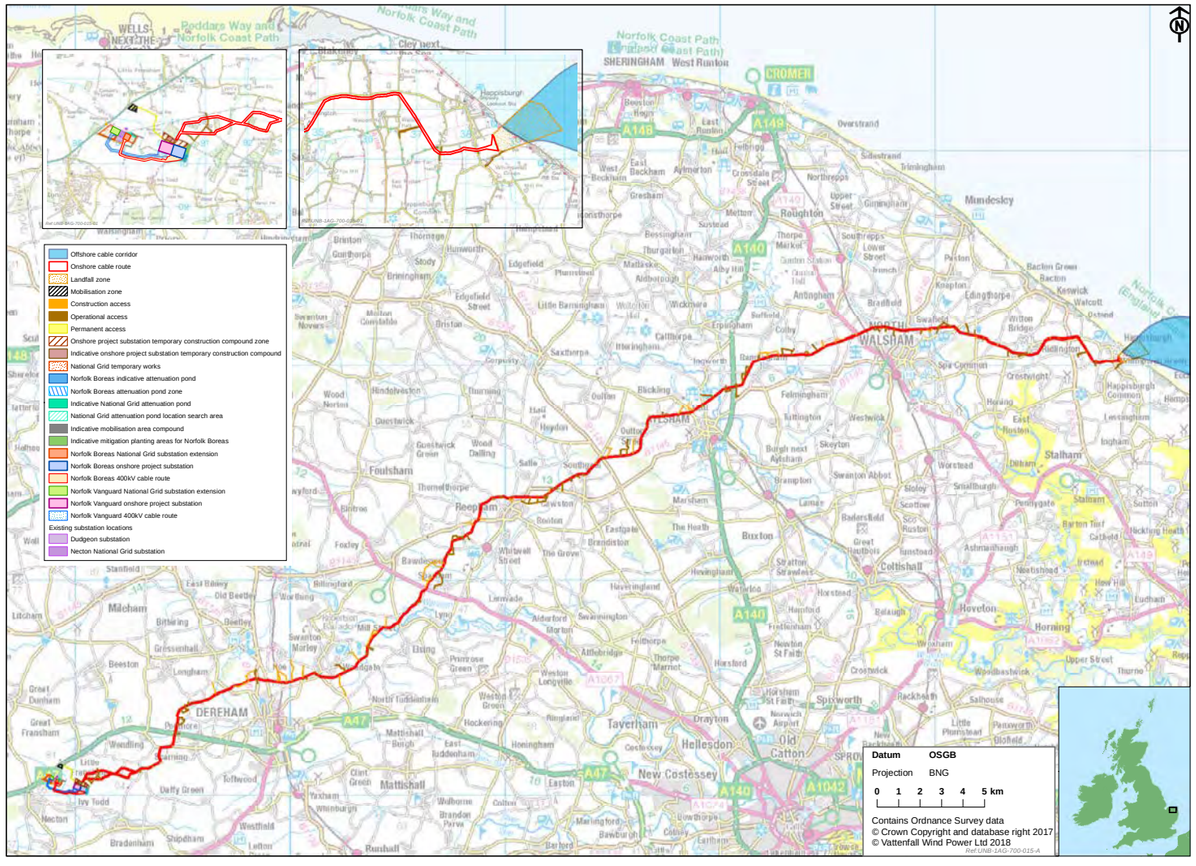
- Subject to both Norfolk Vanguard and Norfolk Boreas receiving consent and progressing to construction, onshore ducts will be installed for both projects at the same time, as part of the Norfolk Vanguard construction works. This would allow the main civil works for the cable route to be completed in one construction period and in advance of cable delivery, preventing the requirement to reopen the land and thus minimising disruption.

Commitment to sectionalised duct installation

- The onshore cable duct installation strategy is proposed to be conducted in a sectionalised approach in order to minimise impacts. This would minimise the amount of land being worked on at any one time and would also minimise the duration of works on any given section of the route

Trenchless Crossings

- Commitment to trenchless crossing techniques to minimise impacts to specific features such as major roads, railways, main rivers and county wildlife sites.



Keeping Informed

Ahead of and during construction, the project will proactively seek to inform local residents, Parish/Town Councils and other stakeholders of the type and timing of works programmed as further details become available. A local liaison officer will respond to queries and concerns.

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Onshore Cable Route

Autumn 2018

This information sheet supplements details regarding the onshore cable route presented in the Norfolk Boreas Preliminary Environmental Information Report[1] (PEIR) and the Non-Technical Summary[2] (NTS) of the PEIR. Links to relevant documents within the PEIR are provided within this sheet for further information.

Method of installation

Construction along the onshore cable route will occur in three distinct stages. The pre-construction stage which prepares the cable route for access and excavations; duct installation stage where ducts are buried along the length of the cable route to accommodate cables; and the cable pull and jointing stage where cables are pulled through the pre-installed ducts to connect the wind farm to the national grid.

If Norfolk Vanguard proceeds to construction and installs ducts for both projects, then Norfolk Boreas will only need to undertake the cable pulling. If Norfolk Vanguard does not proceed then Norfolk Boreas will undertake all three stages.

The activities and procedures for each stage of the construction are briefly summarised below with further details available in FAQs and sections 5.5 to 5.7 of the PEIR.[3]

1. Pre-Construction

- Road Modifications – New or improved junctions off existing public highways to allow for construction traffic to mobilisation areas and associated locations.
- Hedge and tree netting / removal.
- Ecological preparations.
- Archaeological preparations.
- Pre-construction drainage.

2. Duct Installation

- Establish mobilisation areas (100m x 100m) distributed along the cable route. These locations act as the access point from the public highway to the cable route and include welfare facilities, site offices, materials storage and car parking amongst other functions to facilitate the duct installation.
- Establish running track within the cable route between the mobilisation area and the workfront.
- Workfront excavates trenches in approximate 150m lengths, lays ducts to a minimum depth of 1.05m within trenches and backfills. Each 150m length is estimated to be 1 weeks work.
- Following completion of the cable route section assigned to the workfront (average of 4km), land is reinstated, including associated mobilisation area.
- Multiple workfronts to be operating in parallel along the length of the cable route to minimise installation time to within the 2 year period.

3. Cable pull and jointing

- Use of cable logistics area for local site offices and temporary cable storage, located near Oulton (strategic central location along the length of the cable route).[4]
- Use of construction accesses and direct public highway to cable route accesses (no requirement for mobilisation areas).
- Establish short lengths of running track within the cable route where necessary (we estimate this would require no more than 20% of total cable route length to be re-established temporarily) to access joint bays from access point, with joint bays at approximate 800m intervals.
- Pull cable through pre-installed ducts between joint bays, joint lengths of cable and establish link boxes (if required and at minimum 5km spacing).
- Reinstate land.
- Approximately 5 weeks per joint location allowing for establishment and reinstatement although elapsed time may be up to 10 weeks appreciating that two joint bays need to be open concurrently to allow cables to be pulled between and jointed within the bays.
- Multiple cable pulling/jointing teams to be operating in parallel along the length of the cable route to minimise installation time.
- Cables are proposed to be pulled in up to two separate phases for Norfolk Boreas, with each phase lasting up to 1 year.

[1] https://corporate.vattenfall.co.uk/projects/wind-energy-projects/vattenfall-in-norfolk/norfolkboreas/documents/preliminary-environmental-information-report/

[2] https://corporate.vattenfall.co.uk/contentassets/e7459d533c9243caa561d739402300e7/norfolk-boreas-peir-non-technical-summary.pdf

[3] https://corporate.vattenfall.co.uk/contentassets/e7459d533c9243caa561d739402300e7/volume-1-peir-chapters/peir-chapter-05-project-description.pdf

[4] https://corporate.vattenfall.co.uk/contentassets/e7459d533c9243caa561d739402300e7/volume-2-figures/chapter-5-figs/peir-figure-5.04-onshore-project-area-scenario-1-and-2.pdf

Working Hours

Working hours will normally be 7am to 7pm five days per week, plus 7am to 1pm on Saturdays, however there may be certain exceptions which will be discussed with the local authorities (for example, larger components may be best delivered outside these hours to avoid traffic impacts and limited 7 day 24 hour working may be required during trenchless crossing activities).

Traffic and Transport

Materials such as aggregate for the running track (to protect the subsurface), ducts, stabilised backfill and associated machinery will be delivered to the mobilisation areas in heavy goods vehicles (HGVs) during the duct installation, in addition to the daily workforce in light vehicles. The duct installation period of the construction will see the greatest quantum of construction traffic. Duct installation will only be required for Norfolk Boreas if Norfolk Vanguard does not proceed to construction.

Chapter 24 of the PEIR details the traffic and transport baseline traffic flows, estimated vehicle movements to supply materials and manpower (including potential source locations and associated contingencies for alternate sources and increased material requirements) and assesses the impacts of these movements and any additional mitigation which may be required.

The public road network to be used to access the mobilisation areas is presented in Figure 24.2 and Figure 24.3 of the PEIR which distils the road network into individual links which are assessed. A commitment has been made to restrict HGVs from entering the centre of the main towns along the route such as Dereham, Reepham and Aylsham. Furthermore, from the mobilisation area, the materials will be transported to the workfront via the running track within the cable route, minimising vehicle movements on the public highway.

A summary of the construction impact assessment per link is presented in Appendix 24.34 and 24.35 of the PEIR. Where enhanced mitigation measures are identified to be required these are described in Chapter 24, section 24.5 of the PEIR, and will be secured in the relevant management plans (see overleaf for further details on management plans).

Enhanced Traffic Management Plan (TMP) Measures
Driver training and toolbox talks
Driver information packs to include: • Delivery timing constraints (e.g. school arrival/departure times); • HGV delivery routes; • Diversion routes; and • Identify safe areas to pull over to reduce the effect of slow moving platoons of vehicles
Safety Awareness – Educate drivers to report 'near misses'
Engagement structure – to provide clear governance and reporting (stakeholders) structure
Monitoring and Reporting – To monitor traffic flows at mobilisation areas and the onshore project substation
Contact information at all roadwork sites and robust complaint response standards (7 days)

Programme*

The three phases of construction across the onshore cable route will occur concurrently within the proposed timescales of pre-construction across 2022/2023, the duct installation across 2024/2025 and the subsequent cable installation in 2026 and 2027. It should be noted that works will be localised along the cable route for shorter periods of time during these periods.

Activity	Year					
	2022	2023	2024	2025	2026	2027
Onshore cable route						
Preconstruction works						
Duct Installation works						
Cable Pull, Joint and Commission						
Phase 1						
Phase 2						

*Construction years noted in this document are indicative and represent our desired programme. While the durations of each stage are set, dates may change depending on other factors such as Contracts for Difference (CfD) awards.

Management Plans

Following the statutory consultation on the PEIR, we will finalise the application for a DCO. As part of the application, we will produce a number of management plans that will be developed and presented in outline form as part of the Environmental Statement. These management plans will form the basis for enacting the mitigation measures identified from the assessments to minimise impacts and the construction best practice methods to be employed during construction. These outline plans will be further developed post consent as detailed design of the project is conducted and are required to be agreed with relevant statutory authorities prior to construction commencing. Abiding by the management plans will be a condition of the DCO. Onshore management plans will include:

- **Outline Code of Construction Practice (OCoCP)** – Sets out the management measures which we will require our contractors to adopt and implement for any onshore construction works for the project and related off-site activities. The OCoCP, once finalised, provides a key mechanism, enforceable by the DCO, through which the relevant regulatory authorities can be assured that environmental impacts associated with the construction of the onshore infrastructure will be formally controlled and mitigated.
- **Outline Traffic Management Plan (OTMP)** – Sets out the standards and procedures for managing the impact of heavy goods vehicles (HGVs) traffic during the onshore construction period, including localised road improvements necessary to facilitate the safe use of the existing road network.
- **Outline Travel Plan (OTP)** – Sets out a comprehensive strategy, on how onshore construction employee traffic would be managed and controlled to ensure the project is within the bounds of the assessed employee generated traffic impacts. The purpose of the OTP is to limit employee traffic movements and reduce traffic impacts on local communities and commuters in Norfolk. The OTP presents an outline of measures that could be employed to meet these targets, such as encouraging more sustainable methods of travel for construction employees and promoting travel alternatives to single occupancy car trips, but does not seek to be too prescriptive to ensure that innovation by the contractor in bringing forward the final Travel Plan is not constrained.
- **Outline Access Management Plan (OAMP)** – Sets out detail on the location, frontage, general layout, visibility and embedded mitigation measures for access for the onshore project substation, landfall and points of access to the onshore cable route. It presents the requirements and standards that will be incorporated into the final access design and to be observed as part of Contractor's obligations to comply with the DCO.
- **Outline Landscape and Ecological Management Strategy (OLEMS)** – Sets out the landscape and ecological mitigation and enhancement measures that are deemed necessary on the basis of the assessment of impacts during construction, operation and decommissioning of the onshore works. We will work with the relevant local authorities to ensure appropriate resourcing is in place to monitor compliance with the provisions of the OLEMS, and the plans and schemes of which it forms the basis.

Selective Use of Trenchless Methods

We have committed to trenchless installation methods underneath a number of sensitive features along the cable route. This allows direct impacts to features to be mitigated, however the application of trenchless methods has been carefully considered as it can have a number of disadvantages such as:

- Can be more time consuming due to requirement to establish and demobilise drilling rigs, extending the installation programme and generating impacts in a single location for a prolonged period compared to continuous advance of sectionalised duct installation method.
- Requires specialist equipment and services.
- Typically requires additional land take to accommodate temporary drilling rig works area.
- Continuation of the running track may be required to allow works beyond the feature being crossed.
- Typically requires additional site investigations to understand deeper geology which introduces further pre-construction works. Deeper installation can also introduce additional risks associated with groundwater and require increased cable sizes.

It is possible that additional trenchless crossings beyond those currently committed to could be considered post consent, should the benefits of such methods outweigh the disadvantages.

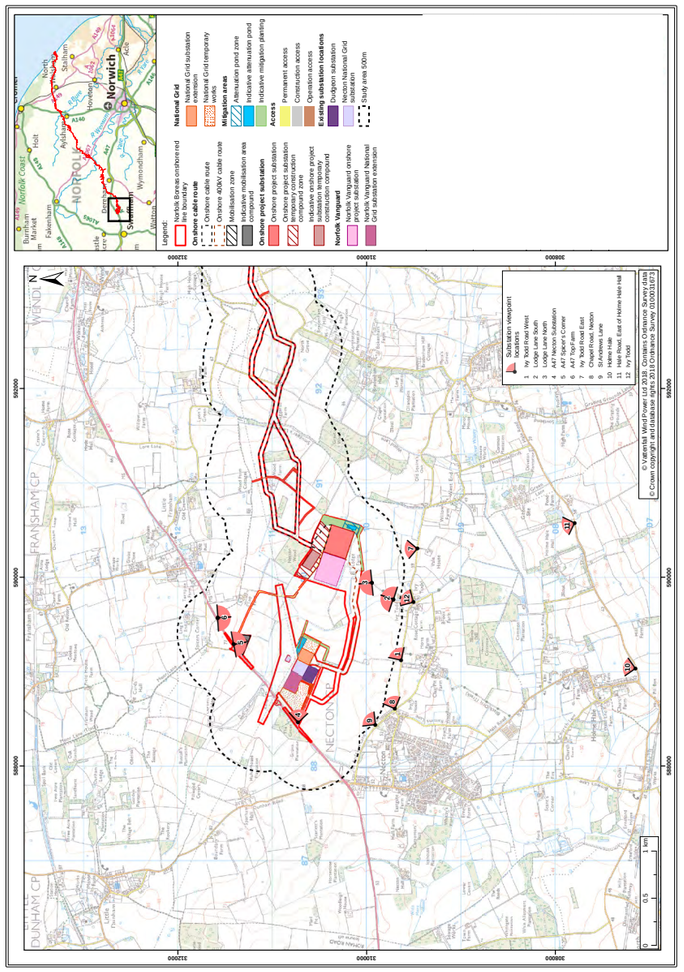
Electromagnetic fields (EMF)

Norfolk Vanguard and Norfolk Boreas Offshore Wind Farms will deploy HVDC transmission technology to transmit power into the National Grid. Expert bodies including Public Health England, the World Health Organisation and the International Agency for Research on Cancer have reviewed the available evidence from studies of humans and animals, and do not identify any health risk for humans or animals exposed to DC magnetic fields.

Furthermore, government EMF guidelines set to protect public health are outlined in a Code of Practice, that was developed by the UK Government. The Code of Practice will be adhered to, to ensure that the maximum EMF strengths that could be generated by the proposed design are well below the guideline exposure limits. This includes any cumulative EMF associated with other electricity circuits, such as Hornsea Project Three. See also our EMF leaflets.[5]

[5] EMF Leaflet 1 – https://corporate.vattenfall.co.uk/contentassets/bf0e5e31bbab467eaf02040c7b17513a/vattenfall-emf-information-sheet.pdf

EMF Leaflet 2 -https://corporate.vattenfall.co.uk/contentassets/bf0e5e31bbab467eaf02040c7b17513a/vattenfall-orsted-emf-information-sheet.pdf



Viewpoints

The map on the right shows the location of twelve viewpoints from which the proposed substation infrastructure would be visible.

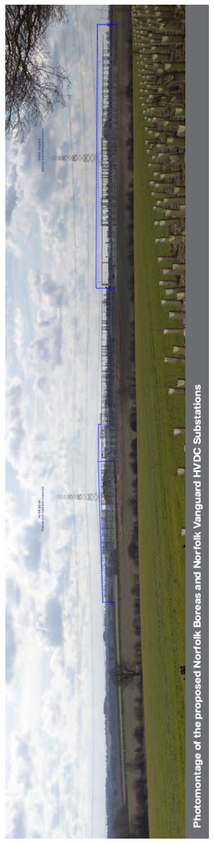
Photomontages from these viewpoints have been published in the Norfolk Boreas Preliminary Environmental Information Report[1] (PEIR). The viewpoints have been chosen to represent those parts of local settlements, public roads and publicly accessible footpaths from which the proposed substation infrastructure would be seen most fully. The extent of visibility across the local area would generally be well-contained and this would limit the effects on local people.

Below, we illustrate two examples, please refer to Figures from Chapter 29 of the PEIR to review the other photomontages.

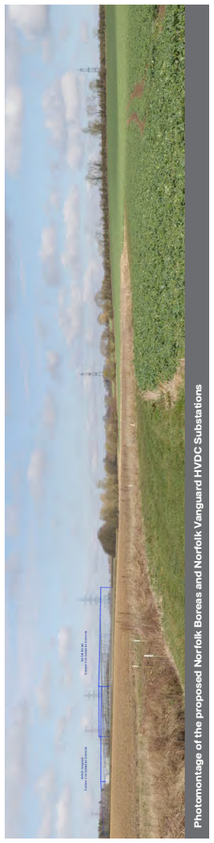
Viewpoint 2 Lodge Lane South is representative of the views of walkers in this area and features Necton National Grid substation and Dudgeon substation..

Viewpoint 5 A47 Spicer's Corner is representative of the views of road users on the A47 which are filtered by bare trees in the winter and screened by leafed trees in the summer.

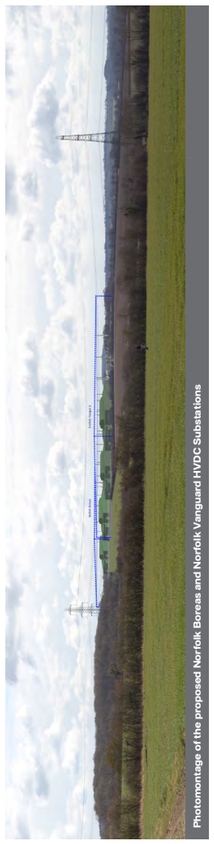
[1] https://corporatevattenfall.co.uk/projects/wind-energy-projects/vattenfall-in-norfolk/norfolkboreas/documents/preliminary-environmental-information-report/



Viewpoint from Lodge Lane South



Viewpoint from A47 Spicer's Corner



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Onshore Project Substation

Autumn 2018

What is the Onshore Project Substation?

The onshore project substation comprises a converter hall and associated outdoor equipment required to convert the High Voltage Direct Current (HVDC) transmitted electricity from the offshore wind farm, to High Voltage Alternating Current (HVAC). This is required for connection into the National Grid electricity transmission system (NGTS). The NGTS delivers power to UK domestic, commercial and industrial consumers of electricity.

What is the National Grid substation extension?

The existing National Grid substation requires additional connection points in order to connect the electricity generated by the Norfolk Boreas project into the electricity transmission network. These additional connection points will be accommodated by extending the existing National Grid substation.

What are the National Grid overhead line modifications?

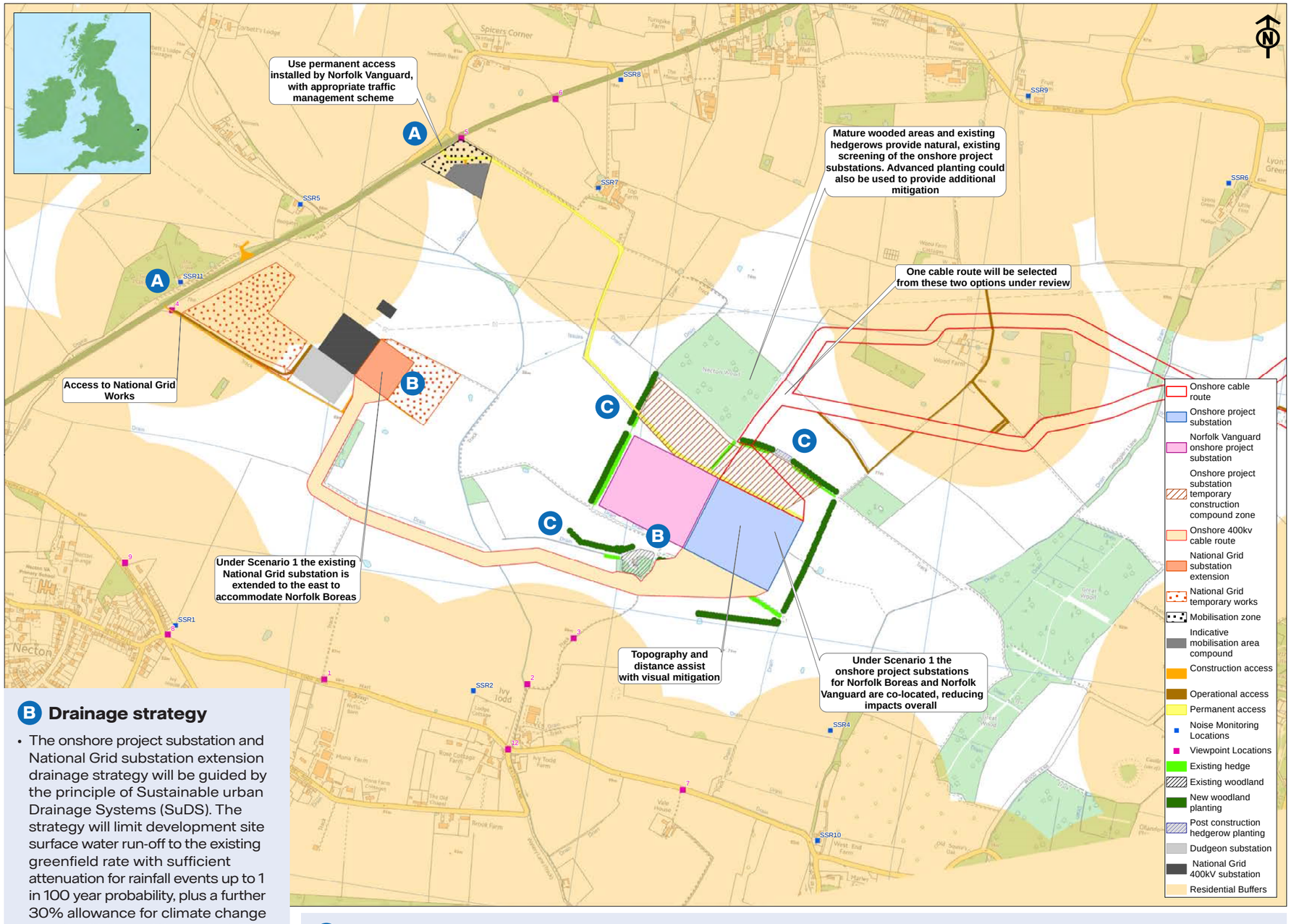
Similarly, the existing connection between the National Grid substation and the overhead lines cannot accommodate an additional 1,800 MW of electricity generated by the Norfolk Boreas offshore wind farm, on top of the electricity generation from Dudgeon offshore wind farm. To connect the additional power, the second circuit of the existing overhead line is required to connect into the National Grid substation extension. This additional connection will use the existing overhead line alignment with one new tower and the modification or replacement of a second tower. To facilitate these works, three temporary towers will be erected to the north and the existing overhead wires moved onto these temporary structures, allowing continued electricity supply. The overhead wires would then be moved back to the existing alignment, on to the new towers, and the temporary towers removed.

If Norfolk Vanguard proceeds to construction then these works will be undertaken to accommodate both projects as part of Norfolk Vanguard. If Norfolk Vanguard doesn't proceed then these works will be undertaken by Norfolk Boreas.

Construction

- Pre-construction works are scheduled to occur over the period 2022/2023 and will include preparatory activities such as road modifications, hedge and tree netting / removal, mitigation planting (where possible), ecological and archaeological preparations and drainage.
- Primary construction works are scheduled to occur over the period 2024-2025 for a maximum of 30 months and will include the construction of temporary construction compounds to facilitate the works, civil and structural works at the project substation and National Grid substation extension, and the necessary National Grid overhead line modifications.
- Electrical equipment will then be installed and commissioned over a maximum of two phases, scheduled for 2026 and 2027, in parallel with the installation and commissioning of the offshore wind turbines and electrical cables.
- Construction activities will normally be conducted during working hours of 7am to 7pm. Evening and/or weekend working could be required periodically to maintain programme progress and for specific time critical activities such as transformer oil filling and processing.
- The construction works will be conducted in line with the Outline Code of Construction Practice (OCoCP), an outline of which will be included as part of the Norfolk Boreas DCO application. This code will set out the management measures that all contractors will be required to adopt and implement such as environmental management, health and safety and construction principles, including relevant best practice method statements and necessary mitigation measures.
- Ahead of and during construction, the project will proactively seek to inform local residents of the type and timing of works programmed. A local liaison officer will respond to queries and concerns.

Commitment to minimising impacts

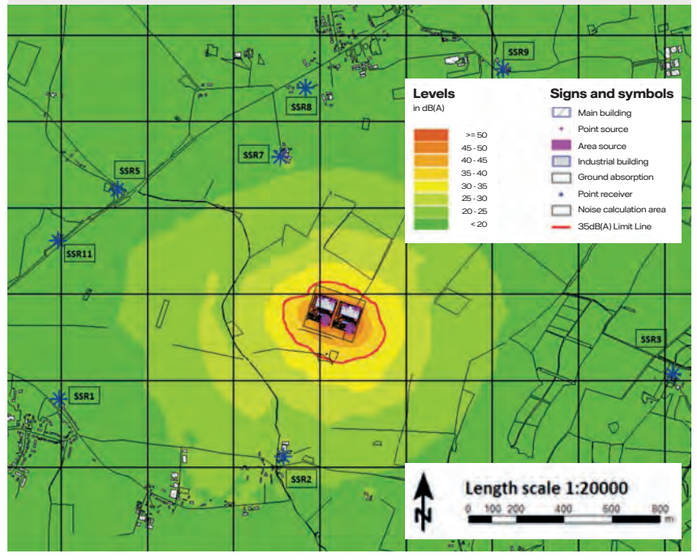


A Access

- Under Scenario 1, a dedicated access will have been constructed by Norfolk Vanguard to gain entry to the onshore project substation, from the A47. This will include a new right turn filter lane to minimise disruption to A47 traffic and ensure safe access.
- A “no-right turn” traffic management scheme is proposed to be in place in order to gain safe access to the National Grid substation extension, and to minimise disruption to A47 traffic.

Operational Noise

- The development will comply with the requirements (conditions) of Breckland Council which is summarised as not exceeding 35 dB LAeq (5minutes) at any time at a free field location immediately adjacent to any noise sensitive location. A further limit of 32 dB Leq (15minutes) also applies to the 100Hz third octave band.
- Detailed noise assessments have shown that with proven noise reduction technology or procurement of low noise emitting equipment, this requirement can be readily achieved and no impacts will occur.[3]



B Drainage strategy

- The onshore project substation and National Grid substation extension drainage strategy will be guided by the principle of Sustainable urban Drainage Systems (SuDS). The strategy will limit development site surface water run-off to the existing greenfield rate with sufficient attenuation for rainfall events up to 1 in 100 year probability, plus a further 30% allowance for climate change over the lifetime of the project. This will be primarily achieved through the siting of an attenuation pond in close proximity to the onshore project substation and a separate attenuation pond in close proximity to the National Grid substation extension, each of which will be suitability sized and designed to meet the above criteria. SuDS provide a natural approach to managing drainage, prevent water pollution and flooding and create habitats for wildlife.

C Mitigation planting

- Additional mitigation planting will be undertaken to enhance the screening effect of existing hedgerows and woodland blocks in the local area. The location of this planting and photomontages/visualisations are provided in Chapter 29. [2]
- Bunds, or earth mounds, will be constructed where possible to increase the base height and maximise the effectiveness of mitigation planting as screening, as soon as possible during operation.
- Mitigation planting will comprise faster growing ‘nurse’ species and slower growing ‘core’ species. Core species with an average growth rate of 250mm per annum will provide 5m to 7m of growth after 20 years which will characterise the woodland structure over the long term. Nurse species would be faster growing (350mm per annum) to provide 7m to 8m of screening after 20 years.
- Where advanced planting can be achieved (in areas not affected by the construction works), this will commence in 2022 which will provide a minimum 3 years of growth prior to commencement of operation which equates to approximately 1.2m of additional growth.

[2] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001517-Chapter%2029%20LVIA%20Norfolk%20Vanguard%20ES.pdf

[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001513-Chapter%2025%20Noise%20and%20Vibration%20Norfolk%20Vanguard%20ES.pdf

Norfolk Vanguard & Boreas Wind Farm Connections- EMF Information

What are electric and magnetic fields?

Electric and magnetic fields (EMFs) are produced wherever electricity is used. Electric fields are produced by voltage, which is the pressure behind the flow of electricity. It can be likened to the pressure of water in a hose. The operating voltage of most equipment is a relatively constant value. Magnetic fields are produced by current, which is the flow of electricity. Current, which is measured in amperes or amps, can be likened to the flow of water in a hose when the nozzle is open, and varies over time. Generally, the higher the power and the current, the higher the magnetic field. Electric fields are measured in volts per metre (V/m) and magnetic fields are measured in microteslas (μT).

Most electricity supply in the UK is alternating current (AC) with a frequency of 50 cycles per second or 50 hertz (Hz). EMFs always have the same frequency as the electricity that produced them, so the EMFs produced also alternate direction with a frequency of 50 Hz. Some cables however use direct current (DC), which have the same direction all the time. This is the same as the earth's natural magnetic field and these are known as 'static fields' and have a frequency of 0 Hz.

The Norfolk Vanguard and Boreas connections could use either High Voltage Direct Current (HVDC) or High Voltage Alternating Current (HVAC) technology to transfer the power generated by the wind farms to the National Grid. DC and AC EMFs have different effects; therefore, each has a separate and distinct set of exposure limits.

Underground cables, irrespective of frequency, have an earthed metallic shield, which protect them from damage but also prevents electric fields escaping from the cable. Magnetic fields are not shielded in the same way as electric fields and will be produced outside the cables.

Do EMFs affect health?

Direct Current

The available evidence from studies of humans and animals has been reviewed by Public Health England and internationally by the World Health Organization and the International Agency for Research on Cancer. None of these expert bodies has identified any health risk for humans or animals exposed to DC magnetic fields.

Alternating Current

Though the weight of evidence is against there being any effect on human health from exposure to EMFs there is some limited scientific evidence suggesting a possible link between unusually high average exposures to AC (50 Hz) magnetic fields and childhood leukaemia. Based on this evidence, magnetic fields are classed by the World Health Organization (WHO) as 'possibly' carcinogenic.

What are the exposure limits?

The UK has a carefully thought-out set of policies for managing EMFs, which includes both numerical exposure guidelines to protect against established effects of EMFs at relatively higher levels, and precautionary policies to provide appropriate protection against the possibility of long-term effects of EMFs at lower levels, including, specifically, the possibility of a risk for childhood leukaemia.

Public Health England (formerly the Health Protection Agency – HPA) recommends limits for exposure to EMFs based on those from the International Commission on Non-Ionizing Radiation Protection (ICNIRP – 1994 & 1998). These guidelines are based on reviews of all the science regarding potential health effects of EMFs and provide limits for continuous public and occupational exposures. The public exposure limit is 360 μT for 50 Hz AC magnetic fields, and 40,000 μT for DC magnetic fields.

National Grid has been engaged by Vattenfall to assess the EMF aspects of this project, which is the subject of this information sheet. The project as a whole and all other aspects of it remain the responsibility solely of Vattenfall.

Will the Norfolk Vanguard Wind Farm Project be compliant with limits?

Vattenfall's policy is only to design and install equipment that is compliant with the relevant exposure limits. To ensure this, all of the equipment for the Norfolk Vanguard Wind Farm Project capable of producing EMFs has been assessed in accordance with the provisions of the Government's Code of Practice on Compliance.

If an HVAC connection is used, both a Cable Relay Station (CRS) and new AC substation would be required to reduce losses and ensure the project can connect to the National Grid. The types of equipment contained within both of these stations means that they are not capable of produce electric or magnetic fields that exceed the ICNIRP limits outside the parameter fence.

Where HVDC technology is used, neither a CRS nor an AC substation will be required. However, a DC Converter Station is needed to convert DC to AC power so that it can connect to the National Grid. The DC Converter station contains some specialised equipment which could potentially exceed the exposure limits if located close to the perimeter fence. This will be considered in the detailed design to ensure that the design fully complies with the public exposure limits.

High voltage underground cables are assessed for compliance with the exposure limits on a case-by-case basis, taking account of maximum power flows and minimum burial depth to ensure that the calculated magnetic fields represent. the maximum magnetic field the cables could possibly produce.

These calculations have been performed for the Norfolk Vanguard project but also taking account of the potential future Norfolk Boreas project. The calculated fields are shown below and are a small fraction of the ICNIRP limits.

Calculated AC Magnetic Fields

	Distance perpendicular from centreline of cables (m)			
	Peak	25m	50m	100m
Magnetic field (μT)	29.7	4.11	0.26	0.03
% ICNIRP exposure limit	8%	1%	<1%	<1%

Calculated DC Magnetic Fields

	Distance perpendicular from centreline of cables (m)			
	Peak	25m	50m	100m
Magnetic field (μT)	33.7	1.27	0.26	0.06
% ICNIRP exposure limit	<1%	<1%	<1%	<1%

Summary

- All of the relay stations, substations and cables will be compliant with the UK exposure limits set to protect members of the public against electric and magnetic field exposure.
- This applies irrespective of whether DC or AC cable connections are used.

Where can I get further information?

More information is available from National Grid's website at www.emfs.info, or from the EMF helpline on 0845 702 3270 or emfhelpline@nationalgrid.com.

Alternatively you can contact the Norfolk Vanguard project team directly on info@norfolkvanguard.co.uk or 01603 567995.

National Grid has been engaged by Vattenfall to assess the EMF aspects of this project, which is the subject of this information sheet. The project as a whole and all other aspects of it remain the responsibility solely of Vattenfall.

Vattenfall and Ørsted Circuit Crossings- EMF Information

In response to local concerns, Ørsted and Vattenfall have jointly commissioned an independent study and resulting report which explores the 'worst case' electric and magnetic fields (EMFs) which may result where it is proposed the power cables from the large wind farms will cross.

Onshore, buried cables from offshore wind farms will necessarily cross other infrastructure, including other power cables. This summary report provides information on the electric and magnetic fields (EMFs) which could occur where power cable circuits cross, specifically assessing the crossing of Ørsted's Hornsea Project Three and Vattenfall's Norfolk Vanguard and Norfolk Boreas offshore wind farms, which are typical of the next generation of offshore wind projects in development by Vattenfall and Ørsted. It represents a conservative assessment of EMFs at such crossings, assessing the worse case parameters for this case study.

Summary of results

- The study found that the maximum calculated AC magnetic fields were 50.7 microtesla (μT) which is 14% of the UK exposure limit values; the maximum calculated DC magnetic fields were 60.8 μT which is less than 1% of the UK exposure limit.
- All of the cable crossing scenarios irrespective of whether DC or AC cable connections are used will be compliant with the UK exposure limits set to protect the health of members of the public against electric and magnetic field exposure.
- As the magnetic field is mainly dependant on cable rating, burial depth and phase separation, all cable crossings with similar or less onerous design parameters will also be compliant.

What are electric and magnetic fields and what policies and exposure limits apply?

EMFs are produced wherever electricity is used. Underground cables, irrespective of frequency, have an earthed metallic shield, which protects them from damage but also prevents electric fields escaping from the cable. Magnetic fields are not shielded in the same way as electric fields and will be produced outside the cables.

Electricity can be transmitted either via High Voltage Direct Current (HVDC) or High Voltage Alternating Current (HVAC) technology producing EMFs of the same frequency.

The UK has a carefully thought-out set of policies for managing EMFs, which includes numerical exposure limits to protect against established effects of EMFs. Public Health England (PHE), formerly the Health Protection Agency, (HPA) recommends limits for exposure to EMFs based on those from the International Commission on Non-Ionizing Radiation Protection (ICNIRP – 1994 & 1998)[1,2]. These guidelines are based on reviews of all the science regarding potential health effects of EMFs and provide limits for continuous public and occupational exposures. DC and AC EMFs have different effects on humans; therefore, each has a separate and distinct set of exposure limits to protect against exposure. PHE issued guidance on the application of exposure limits, which stated that the public exposure limit is 360 μT for 50 Hz AC magnetic fields, and 40,000 μT for DC magnetic fields[3]. In the UK the Earth's DC magnetic field measures around 50 μT, and the background AC magnetic field in a home ranges between 0.01- 0.2 μT.

More information on the science, exposure limits and policies can be found at www.emfs.info.

[1] https://www.icnirp.org/cms/upload/publications/ICNIRPstatic.pdf
[2] http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
[3] http://webarchive.nationalarchives.gov.uk/20140713082604/http://www.hpa.org.uk/Publications/Radiation/NPRBArchive/DocumentsOfTheNRPB/Absd1502/

Where onshore wind farm circuits cross onshore, will these be compliant with exposure limits?

The electricity industry's policy is only to design and install equipment that is compliant with the relevant exposure limits. To ensure electricity Industry remain with the exposure limits the Government produced a Code of Practice on EMF compliance which sets out the approved calculation methodology for assessing compliance for new and existing electricity assets. This methodology takes account of maximum power flows and minimum burial depth to ensure that the calculated magnetic fields represent the maximum magnetic field that the electrical infrastructure could possibly produce.

There are multiple possibilities for cable crossing points i.e. AC or DC, which cables are on top, where they cross, the crossing angle – so the calculations in this summary report are the worst-case scenarios typical of the next generation of Vattenfall and Ørsted offshore wind projects in development in the UK.

If both cable routes that cross use the same power transmission technology, i.e. AC and AC or DC and DC, the fields can combine to add or subtract from one another. However, if different technologies are used, i.e. AC and DC, the magnetic fields do not interact with one another. In that scenario, the installations of the HVAC and HVDC cables can be considered separately.

These assessments represent the worst-case scenario for two crossing points, one where both transmission systems use HVAC technology and the other where both use HVDC technology. The parameters modelled are included in the tables below and are conservative as maximum rating, minimum burial depth and most acute crossing angle (45°) were taken and the most highly loaded circuits were located on top which produced the highest magnetic fields.

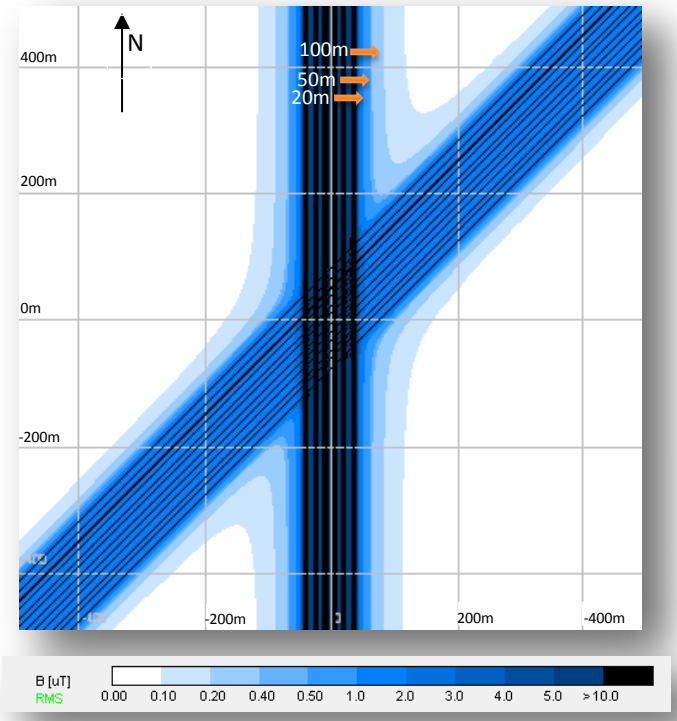
The calculated fields are shown below and are a small fraction of the AC and DC ICNIRP limits.

Cable design parameters

	2 x HVAC routes		2 x HVDC Routes	
	'On Top'	**'On Bottom'**	**'On Top'**	**'On Bottom'**
Number of circuits	6	12	2	4
Maximum load current per circuit	1620A	900A	2220A	1400A
Maximum circuit spacing at crossing	15.0m	10.0m	15.0m	10.0m
Spacing between phase centres	0.313m	0.25m	0.43m	0.25m
Cable formation in trench	Flat	Trefoil	Flat	Flat
Depth of burial, to circuit centres	0.8m	2.8m	0.8m	2.8m

National Grid has been engaged by Vattenfall and Ørsted to assess the EMF aspects of this case study, as described in this summary report. The projects as a whole and all other aspects of them remain the responsibility solely of Vattenfall and Ørsted.

AC magnetic field calculations for HVAC cable crossings



Calculated worst-case AC Magnetic Fields

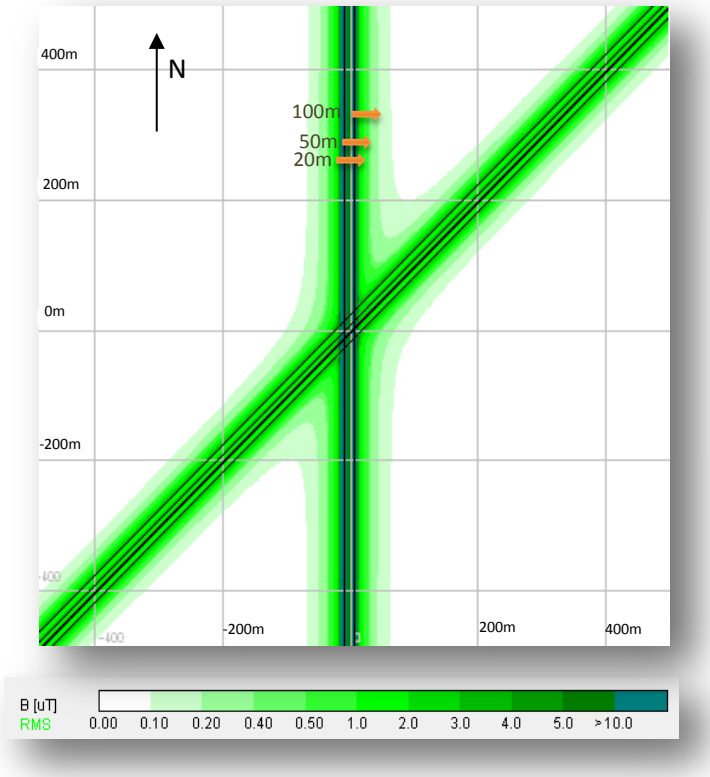
	Distance perpendicular from outer cable (m)			
	Peak	20m	50m	100m
Magnetic field (μT)	50.7	1.14	0.49	0.23
% ICNIRP exposure limit*	14%	<1%	<1%	<1%

*AC public exposure limit of 360μT

Worst-case calculated magnetic fields from AC circuits: The two cable routes modelled include 6 circuits running in a North-south direction with each circuit rated at 1620A; and 12 circuits which run underneath in a North East-South West direction with 900A rated circuits. Coloured bands represent magnetic field. Each square represents 200m distance. The orange arrows indicate the distance perpendicular from the outer cables that correspond to the table above.

The maximum calculated magnetic fields at various distances from the outer cable are included in the table and demonstrate that all AC magnetic fields are below the UK exposure limits

DC magnetic field calculations for HVDC cable crossings



Calculated worst-case DC Magnetic Fields

	Distance perpendicular from outer cable (m)			
	Peak	20m	50m	100m
Magnetic field (μT)	60.8	1.46	0.57	0.23
% ICNIRP exposure limit*	<1%	<1%	<1%	<1%

*DC public exposure limit 40,000μT

Worst-case calculated magnetic fields from DC circuits: The two cable routes modelled include 2 circuits running in a North-south direction with each circuit rated at 2220A; and 4 circuits which run underneath in a North East-South West direction with 1400A rated circuits. Coloured bands represent magnetic field. Each square represents 200m distance. The orange arrows indicate the distance perpendicular from the outer cables that correspond to the table above.

The maximum calculated magnetic fields at various distances from the outer cable are included in the table and demonstrate that all DC magnetic fields are below the UK exposure limits.

Where can I get further information?

More information is available from National Grid's website at www.emfs.info or from the EMF helpline on 0845 702 3270 or emfhelpline@nationalgrid.com.

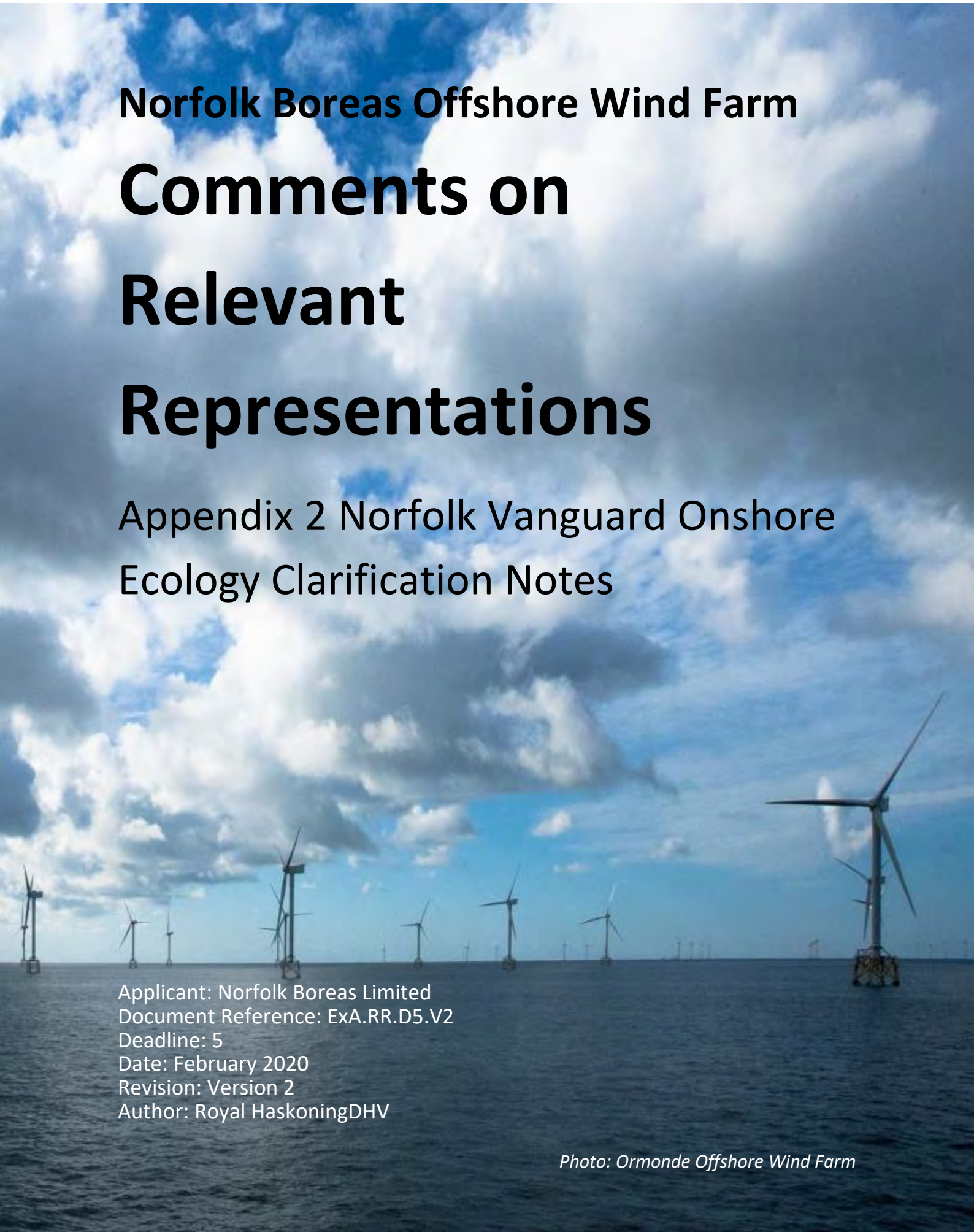
Alternatively you can contact the Norfolk Vanguard project team directly on info@norfolkvanguard.co.uk or 01603 567995 or Hornsea Project Three on contact@hornsea-project-three.co.uk or 0800 0288 466.

VATTENFALL

Norfolk Boreas Offshore Wind Farm

Comments on Relevant Representations

Appendix 2 Norfolk Vanguard Onshore Ecology Clarification Notes



Applicant: Norfolk Boreas Limited
Document Reference: ExA.RR.D5.V2
Deadline: 5
Date: February 2020
Revision: Version 2
Author: Royal HaskoningDHV

Photo: Ormonde Offshore Wind Farm

Appendix 2 Norfolk Vanguard Onshore Ecology Clarification Notes

This Appendix contains the following documents:

- Norfolk Vanguard Water Dependent Designated Sites
- Norfolk Vanguard Bat Impact Assessment – Paston Great Bran SAC
- Norfolk Vanguard Sediment Management at the River Wensum Crossing
- Norfolk Vanguard Other Outstanding issues raised by Natural England

Appendix 2 (version 2)
Clarification Note: Norfolk Vanguard Water Dependent Designated Sites

HaskoningDHV UK Ltd.

1 Introduction

Within their Relevant Representation to the Norfolk Vanguard Offshore Wind Farm Development Consent Order (DCO) application, Natural England stated:
"*From the information provided, we are not able to agree with this conclusion* [of no impact to Norfolk Valley Fens Special Area of Conservation (SAC) and The Broads SAC] *as all sites are dependent on groundwater supply. We advise that further information is obtained from Environment Agency and used in a detailed appraisal of groundwater effects, e.g. WetMex* [sic] *data showing the water supply mechanism for all the component sites and/or Environment Agency's groundwater modelling. If the installation of the cable route would affect the groundwater supply to these sites, then a detailed assessment should be undertaken and mitigation measures implemented to minimise any identified effects*."

"*Natural England notes that nationally designated sites over 500m from the project area have been screened out, however on that basis, Dereham Rush Meadow SSSI should have been screened in. We suggest the following wetland sites should be screened in for further consideration of impacts on groundwater supply and surface water quality:*

- *Dereham Rush Meadow SSSI (0.4km away);*
- *Holly Farm Meadow, Wendling SSSI (0.9km away);*
- *Whitwell Common SSSI (1.2 km away)*"

The information within this note provides clarification of the groundwater supply to the designated sites identified by Natural England above, and examines the potential for the installation of the onshore cables for Norfolk Vanguard to affect this groundwater supply. In addition, clarification is also provided with regards to the potential for impacts on surface water quality to affect these designated sites.

Following further consultation with Natural England on the 22nd January 2019, this note has been updated to include provision of a conceptual model of groundwater flows with respect to Norfolk Valley Fens SAC (Booton Common SSSI component), to provide further clarity regarding groundwater flows for this site.

2 Groundwater supply

The Environment Agency's WetMecs data has been reviewed in detail to identify the groundwater supply mechanism for each of the sites identified above. The WetMecs information for each site is summarised in **Table 1** below.

Table 1: Water dependent designated sites and their water supply mechanism

Designated site	Designated site water supply mechanism (WetMecs data)
Norfolk Valley Fens SAC (Booton Common component SSSI)	The following WetMecs are present at Booton Common: ***WETMEC 10a ('Type 1'):*** Localised Strong Seepage ***WETMEC 10b ('Type 1'):*** Diffuse Seepage ***WETMEC 11a ('Type 2'):*** Permeable Partial Seepage ***WETMEC 11b ('Type 2'):*** Slowly Permeable Partial Seepage ***WETMEC 13a ('Type 4'):*** Seepage Percolation Surface (small hollow) ***WETMEC 17a ('Type 1')***: Groundwater-Flushed Slope (part of slope). The site is an elongated mire developed on a narrow seepage slope above the Blackwater Drain. There are two main ecohydrological facets to the site: (i) near the west end there is a small, sloping permanent seepage face, occupying and adjoining a shallow, flushed gully, which supports the primary conservation interest (M13); (ii) East of this, and continuous with it, are various types of less rich fen vegetation (mainly fen meadow and tall herb fen) in locations where – for the most part – the water table scarcely reaches the surface, or does so only intermittently. Groundwater discharge to the site is considered to be predominantly artesian water from the Upper Chalk aquifer beneath the site, particularly in its western end. The water supply for the eastern site is less certain, and may either arise due to upward leakage from the chalk water, or intermittent lateral seepage from the drift deposits, or both. Surface water flows are considered to have little relevance to the site water balance. The main stream to the north of the site is Internal Drainage Board (IDB) managed, and does not regularly flood the site. ***Summary:*** Predominantly fed by artesian water from the semi-confined chalk aquifer (vertical flows), with the possibility of some additional lateral flows from the drift aquifer feeding the eastern site.
The Broads SAC (Broad Fen, Dilham component SSSI)	The exact WetMecs present at Broad Fen, Dilham have not been determined. The following WetMecs may be present (Wheeler & Shaw, 2000): ***WETMEC Type 4:*** Seepage Percolation Basins ***WETMEC Type 5:*** Summer 'Dry' Percolation Surfaces ***WETMEC Type 6:*** Surface Water Percolation Floodplains ***WETMEC Type 7:*** Summer 'Dry' Floodplains The site is a large area of fen, counting a series of ponds and terrestrialised turf ponds.

Designated site	Designated site water supply mechanism (WetMecs data)
	Access constraints in recent years mean that rather little is known about the characteristics of the site. It is possible that groundwater flows predominantly from the underlying Contorted Drift and Crag, contribute to the site's water supply. The fen is also regularly flooded, and although this is likely to be surface water the provenance of the water is not known. ***Summary:*** Water supply for this site has not been established with any certainty. It is likely that groundwater supply (predominantly from the underlying Drift and Crag) and surface water supply (predominantly from winter flooding from adjacent watercourses) are important, but no evidence is available as to what extent these play a role is maintaining site integrity.
Dereham Rush Meadow SSSI	Dereham Rush Meadow has not been assigned WetMecs following Wheeler & Shaw. The descriptive assessment of the water supply mechanism provided below is derived from the SSSI citation. The site is an area of winter-flooded meadowland and alder carr situated in the valley of a the Wendling Beck. The site is predominantly subject to seasonal water supply from wintering surface water flooding of the valley basin. The river now occupies a new cut on the valley side, and the old stream course in the bottom is subject to regular inundation. The northernmost (downstream) part of the site is likely subject to some groundwater influence giving rise to calcareous vegetation types including bird cherry *Prunus padus* and guelder rose *Viburnum opulus* in the shrub layer. Dog's mercury *Mercurialis perennis*. ***Summary:*** The site is predominately surface water fed from inundation from the Wendling Beck. Evidence of localised groundwater intrusion is apparent in the downstream end of the site.
Holly Farm Meadow, Wendling SSSI	The following WetMecs are present at Holly Farm Meadow: ***WETMEC Type 2:*** Intermittent Seepage The site consists mainly of moist marshy grassland, with a tiny area of true fen in the western part of the site. Geological data for the site indicates that the primary water supply mechanism for the site is weak upward flow from the semi-confined Chalk aquifer. The site only experiences minimal, localised flushes so the water supply at this site is marginal. Drains constructed for the nearby A47 / railway cutting have likely restricted water levels at the site. No surface water supply sources have been noted. ***Summary:*** Fed by weak upward leakage from underlying Chalk aquifer (vertical flows).
Whitwell Common SSSI	The following WetMecs are present at Whitwell Common: ***WETMEC Type 1:*** Permanent Seepage Slope

Designated site	Designated site water supply mechanism (WetMecs data)
	WETMEC Type 2: Intermittent Seepage ***WETMEC Type 4:*** Seepage Percolation Basins ***WETMEC Type 8:*** Valley Bottom Wetlands The site comprises a large valleyhead fen on the Blackwater Drain, downstream of Booton Common and upstream of the River Wensum. The water levels and supply varies across the site, and the site supports a number of habitats, including wet fen woodland, tall herb fen, fen meadow (in depression and seepage slopes), reedbed, but also dry oak woodland. Groundwater appears to be the main source of water supply to the site, arising from Chalk aquifer below 3-10m below the site and from lateral and vertical flows from the shallower Drift deposits sitting above the Chalk. Aquitards are present within the Drift which focus the vertical groundwater flow into discrete seepages within the site. No notable surface water input has been identified for the site. ***Summary:*** Groundwater appears to be the main source of water (vertical flows), arising through the Chalk and Drift hydrogeological unit beneath the site.

Table 2 provides details of each water dependent designated site, their proximity to the buried onshore cables (both shallow trenched installation and deeper trenchless installation). It also contains the depth of the water bearing strata in proximity to the construction works, sourced from British Geological Survey (BGS) borehole online data.

The locations of these designated sites are shown on Figure 22.2 of Environmental Statement (ES) Chapter 22 Onshore Ecology (DCO document 6.2) and Figure 5.5 of Information to Support Habitats Regulation Assessment (DCO document 5.3).

The underlying solid geology throughout the onshore project area is Chalk overlain by diamicton (boulder clay). The solid geology and drift geology are presented on Figures 19.1 and 19.2 of ES Chapter 19 Ground Conditions and Contamination (DCO document 6.2). The depth of the Chalk aquifer along the cable route is identified within **Table 2**.

Table 2: Water dependent designated sites and their proximity to the proposed Norfolk Vanguard onshore buried cables

Designated site	Distance to nearest trenching works	Distance to nearest trenchless crossing	Designated site water supply mechanism (*as detailed in in Table 1*)	Approximate depth of Chalk aquifer at nearest trenchless crossing (*based on BGS boreholes TG02SE14 and TG12SW11*)	Importance of groundwater flows to water supply
Norfolk Valley Fens SAC (Booton Common component SSSI)	0.6km	0.6km	Predominantly fed by artesian water from the semi-confined chalk aquifer (vertical flows), with the possibility of some additional lateral flows from the drift aquifer feeding the eastern site.	18m	Important
The Broads SAC (Broad Fen, Dilham component SSSI)	3.6km	4km	Water supply for this site has not been established with any certainty. It is likely that groundwater supply (predominantly from the underlying Drift and Crag) and surface water supply (predominantly from winter flooding from adjacent watercourses) are important, but no evidence is available as to what extent these play a role is maintaining site integrity.	40m	(Potentially) Important)
Dereham Rush Meadow SSSI	0.4km	0.4km	The site is predominately surface water fed from inundation from the Wendling Beck. Evidence of localised groundwater intrusion is apparent in the downstream end of the site.	18m	Not important
Holly Farm Meadow, Wendling SSSI	0.9km	0.9km	Fed by weak upward leakage from underlying Chalk aquifer (vertical flows).	17m	Important
Whitwell Common SSSI	1.2km	1.6km	Groundwater appears to be the main source of water (vertical flows), arising through the Chalk and Drift hydrogeological unit beneath the site.	24m	Important

The WetMecs data indicates that three of these designated sites are predominantly groundwater fed, with a lack of information available to confirm whether a fourth is also reliant on groundwater. In order to understand the groundwater flows between these sites and the Norfolk Vanguard project area, a conceptual model of groundwater flows has been developed.

3 Conceptual Model

A conceptual model has been developed in order to illustrate the likely risks to groundwater supply to these sites from the installation of the cable route and habitats most likely impacted by any changes to groundwater (see **Table 1**). This is shown in **Figure 1** and the pollutant linkages are described in more detail in **Table 3**. The risk ratings applied in **Table 3** are defined in **Table 4**.

The underlying geology of this part of Norfolk is Chalk overlain by diamicton (boulder clay), with crag and Quaternary (drift) deposits at the surface; therefore, the interactions between the project and the underlying geology is likely to be similar for all sites. A conceptual model has therefore been developed for Booton Common, as the closest site to the onshore project area (0.6km). This site has also been identified as the designated site of key concern through consultation with Natural England on this topic[1].

The key components of the conceptual model are discussed in more detail below.

Characteristics of the Chalk aquifer

Along the onshore cable route, the Chalk aquifer is present at depths of 18-40m below ground level and overlain by diamicton (boulder clay). Site investigations have been undertaken at the majority of the trenchless crossing locations along the onshore cable route and a description of the geological horizons is provided within ES Chapter 19 Ground Conditions and Contamination – section 19.6.2.1. BGS borehole data has also been included in **Table 1** for added context as the Chalk aquifer is deeper than most of the site investigation boreholes that were installed for the project.

Interactions between proposed cable installation and water supply mechanisms to designated sites

The onshore cable installation works comprise open cut trenching (to typical 1.5m trench depth) and a number of trenchless crossings (typically 6-8m below ground level) at key sensitive features. Based on the known depths of the Chalk aquifer, this would locate the installation of the cables at least 7m above the aquifer at its shallowest point. As such, direct impacts to underlying Chalk will not occur.

The groundwater flows supplying the designated sites, as identified in **Table 1**, are predominantly vertical, with typically only intermittent or weak localised lateral flows through the drift deposits. It is therefore assumed that the Chalk and/or Drift deposits located in the immediate vicinity of the sites are providing water supply to those sites which are predominantly groundwater-fed.

Figure 1 illustrates that the cable route will not extend beneath the diamicton (boulder clay) layer. This is lower permeability material than the overlying sand and gravel of the glaciofluvial deposits (where present) and the underlying Chalk.

Given that there will be no excavation into the Chalk aquifer across the onshore cable route, pollution of groundwater directly affecting the saturated Principal Aquifer as a result of installation of the onshore cables is not a consideration.

[1] Discussed at the meeting between the Applicant and Natural England on 22nd January 2019, as part of the Norfolk Vanguard Examination.

Interactions between proposed dewatering and water supply mechanisms to designated sites
It is likely that periodic dewatering within the onshore cable trenches (from rainfall and groundwater) will be required during the construction works. Construction teams will only work on a short length of cable route (approximately 150m section) at a time. Once the ducts have been installed in a 150m section the trenches would be back-filled with subsoils, and the stored topsoil re-distributed over the area of the 150m workfront. The time from topsoil strip to reinstatement would typically be two weeks in each 150m section.

Given that trenches will only be open for short stretches and for 1-2 weeks at a time this activity unlikely to comprise significant volumes of water (to dewater), and there is unlikely to be a significant impact to the Principal Chalk Aquifer. Moreover, the presence of the boulder clay aquiclude above the chalk means there is only weak connectivity between the chalk and the superficial deposits, and therefore any water supply generated is unlikely to make its way into the chalk aquifer.

A Surface Water Drainage Plan (SWDP) will be prepared post-consent which will require approval by the relevant planning authority in consultation with the Environment Agency and Norfolk County Council and Lead Local Flood Authority. The SWDP will be implemented to minimise water within the onshore cable trench and other working areas and ensure ongoing drainage of surrounding land prior to construction. This commitment is secured through Requirement 20(2)(i) (Surface Water Drainage Plan) of the draft DCO.

Pollutant linkages
No pollutant linkages have been identified for the proposed development during its operational phase, therefore, there is not considered to be a risk to groundwater during the operation of the proposed onshore cable route.

Watercourse crossings
Dereham Rush Meadow SSSI and Holly Farm Meadow SSSI are both located upstream of the watercourse crossing works associated with Norfolk Vanguard. On this basis, there would be no direct pathway for pollutants between these sites and the onshore construction works.

Surface water impacts to Booton Common SSSI are considered in detail within the Information to Support Habitats Regulation Assessment (DCO document 5.3) at Section 9.3.3.2, which concludes no adverse effect on integrity. Whitwell Common SSSI is fed by the Blackwater Drain downstream from Booton Common. The findings for Booton Common SSSI would be equally applicable to Whitwell Common SSSI, i.e. no adverse effect on integrity.

In addition, the Applicant has committed to develop a scheme and programme for each watercourse crossing, diversion and reinstatement, which will include site specific details regarding sediment management and pollution prevention measures. This scheme will be submitted to and approved by the relevant planning authority in consultation with Natural England. This commitment is secured through Requirement 25 (Watercourse Crossings) of the draft DCO.

With these commitments in place there will be sufficient control measures to safeguard designated sites in relation to sediment control, pollution prevention and reinstatement of all work areas at watercourse crossings.

Figure 1: Conceptual Model

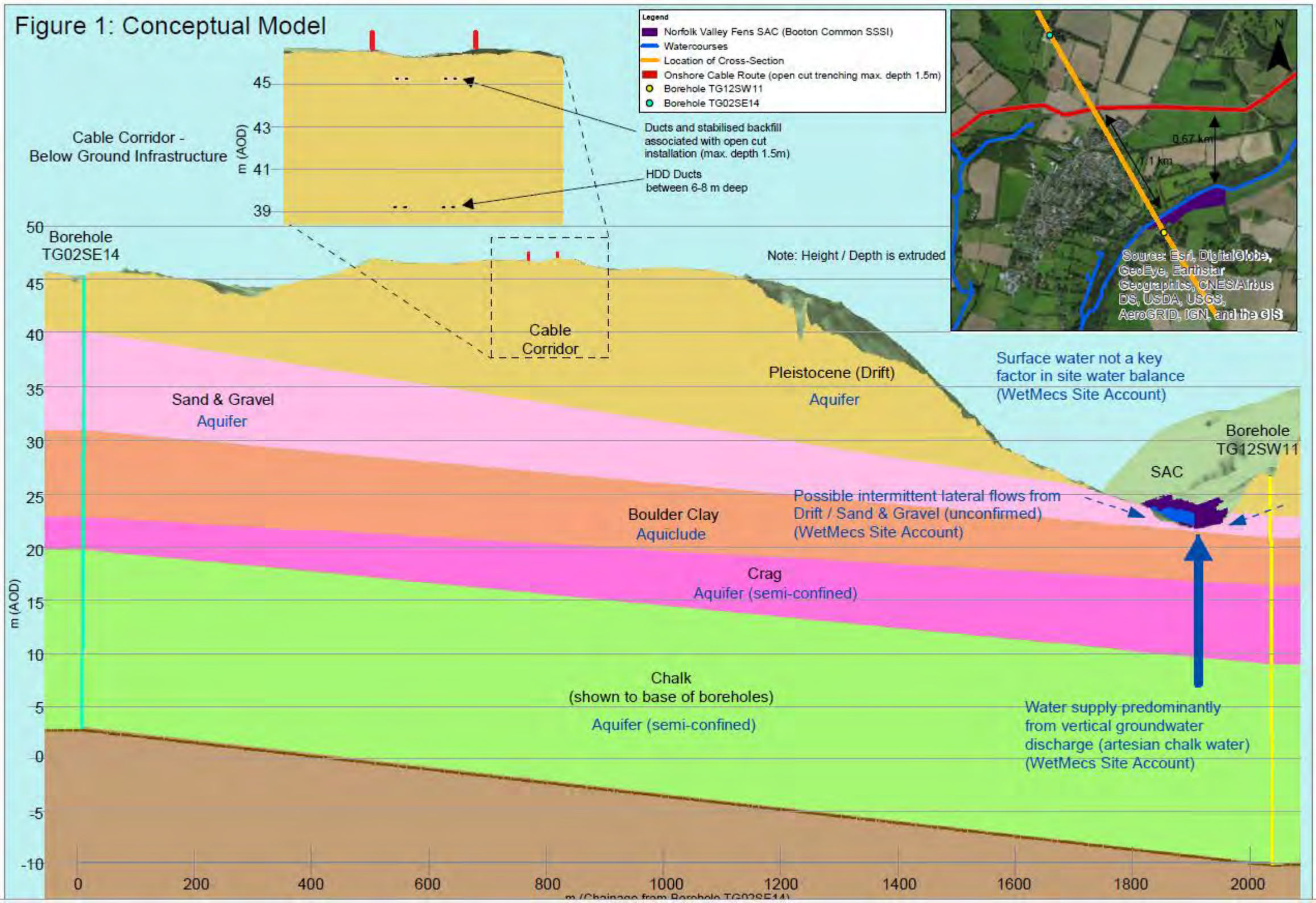


Table 3: Summary of Conceptual Model – Pollutant Linkages

Source	Pathway	Receptor	Risk rating	Mitigation proposed	Risk rating following mitigation
Fuel or oil spills from machinery on site	Excavation of trench for cable route and surface water run-off	Groundwater in superficial aquifer (where present) Groundwater in Chalk aquifer	High	• No refuelling in or in proximity to designated sites. • No storage of any potentially contaminative materials in or in proximity to designated sites. • No welfare facilities in or in proximity to designated sites. Mitigation secured within the project's post-consent Code of Construction Practice, which Natural England will be consulted on prior to discharge.	Low
Sediment fines	Open trench through small drainage channels	None likely – not a pollutant linkage. The sediment fines will be trapped by superficial aquifer and will not travel through the silty clay layer	Negligible	Prevent silt generation through use of silt trapping devices when working in crossing areas. Mitigation secured within the project's post-consent Surface Water Drainage Plan, which Natural England will be consulted on prior to discharge.	Negligible
Contaminated surface water	Over-pumping during open trenching and discharge to ground. Dewatering excavations	Groundwater in superficial aquifer (where present) Groundwater in Chalk aquifer	Medium	Any dewatering would be restricted to pumping direct to interceptor drains within our surface water drainage system (as set out in the Surface Water Drainage Plan). These would include sediment traps. Water would recharge to the surrounding land from the interceptor drains.	Negligible
Contaminated groundwater from superficial aquifer	Dewatering during trenching	Groundwater in superficial aquifer (where present) Groundwater in Chalk aquifer	Medium	Any dewatering would be restricted to pumping direct to interceptor drains within our surface water drainage system (as set out in the Surface Water Drainage Plan). These would include sediment traps. Water would recharge to the surrounding land from the interceptor drains.	Negligible

Table 4: Risk rating terminology

Risk Rating	Description
High risk	• Contaminants very likely to represent an unacceptable risk to identified receptors • Site probably not suitable for current/future use • Enforcement action possible • Urgent action required
Medium risk	• Contaminants likely to represent an unacceptable risk to identified receptors • Site probably not suitable for current/future use • Action required in the medium term
Low risk	• Contaminants may be present but unlikely to create unacceptable risk to identified receptors • Site probably suitable for current/future use • Action unlikely to be needed whilst site remains in current use
Negligible risk	• If contamination sources are present they are considered to be minor in • nature and extent • Site suitable for current/future use • No further action required

4 Conclusion

Following the information provided in Wheeler & Shaw (2000), of the five sites considered within this clarification note, four are either predominately groundwater-fed of have not had their water supply provenance established. Of these, all are predominantly fed by vertical upflow from the underlying chalk aquifer. Although intermittent lateral flows from local drift deposits are apparent at some sites, these are not the primary source of water supply for any of the sites identified. A conceptual model has been developed for Booton Common, as the closest site to the onshore project area. The model demonstrates that the onshore cable trenching and HDD activities associated with the onshore project construction phase will remain at least 7m above the Chalk aquifer at any point, and will be separated from the chalk aquifer by the boulder clay aquiclude. As such, no pathway between the onshore project area and any of the designated sites identified within this clarification note has been identified. As the installation of the cable route cannot be demonstrated to affect the groundwater supply to these sites, further detailed assessment is not deemed necessary.

5 References

Wheeler, B.D. and Shaw, S.C. (2000) A Wetland Framework For Impact Assessment At Statutory Sites In Eastern England: Site Accounts. R&D Technical Report W6-068/TR2. Environment Agency, Bristol.

Wheeler, B.D. and Shaw, S.C. (2006) Ecohydrological site accounts for East Anglia. Appendix 3A Booton Common.

Appendix 3
Clarification Note: Norfolk Vanguard
Bat Impact Assessment – Paston Great Barn Special Area of Conservation (SAC)

HaskoningDHV UK Ltd.

1 Introduction

Within their Relevant Representation to the Norfolk Vanguard Offshore Wind Farm Development Consent Order (DCO) application, Natural England stated:
"*From the information provided, we consider that there is likely to be an impact on the SAC due to loss and severance of foraging and commuting habitat over at least 7 years…. As requested previously, in order to fully assess the impact we would like more information about each hedgerow to be removed in Table 9.10 plus an accurate estimation of the timescale for recovery to previous condition (or better) following installation of the cable trench. The assessment should provide an indication of hedgerow quality for bats, as well as the potential long term effects on quality with estimated timescales. Quality factors likely to be of relevance to bats include height, gaps/solid hedge ratio, aspect, species composition of hedgerow shrubs and non-woody plants, width of hedge etc.*

"Also, we would like to see an estimation of the importance to bats from Paston Great Barn of the 11ha of woodland that will be fragmented by the hedgerow removal.

"We advise that, as a requirement of the development, that prior to removal of hedgerows, a mitigation plan should be drawn up and agreed with Natural England. The plan should include for the improvement of the hedgerows either side of the section to be removed including any gapping up, tree management and the development of scrub/rough grassland margins. The mitigation plan should be in place for 7 years or until the original hedgerow has recovered fully."

This note provides clarification in relation to queries raised by Natural England in their Relevant Representation regarding the information provided for Norfolk Vanguard Offshore Wind Farm (the project) to support a Habitats Regulations Assessment (HRA) for the Paston Great Barn Special Area of Conservation (SAC) and the barbastelle bat maternity colony for which it is designated.

This note sets out the following:

- A summary of the approach to survey and assessment of the Paston Great Barn SAC undertaken for the project;
- A summary of the status of the commuting and foraging bat habitat both directly and indirectly affected by the project during construction as a result of habitat fragmentation;
- A summary of the mitigation proposed; and
- Links to where further detail on the points summarised here are presented within the Information to support Habitats Regulations Assessment and Environmental Impact Assessment (EIA).

Following further consultation with Natural England on the 22nd January 2019, this note has been updated to include additional information regarding the extent of available alternative foraging habitat for barbastelles of the Paston Great Barn colony, the location of habitat potentially temporarily fragmented as a result of the construction of the project, and the locations of hedgerows temporarily affected during the construction works.

2 Approach to survey and assessment for the Paston Great Barn SAC

The following steps were undertaken to identify the potential impacts of the project upon the barbastelle bats of the Paston Great Barn SAC maternity colony:

1. **Bat study area** - An initial bat study area of all land within the onshore project footprint and within 5km from Paston Great Barn SAC was identified as an appropriate study area for potential effects upon barbastelle bats of the Paston Great Barn SAC colony. The 5km buffer was agreed through consultation with Natural England and Norfolk County Council.

2. **Habitat assessment** – An Extended Phase 1 Habitat Survey was undertaken pre-application of all habitats located within the bat study area. This survey identified 18 hedgerows (and associated habitats) that were present within the bat study area. Landowner access was not granted to survey 5 of these 18 hedgerows. The limitations of survey access were discussed as part of the associated Expert Topic Group and it was agreed that a precautionary approach could be adopted where access was not granted. In addition, aerial photography was reviewed where access was not granted.

   A habitat assessment of the accessible hedgerows was undertaken, and the quality of each hedgerow for supporting commuting or foraging bats was assessed against the criteria set out in Table 4.1 of the Bat Conservation Trust (BCT) bat surveys guidance (Collins, 2016). Through this exercise, 12 of the 13 accessible hedgerows surveyed were identified as providing moderate or high suitability for supporting commuting or foraging bats. The remaining five hedgerows which could not be surveyed were also assumed to be of moderate / high suitability for supporting commuting or foraging bats (adopting a precautionary principle), therefore 17 of the 18 hedgerows identified were classed as having moderate or high suitability.

3. **Radio-tracking data** – The Norfolk Barbastelle Study Group (NBSG) radio-tracking dataset – a dataset tracking three females of the Paston Great Barn SAC colony over a period from 2013 – 2015 – was then used to identify whether any of these hedgerows were located within known important features for barbastelles of the Paston Great Barn SAC colony. The data identified five important barbastelle features within the bat study area. These five broad features included 11 of the 17 hedgerows identified as providing moderate or high suitability.

4. **Bat activity survey data** – Bat activity survey data was collected monthly for 6 months during the 2018 bat activity season to provide a further dataset alongside the habitat assessment and radio-tracking data. Where survey access was possible, activity transects were walked to cover all the hedgerows identified as moderate or high suitability. The transects covered five of the 17 hedgerows identified. Barbastelle were recorded on all five of these hedgerows, confirming that all suitable hedgerows are likely being used by commuting / foraging barbastelle.

5. **Assessment** (*Please refer to **Table 3** for the location of key assessment information and application documentation*) – Potential direct and indirect effects on barbastelle of the Paston Great Barn SAC maternity colony using the commuting and foraging habitat within the bat study area were considered. This included quantifying the following key effects:
   a. The length / area of suitable commuting / foraging habitat temporarily lost during construction (i.e. total hedgerow loss before reinstatement), and the duration of this loss, in the context of the available resource for the Paston Great Barn SAC colony.

b. The fragmentation of the commuting / foraging habitat, and the length / area of habitat isolated by severance to linear features, in the context of the available resource for the Paston Great Barn SAC colony.
c. Indirect effects (e.g. from construction lighting).

3 Status of hedgerow resource affected by the project

Table 1 below provides a summary of the 18 hedgerows located within the bat study area that may be affected by the project. The locations of these hedgerows are shown on **Figure 1**. It includes details of the quality of the habitat, and its suitability for supporting commuting / foraging bats, based on Table 4.1 of the BCT bat survey guidelines (Collins, 2016).

Table 1: Hedgerows potentially affected by the project (hedgerow numbering as shown on Important Hedgerows Plan (DCO document 2.11 (Version 2 Jan 2019)) (see Figure 1 for locations)

Hedgerow	Habitat assessment[1]	Assessed potential for support commuting / foraging bats[2]	Length potentially affected (m)	Quality factors					Further comments
				Height	Width	Gaps/Solid hedge ratio	Aspect	Species composition	
15	Species-poor	Moderate - High	20	5-10	4	0% gappy	E-W facing	Intact species poor.	Hedgerow connected to drainage ditch and rank grassland network foraging habitat at Ridlington Street, which also provides good connectivity in the wider area.
16	Species-poor with trees	Moderate - High	15	3-5	7	0% gappy	E-W facing	Species poor hedgerow with mature trees; hawthorn, oak, bramble, ivy and dry ditch.	As above
18	N/A	Moderate - High	25	1-2	2	5% gappy	NW-SE facing	[No information available]	No assessment conducted as access was not granted. Under a precautionary principle, these hedgerows are assumed to be of moderate – high suitability for supporting commuting foraging bats.
19	N/A	Moderate - High	23	2-3	3	5% gappy	NE-SW facing	[No information available]	
21	N/A	Moderate - High	23	2-3	3	5% gappy	NE-SW facing	[No information available]	
22	N/A	Moderate - High	25	2-3	3	5% gappy	NW-SE facing	[No information available]	
23	Species-poor with trees	Moderate - High	23	1	3	5% gappy	E-W facing	Intact species poor.	Hedgerows with trees providing minimum shelter and isolated from higher quality areas of foraging habitat. May be important as part of wider commuting / foraging routes.
24	Species-poor with trees	Moderate - High	20	1	3	10% gappy	E-W facing	Intact species poor. Common oak, bramble, hawthorn.	As above

[1] Based on Extended Phase 1 Habitat Surveys conducted in February 2017 and February 2018.
[2] Based on Extended Phase 1 Habitat Surveys conducted in February 2017 and February 2018.

Hedgerow	Habitat assessment[1]	Assessed potential for support commuting / foraging bats[2]	Length potentially affected (m)	Quality factors					Further comments
				Height	Width	Gaps/Solid hedge ratio	Aspect	Species composition	
25	N/A	Moderate - High	20	3-5	4	0% gappy	E-W facing	Intact species poor with trees. Common oak, bramble, hawthorn.	No assessment conducted as access was not granted. Under a precautionary principle, this hedgerow was assumed to be of moderate – high suitability for supporting commuting foraging bats.
26	Species-rich with trees	Moderate - High	25	3-5	4	10% gappy	N-S facing	Intact species-rich with trees. Hawthorn, blackthorn, holly, ash, common oak. Ground flora: red dead nettle, cleavers, herb robert, nipplewort, ground ivy, ribwort plantain, fern sp.	Mature hedgerow with occasional gaps and mature trees. Provides good shelter between large open fields.
Unnamed	Species-rich with trees (woodland)	Moderate - High	N/A	N/A	N/A	N/A	N/A	N/A	80m wide plantation woodland block at Witton. Provides connectivity with Bacton Wood (coniferous plantation) to the south, and Northern Plantation (broadleaved plantation woodland) to the north.
29	Species-rich	Moderate - High	21	1-2	2	20% gappy	E-W facing	Intact species-rich with trees.	Narrow, low hedgerow surrounded by open arable landscapes. Provides connectivity between Bacton Wood and species-rich hedgerows at Edingthorpe.
30	Species-poor with trees	Moderate - High	20	2-3	3	10% gappy	NW-SE facing	Intact species poor.	Semi-mature hedgerow with gaps and trees running along North Walsham Road. Provides some connectivity with the wider hedgerow network.
31	Species-poor with trees	Moderate - High	20	5-10	4	10% gappy	NW-SE facing	Intact species poor.	As above.

Hedgerow	Habitat assessment[1]	Assessed potential for support commuting / foraging bats[2]	Length potentially affected (m)	Quality factors					Further comments
				Height	Width	Gaps/Solid hedge ratio	Aspect	Species composition	
34a	Species-poor with trees	Moderate - High	25	15-20	8	10% gappy	NW-SE facing	Intact species poor with trees. Hawthorn, ash, common oak; bramble, nettle, ferns, dog rose, cocks foot.	Mature hedgerow with gas adjacent to wider network for semi-improved grassland for foraging.
34b	Species-poor with trees	Moderate - High	25	5-10	7	10% gappy	NW-SE facing	Intact species poor with trees. Hawthorn, ash, common oak; bramble, nettle, ferns, dog rose, cocks foot.	Hedgerow with gaps adjacent to good network of superior hedgerows (species-rich with trees) and for semi-improved grassland for foraging.
Unnamed	Defunct hedgerow	Low	25	1	2	60% gappy	NW-SE facing	Defunct, species-poor. Hawthorn; ground flora ivy, bramble and nettle.	Defunct hedgerow, with low vegetated bank and occasional shrubs only.
37	Species-poor with trees	Moderate - High	23	2-3	3	20% gappy	NE-SW facing	Intact species-poor. Hawthorn with scattered ash and common oak, bramble.	Mature hedgerow with gaps adjacent to wider network for semi-improved grassland for foraging.

4 Status of habitat fragmented by temporary hedgerow loss

An 11ha habitat mosaic of broadleaved woodland, rank grassland, hedgerows and drainage ditches is present at the edge of the 5km buffer from Paston Great Barn SAC, in proximity to the village of Witton. This habitat mosaic is shown on **Figure 2** of this clarification note. This 11ha will potentially be fragmented due to temporary crossings by the onshore cable route of two hedgerows located along the road from Bacton Wood to Witton (25 and 26), i.e. temporary gaps in the hedgerows that maintain connectivity to this 11ha habitat. The potential suitability of these 11ha has been assessed using aerial photography and using the NBSG bat radio-tracking data. This habitat mosaic feature has been assessed for its potential suitability as a foraging resource as follows:

Table 2: Suitability of habitat mosaic as a potential foraging resource (as shown on Figure 2 of this clarification note (and Figure 9.3 of the Information for the Habitats Regulations Assessment (DCO document 5.3)))

Location	Habitat assessment	Assessed potential for support foraging bats	% of all suitable habitats located within barbastelle home range[3]
Witton	Mosaic of habitats associated within the upper reaches of the Hundred Stream. Habitats include semi-natural broadleaved woodland (approximately 7ha) and semi-improved grassland (approximately 4ha) and an intersecting drainage ditch network associated with the Hundred Stream, plus approximately 1km of species-rich hedgerow with trees.	Moderate - High	0.6%

Bats have not been confirmed using this habitat to date and, therefore, a precautionary approach has been applied, and it has been assumed that this mosaic potentially supports foraging barbastelle bats.

5 Extent of alternative foraging habitat within the study area

The 11ha of habitat fragmented during construction of the project represents approximately 0.6% of the potentially suitable habitats for supporting commuting / foraging bats located within the Paston Great Barn study area. The extent of the potentially suitable habitats for supporting commuting / foraging bats located within the Paston Great Barn study area is shown on Figure 2. These include the following habitats:

- grassland,
- riparian habitats,
- woodlands,
- hedgerows,
- coastal cliffs.

[3] Calculated using aerial imagery to identify all potentially suitable habitats for supporting commuting / foraging bats (grassland, riparian habitats, woodlands, hedgerows). It should be noted that the key foraging area identified by the radio-tracking data is the coastal cliffs at Mundesley. The inland foraging areas (including all of those listed above) were recorded during inclement weather conditions along the coast, making foraging at the cliffs unfavourable. Inland foraging was therefore also predominantly recorded in spring and autumn (NBSG, 2017).

It should be noted that the key foraging area identified by the radio-tracking data is the coastal cliffs at Mundesley (NBSG, 2017). Bats were only recorded using the inland foraging areas (including all of those listed above) during inclement weather conditions along the coast, when foraging at the coastal cliffs was unfavourable. Inland foraging was predominantly recorded in spring and autumn (NBSG, 2017). Given the very small percentage of the available habitat which will be potentially fragmented, and the fact that this is both not part of the key foraging area along the coast near Mundesley and is on the edge of the study area, fragmentation of these 11ha are not considered to give rise to likely significant effects on the integrity of the Paston Great Barn SAC.

6 Construction Methodology and Mitigation

The onshore cable duct installation strategy will be conducted in a sectionalised approach in order to minimise impacts. Construction teams would work on a short length (approximately 150m section) at a time. Topsoil would be stripped and temporarily stored within each 150m section and subsoils stored separately also within the same 150m section. Where the 150m section crosses a hedgerow, the working width will be reduced from 45m to 20m to minimise the length of hedgerow that is temporarily removed.

Once the ducts have been installed in a 150m section the trenches would be back-filled with subsoils, and the stored topsoil re-distributed over the area of the 150m workfront, with the exception of the running track and any associated drainage retained for the cable pulling phase (the retained running track would be 6m wider and will only be retained for the cable pull for approximately 20% of the cable route). The time from topsoil strip to reinstatement would typically be two weeks in each 150m section (with the exception of the 6m wide running track where this is retained).

Hedgerows, which are temporarily removed to enable the project, will also be reinstated as soon as possible. Replanting will be implemented, where possible, in the first winter after they have been removed, with the exception of any 6m gap required for the running track, where this need to be retained for cable pulling phase. Any remaining 6m hedgerow gaps will be replanted following the completion of the cable pull phase.

Following reinstatement, hedgerows are anticipated to take between 3-7 years to mature back to a standard whereby the hedgerow is providing value for commuting and foraging barbastelle bats (provision of shelter and invertebrate assemblage). Where the hedgerow lost is a species-rich hedgerow with trees, recovery is expected to be take the full seven years for the replacement hedgerow to reach the full value of the lost hedgerow. However, only two of the 18 hedgerows affected were identified as species rich with trees. Taking this recovery time into account, given the localised loss of hedgerow within habitats in the edge of the study area the anticipated the removal and subsequent reinstatement of hedgerow is not considered to give rise to likely significant effects on the integrity of the Paston Great Barn SAC.

The following mitigation will be implemented at the important hedgerow features (a summary only is provided below – further detail is provided within Section 9.3.2.1.1 of the Information for the Habitats Regulations Assessment (DCO document 5.3) and within the Outline Landscape and Ecology Strategy (DCO document 8.7), an is secured through Requirement 24 - Ecological Management Plan (EMP):

- The width of the working corridor has been reduced from 45m to 20m[4] at hedgerow crossings to minimise impacts from hedgerow removal as far as possible.
- Mature trees in hedgerows will be avoided where possible during micrositing.
- Hedgerow removal will be programmed for winter where possible, to give bats time to adjust to the change prior to maternity period (a hedgerow removal plan will form part of the submitted EMP).
- Replanting will follow guidance within the Norfolk Hedgerow Biodiversity Action Plan and will include appropriate species for northeast Norfolk, including ground flora planting designed to encourage insect biomass (BCT, 2012). Replanting will take place within the full extent of the cable easement. Future hedgerow management to include allowing standard trees to develop (taking into account the restrictions on tree planting immediately above the cable easement).
- Subject to landowner permissions, for each hedgerow that is important for foraging and commuting bats up to 25m either side of the section to be removed prior to construction would be left to become overgrown to improve the quality of the surrounding hedgerow as a resource for commuting and foraging bats (Bates, 2010). These permissions are being sought as part of the ongoing landowner agreement discussions.
- Pre-construction activity surveys will be undertaken to cover any gaps within the baseline data presented within the Information for the Habitats Regulations Assessment (DCO document 5.3).

- Five years of hedgerow aftercare will be delivered to ensure the establishment and development of the replacement hedgerows. Any replacement hedgerow planted as part of an approved Landscape Management Scheme that, within the first five years of the aftercare period, is removed, dies or becomes, seriously damaged or diseased, must be replaced in the first available planting season with a specimen of the same species and size as that originally planted.

7 Conclusion

17 predominantly species poor hedgerows with gaps have been identified with moderate-high potential to support foraging barbastelle bats associated with the Paston Great Barn SAC. During construction, these hedgerows will be crossed and a temporary 20m gap will be created. In addition, connectivity to an 11ha mosaic of woodland and grassland will be temporarily severed by crossing one of these 17 hedgerows. However, the hedgerows are at the edge of the assumed 5km range of the Paston Great Barn SAC and the effects are considered temporary and small-scale. With mitigation in place hedgerows are expected to fully recover within 3-7 years and efforts will be taken to improve the quality of the adjacent hedgerows prior to construction (allowing them to overgrow). As such, **no potential adverse effect on the integrity** of the Paston Great Barn SAC, in relation to the conservation objectives for the site are anticipated.

8 Further information

Table 3 provides a signpost to where further details of the information presented in this note can be found within the information submitted to date as part of the project DCO application.

[4] This is at perpendicular crossings – this value can be up to 25m where the project crosses hedgerows at an oblique angle.

Table 3: Further information

Topic	Document	Document Reference	Section
Conservation objectives for Paston Great Barn SAC	Information for the Habitats Regulations Assessment	5.03	9.1.2.3.
Methodology used for characterising hedgerows	Information for the Habitats Regulations Assessment	5.03	9.1.2.2.2, 9.3.2.1.1 9.3.2.1.2
Location of hedgerows	Important Hedgerows Plan	2.11	-
	Appendix 22.1 Extended Phase 1 Habitat Survey Report	6.2.22.1	Figure 4 (Pages 19-20, 23-24)
Habitat assessment of hedgerows	Appendix 22.1 Extended Phase 1 Habitat Survey Report	6.2.22.1	Annex C: Target Notes
Location of important barbastelle features	Information for the Habitats Regulations Assessment	5.03	Figure 9.4
Location of Verona Planation	Information for the Habitats Regulations Assessment	5.03	Figure 9.4
Bat activity survey results	Appendix 22.4 Bat Activity Survey Report	6.2.22.4	BACT 19 BACT 21 BACT 22 BACT 24 BACT 34
Results of NBSG radio-tracking data	Information for the Habitats Regulations Assessment	5.03	Figure 9.4

9 References

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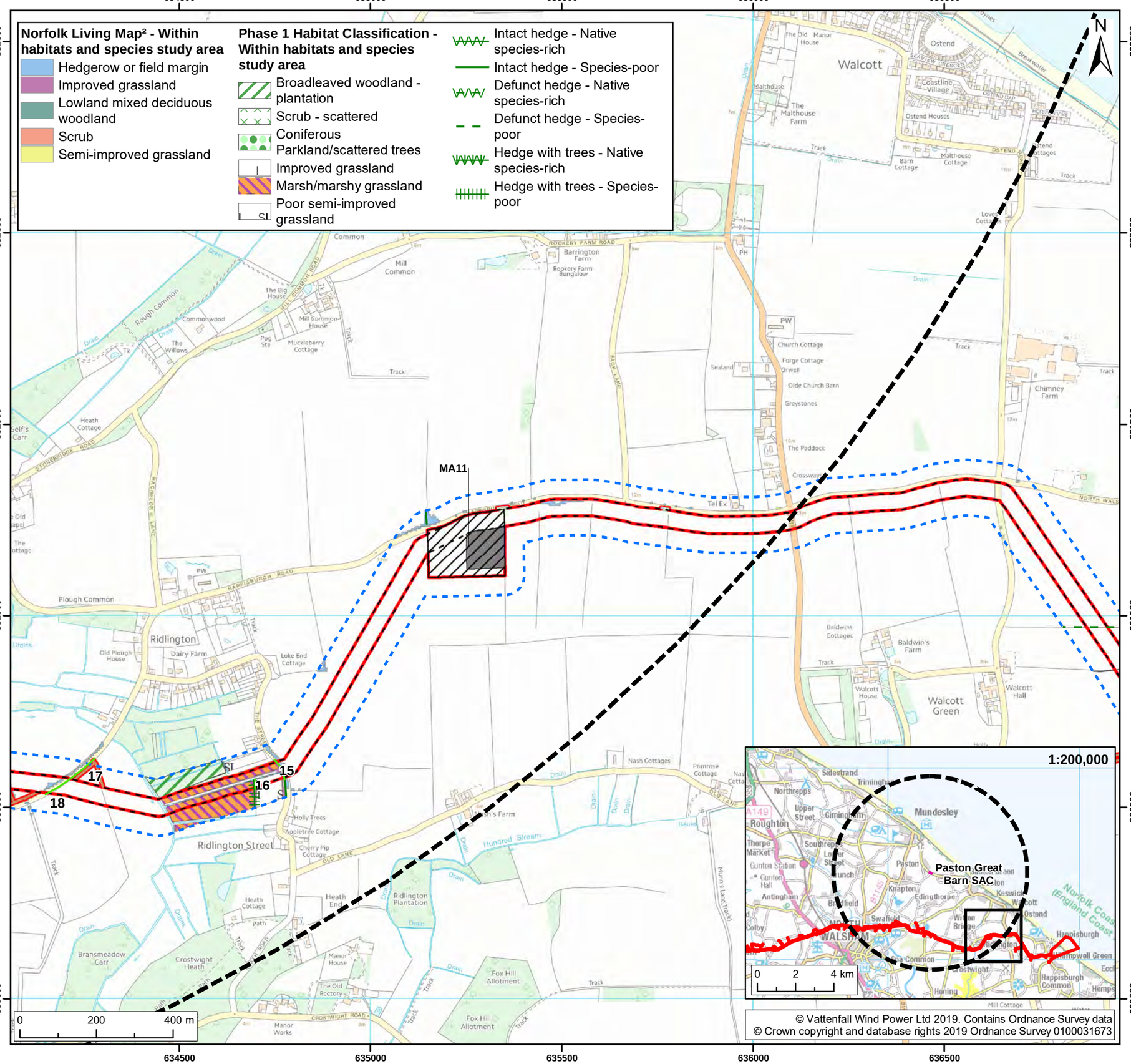

Norfolk Living Map² - Within habitats and species study area

- Hedgerow or field margin
- Improved grassland
- Lowland mixed deciduous woodland
- Scrub
- Semi-improved grassland

Phase 1 Habitat Classification - Within habitats and species study area

- Broadleaved woodland - plantation
- Scrub - scattered
- Coniferous Parkland/scattered trees
- Improved grassland
- Marsh/marshy grassland
- Poor semi-improved grassland

- Intact hedge - Native species-rich
- Intact hedge - Species-poor
- Defunct hedge - Native species-rich
- Defunct hedge - Species-poor
- Hedge with trees - Native species-rich
- Hedge with trees - Species-poor

Legend:

- Norfolk Vanguard onshore red line boundary
- Paston Great Barn Special Area of Conservation (SAC) 5km buffer

Onshore cable route

- Onshore cable route
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

Environmental Designations¹

- Special Area of Conservation (SAC)

Study area

- Habitats and species study area
- Commuting / foraging features within the study area
- 11 Hedgerow number (following important hedgerow Plan Document Reference 2.11)

¹ Natural England, 2018.
² NBIS, 2018.

Project:	Report:
Norfolk Vanguard	Examination: For Information Only

Title:

Paston Great Barn SAC – Location of features of particular importance for barbastelle (Map 1 of 4)

Figure: 1 | Drawing No: PB4476-008-006-002

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	25/02/2019	JT	GC	A3	1:10,000
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Co-ordinate system: British National Grid **EPSG:** 27700

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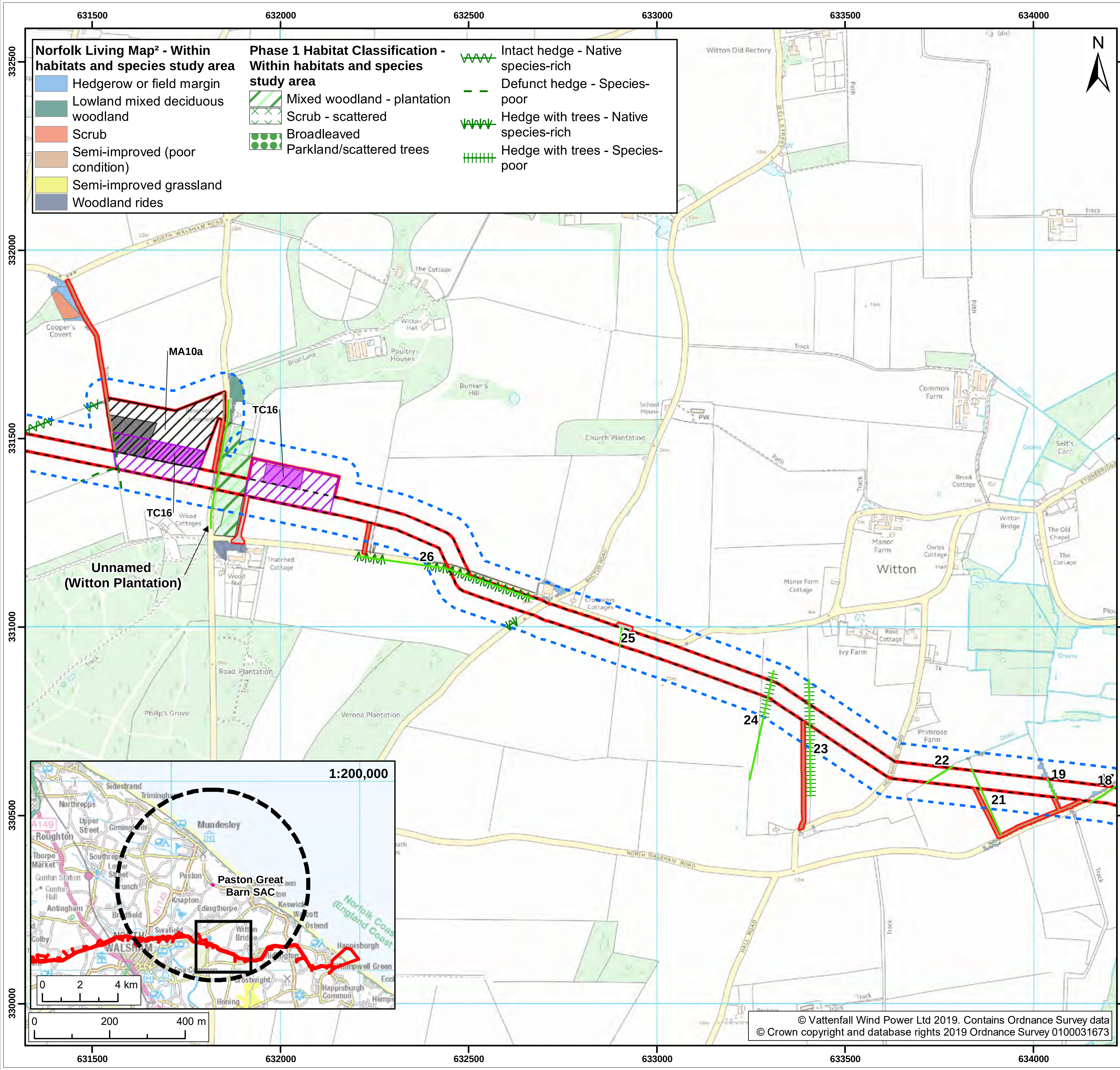
Norfolk Living Map² - Within habitats and species study area
Hedgerow or field margin
Lowland mixed deciduous woodland
Scrub
Semi-improved (poor condition)
Semi-improved grassland
Woodland rides
Phase 1 Habitat Classification - Within habitats and species study area
Mixed woodland - plantation
Scrub - scattered
Broadleaved Parkland/scattered trees
Intact hedge - Native species-rich
Defunct hedge - Species-poor
Hedge with trees - Native species-rich
Hedge with trees - Species-poor
N
MA10a
TC16
TC16
Unnamed (Witton Plantation)
26
25
24
23
22
21
19
18
Witton
1:200,000
Paston Great Barn SAC
Mundesley
0 2 4 km
0 200 400 m
631500
632000
632500
633000
633500
634000
332500
332000
331500
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330500
330000
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Legend:

- Norfolk Vanguard onshore red line boundary
- Paston Great Barn Special Area of Conservation (SAC) 5km buffer

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

Environmental Designations¹

- Special Area of Conservation (SAC)

Study area

- Habitats and species study area
- Commuting / foraging features within the study area
- 11 Hedgerow number (following important hedgerow Plan Document Reference 2.11)

¹ Natural England, 2018.
² NBIS, 2018.

Project:	Report:
Norfolk Vanguard	Examination: For Information Only

Paston Great Barn SAC – Location of features of particular importance for barbastelle (Map 2 of 4)

Figure: 1	Drawing No: PB4476-008-006-002				
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British National Grid **EPSG:** 27700

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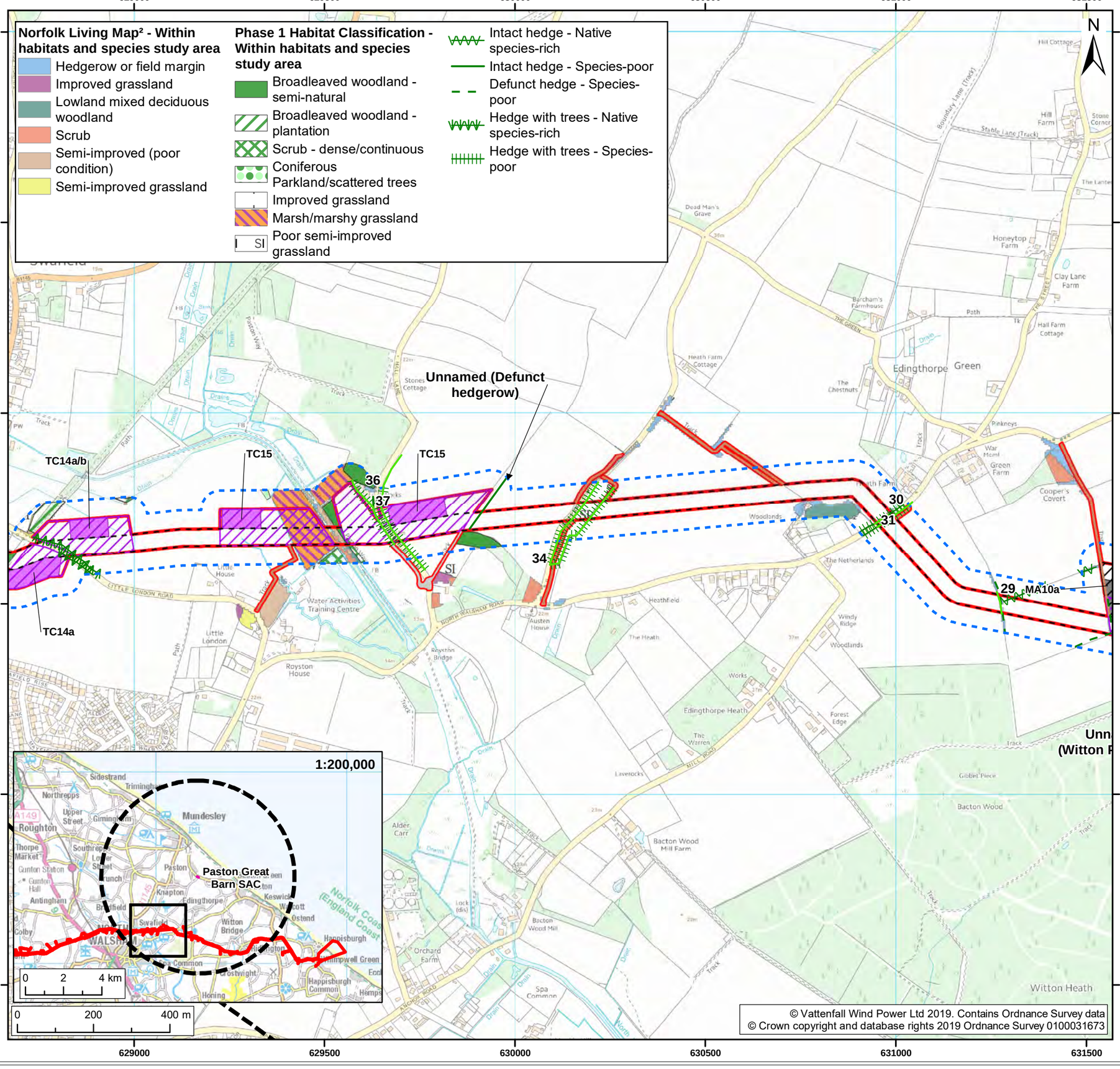

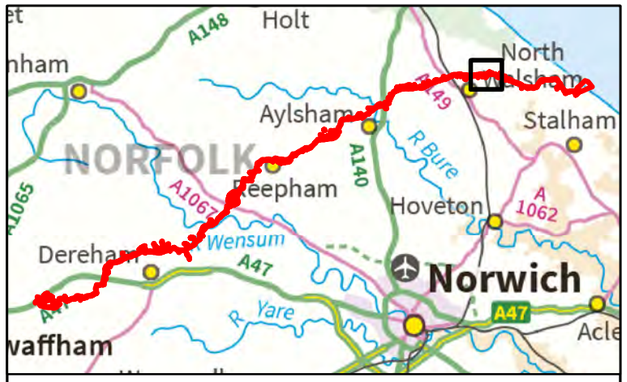

Legend:

- Norfolk Vanguard onshore red line boundary
- Paston Great Barn Special Area of Conservation (SAC) 5km buffer

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

Environmental Designations[1]

- Special Area of Conservation (SAC)

Study area

- Habitats and species study area
- Commuting / foraging features within the study area
- 11 Hedgerow number (following important hedgerow Plan Document Reference 2.11)

[1] Natural England, 2018.
[2] NBIS, 2018.

Project:	Report:
Norfolk Vanguard	Examination: For Information Only

Paston Great Barn SAC – Location of features of particular importance for barbastelle (Map 3 of 4)

Figure: 1 | Drawing No: PB4476-008-006-002

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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01	22/02/2019	JT	GC	A3	1:10,000

British National Grid **EPSG:** 27700

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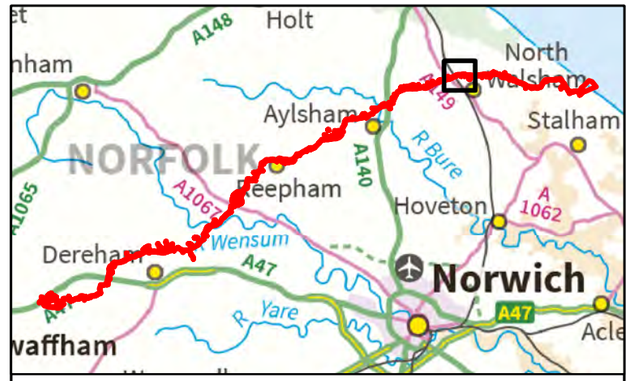
Norfolk Living Map² - Within habitats and species study area

- Coniferous plantation
- Hedgerow or field margin
- Improved grassland
- Lowland mixed deciduous woodland
- Scrub
- Semi-improved (poor condition)
- Semi-improved grassland

Phase 1 Habitat Classification - Within habitats and species study area

- Broadleaved woodland - semi-natural
- Broadleaved woodland - plantation
- Mixed woodland - plantation
- Scrub - dense/continuous
- Improved grassland
- Poor semi-improved grassland
- Cultivated/disturbed land - amenity grassland
- Intact hedge - Native species-rich
- Intact hedge - Species-poor
- Defunct hedge - Native species-rich
- Hedge with trees - Native species-rich
- Hedge with trees - Species-poor



Legend:

- Norfolk Vanguard onshore red line boundary
- Paston Great Barn Special Area of Conservation (SAC) 5km buffer

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

Environmental Designations¹

- Special Area of Conservation (SAC)

Study area

- Habitats and species study area
- Commuting / foraging features within the study area
- 11 Hedgerow number (following important hedgerow Plan Document Reference 2.11)

¹ Natural England, 2018.
² NBIS, 2018.

MA9 TC12 TC13 TC13 TC14a/b TC14a MA10

1:200,000

Paston Great Barn SAC

0 2 4 km

0 200 400 m

Project:	Report:
Norfolk Vanguard	Examination: For Information Only

Paston Great Barn SAC – Location of features of particular importance for barbastelle (Map 4 of 4)

Figure: 1 Drawing No: PB4476-008-006-002

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	25/02/2019	JT	GC	A3	1:10,000
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British National Grid **EPSG:** 27700

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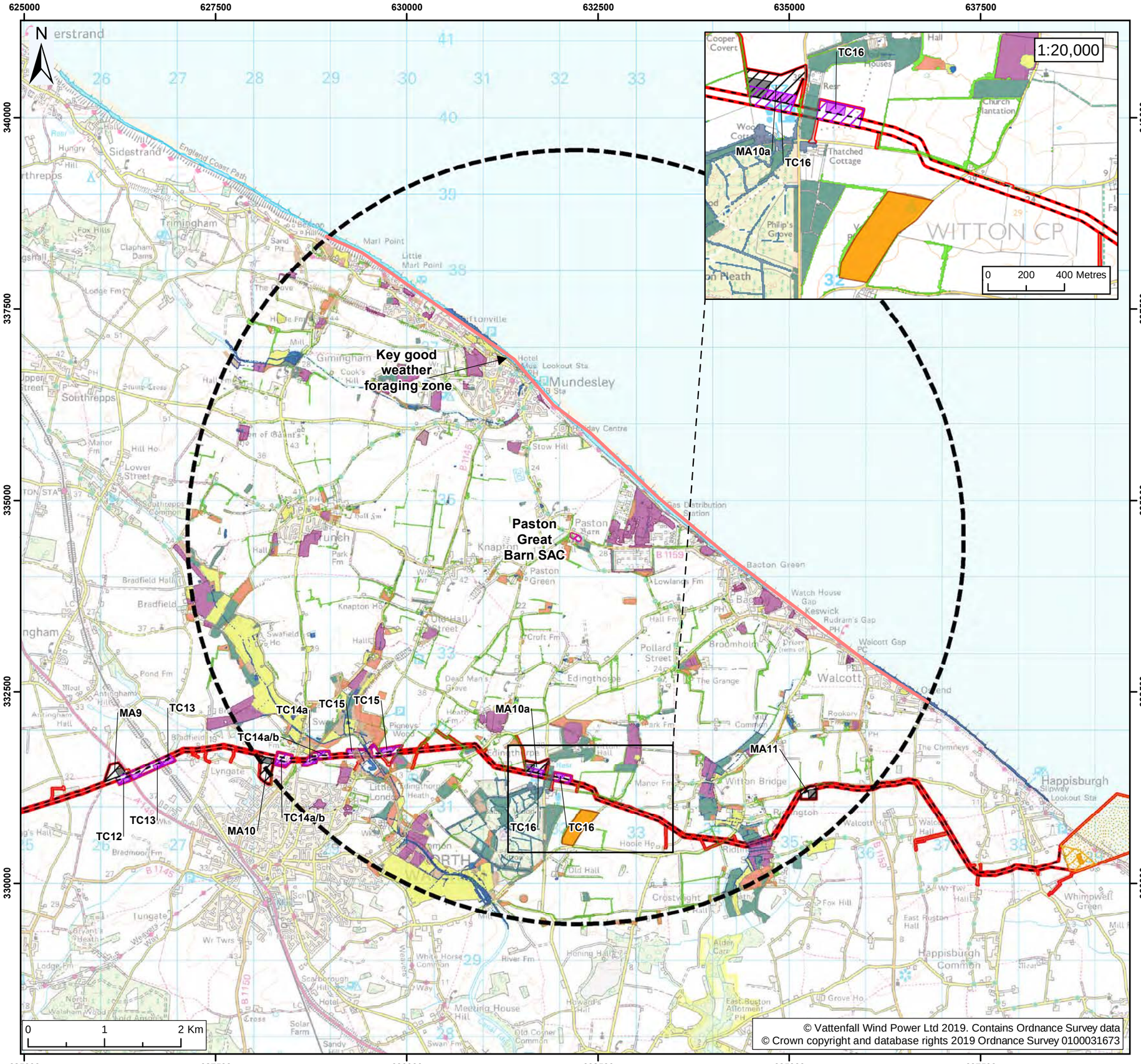

Legend:

- Norfolk Vanguard onshore red line boundary
- Paston Great Barn Special Area of Conservation (SAC) 5km buffer

Environmental Designation

- Special Area of Conservation (SAC)[1]

Landfall

- Landfall zone
- Landfall compound zone
- Indicative landfall compound

Onshore cable route

- Onshore cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound

Access

- Construction access
- Operation access

Suitable habitats for foraging barbastelle'

- Coastal sediment
- Fen, Marsh and Swamp
- Hedgerow or field margin
- Improved grassland
- Lowland mixed deciduous woodland
- Scrub
- Semi-improved (poor condition)
- Semi-improved (scrub)
- Semi-improved grassland
- Waterbodies
- Woodland rides
- Habitat fragmented during construction
- Key good weather foraging zone

[1] NBIS, 2018

Project:	Report:
Norfolk Vanguard	Examination: For Information Only

Title:

Bat foraging areas within the study area

Figure: 2 | Drawing No: PB4476-008-006-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/02/2019	JT	GC	A3	1:50,000
01	19/02/2019	JT	GC	A3	1:50,000

Co-ordinate system: British National Grid **EPSG:** 27700

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Clarification Note: Norfolk Vanguard
Sediment Management at the River Wensum crossing

HaskoningDHV

1 Introduction

The purpose of this note is to clarify the Applicant's approach to onshore construction works within functional floodplains, with particular reference to the crossing of the River Wensum Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI). This is in response to queries raised by Natural England and the Environment Agency within Relevant Representations and Written Representations to the Norfolk Vanguard Offshore Wind Farm Development Consent Order (DCO) application.

1.1 Background

1.1.1 Natural England

Natural England within its Relevant Representation and Written Representation to the Norfolk Vanguard DCO application has stated:

"*Works to facilitate the trenchless crossing of the River Wensum may take place within the River Wensum floodplain north of Penny Spot Beck, restoration of this site should be undertaken sensitively: deep turf stripping and reinstatement is more appropriate than natural regeneration or reseeding. We would be happy to agree a restoration plan when more information is known.*

There is insufficient detail in the Code of Construction Practice (CoCP) for measures to safeguard the designated site in relation to sediment control and reinstatement of all work areas. In addition, detailed management and monitoring procedures should be provided in the CoCP in case of 'breakout' (where the drilling fluid leaves the bore and escapes into the surrounding substrate).

Details of actual methods employed are needed in relation to sediment control, and reinstatement of all work areas.

Further detail on the ongoing management of silt traps and screens and decommissioning/disposal of retained sediment is required.

Location of permanent access tracks is not provided and is needed. These would require the retention and maintenance of sediment and surface water control measures

Interceptor drains are an important part of sediment control and therefore need to be combined with sediment management measures

It is unclear whether there would be 2 HDD's or 1 if the location north of Penny Spot Beck is used."

1.1.2 Environment Agency

The Environment Agency within its Relevant Representation and Written Representation to the Norfolk Vanguard Offshore Wind Farm DCO application has stated:

"The applicant has proposed that spoil can be stored in the floodplain in separate piles to enable floodwater to pass through the floodplain. This issue is a matter of concern to the Environment Agency because of its potential effects in relation to flood risk and the ecology of waterbodies.

The storage of spoil in the floodplain is unacceptable in respect of ecology and water quality, this is because in a flood event or periods of heavy rainfall sediment or soil could be mobilised.

To overcome our concerns, any proposal to store spoil in the floodplain would need to be assessed for each individual location. We will require an assessment to be undertaken for each site where it is proposed to store spoil in a floodplain to determine the impact of spoil piles on flood storage and flood flow; without this we will not permit. In addition, it will be necessary for the landscape and ecological management plan to include procedures to monitor and mitigate for effects during heavy rainfall events when runoff or mobilisation is likely to occur."

2 Potential works within the functional floodplain

The presence of a functional floodplain (Flood Zone 3b) is shown on Figure 20.5 of Environmental Statement (ES) Chapter 20 Water Resources and Flood Risk. There are 13 instances where the onshore cable route crosses Flood Zone 3b, as shown on Figure 20.5 and these are also detailed within Appendix 20.4 of Chapter 20. The 13 crossings are described below in Table 1.

Table 1 – Instances where the onshore cable route crosses the functional floodplain

Watercourse	Shown on Figure 20.5 of Chapter 20	Crossing method	Construction presence within the functional floodplain?
North Walsham and Dilham Canal (Main River)	Map 2	Trenchless	No. Trenchless crossing compounds located outside of Flood Zone 3b
Suffield Beck (IDB drain)	Map 3	Open cut	No. Flood Zone 3 does not extend beyond the channel edge in this location
Blackwater Beck	Map 3	Trenchless	No. Trenchless crossing compounds located outside of Flood Zone 3b
River Bure (Main River)	Map 4	Trenchless	No. Trenchless crossing compounds located outside of Flood Zone 3b
Booton Watercourse	Map 5	Open cut	**Yes**. Flood Zone 3b approximately 100m wide where cable route crosses the watercourse
Reepham Stream (east) (IDB drain)	Map 5	Open cut	No. Flood Zone 3 does not extend beyond the channel edge in this location
Reepham Stream (west) (IDB drain)	Map 6	Open cut	**Yes**. Flood Zone 3b approximately 30m wide where cable route crosses the watercourse
Unnamed (Sparham House) (Main River)	Map 6	Open cut	No. Flood Zone 3 does not extend beyond the channel edge in this location
River Wensum (Main River)	Map 7	Trenchless	**Yes**. There are three trenchless crossing compounds in this location. Two of these are located within Flood Zone 3b

Penny Spot Beck	Map 7	Trenchless	**Yes**. There are three trenchless crossing compounds in this location. Two of these are located within Flood Zone 3b
Penny Spot Beck (second crossing 1.2km south of the confluence with the River Wensum)	Map 7	Open cut trench	**Yes**. Flood Zone 3b approximately 120m wide where cable route crosses the watercourse
Wendling Beck (Main River)	Map 8	Trenchless	No. Trenchless crossing compounds located outside of Flood Zone 3b
Wendling Beck (Main River)	Map 8	Trenchless	**Yes**. One of the two trenchless crossing compounds is partially located within Flood Zone 3b

Table 1 indicates that there are six instances where construction activity may be required along the onshore cable route within the functional floodplain. The remainder of this note will focus on the River Wensum / Penny Spot Beck crossings, but the approach to sediment management within the functional floodplain would be delivered for all six instances where works are required in the functional floodplain.

3 River Wensum / Penny Spot Beck crossings

3.1 Construction methodology

Trenchless crossing (e.g. HDD) at the River Wensum and Penny Spot Beck is proposed to avoid direct interaction with the channel habitats. The preferred crossing is a single trenchless crossing from the north of the River Wensum to the south of both the River Wensum and Penny Spot Beck TC5a/b to TC5a/b (white dashed line shown on Figure 1), which would avoid the floodplain habitats north of Penny Spot Beck.

Prior to detailed design there remains the possibility that a third compound (TC5a) may be required within the River Wensum floodplain north of Penny Spot Beck if two trenchless crossings are required due to local ground conditions (i.e. one to cross the Wensum north of the Penny Spot Beck, and a second one to cross the Penny Spot Beck; see the yellow dashed lines on Figure 1). The assessment included within the application (Information to Support Habitats Regulations Assessment - document reference 5.3) assumed that works to facilitate the trenchless crossing of the River Wensum may require both crossings as a worst case, i.e. works would take place within the River Wensum floodplain north of Penny Spot Beck.

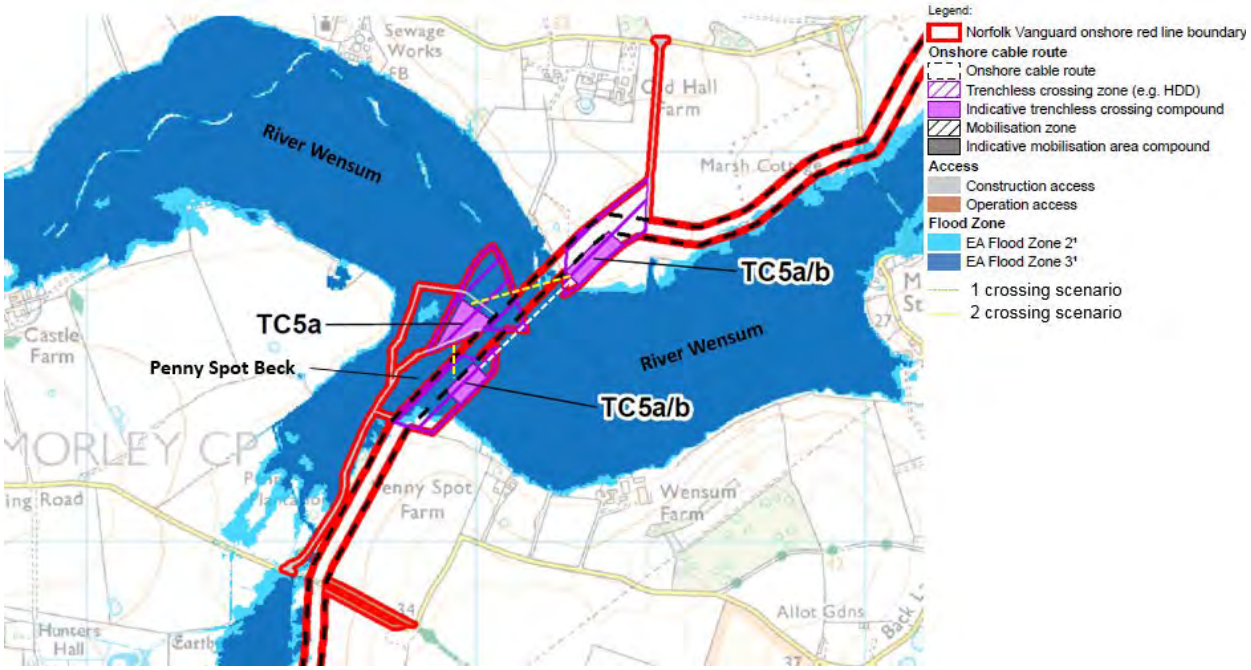

Figure 1 – location of trenchless crossings in proximity to the River Wensum and Penny Spot Beck

The proposed works associated with the River Wensum crossing are described within the Information to Support Habitats Regulations Assessment (document reference 5.3). The works will entail the introduction of temporary vehicle access and earthworks to establish the trenchless crossing compounds. Subject to ground conditions the preferred way of working in the functional floodplain would be to establish the compound area by placing protective matting (geotextile) down on top of the existing pasture grassland (i.e. avoiding the requirement for a topsoil strip). Some earthworks would still be required, for example where the drill rig itself would operate, but the remainder of the compound areas would not necessarily require a topsoil strip.

As a worst-case, a topsoil strip may still be required to establish the trenchless crossing compounds. This will be determined pre-construction following further site investigation and will be confirmed during detailed design. The three identified trenchless crossing compounds associated with the River Wensum crossing, shown on Figure 1, comprise:

- 0.75ha area on the northern side of the River Wensum, outside of the functional floodplain,
- 0.5ha area on the southern side of the River Wensum within the functional floodplain; and
- 0.7ha located north of the Penny Spot Beck within the functional floodplain (for the third compound if required).

In the worst case-scenario, up to approximately 1.2ha of topsoil within the functional floodplain will be stripped and stored during construction to accommodate the required trenchless crossing compounds (which represents 0.4% of the overall onshore cable route).

Access to the works compounds will be along the running track (outside of the functional floodplain). If the third compound is required then temporary new construction accesses will be formed of protective matting (geotextile), temporary metal road or permeable gravel aggregate, dependant on the ground conditions.

Plant, including a drilling rig, haulage vehicles and earth-moving equipment will be operating within the trenchless crossing compounds for approximately eight weeks. A small amount of additional material will be brought into site for drilling fluid. This will be a mixture of water and natural clays (e.g. bentonite), which will be removed from site as waste upon completion of the works.

Following completion of the trenchless crossing (taking approximately eight weeks) the working areas within the functional floodplain will demobilised and reinstated.

There are no new permanent accesses required for operation across the functional floodplain.

3.2 Mitigation measures

The following mitigation measures will be implemented to minimise the risk of sediment or pollutant release into the River Wensum and Penny Spot Beck.

Sediment management – works within the functional floodplain

- The preferred way of working within the functional floodplain will be to establish the trenchless crossing compounds by placing geotextile on top of the existing pasture grassland. Whilst it is accepted that grass covered by geotextile for 8 weeks will die back, it will not expose bare soils beneath and the grass will recover more quickly than reseeding or natural regeneration in the case of topsoil stripping.
- Where a topsoil strip is required, for existing grassland located within the functional floodplain, this will be undertaken using a turf cutter. Turf rolls will be retained and reinstated after the works are complete (approximately eight weeks) to maximise the potential for reinstatement / restoration to be effective.
- Removed topsoil and turf will be stored outside of the functional floodplain.
- Any damage to ground conditions caused by vehicle tracking will be rectified prior to the reinstatement of topsoil/turf.
- Construction drainage will be introduced along the onshore cable route in advance of the works. The drainage will be designed to minimise water entering works areas and to ensure ongoing drainage of surrounding land. A surface water drainage plan will be included within the final CoCP produced post-consent, which will be in accordance with the certified Outline CoCP. This will include the following measures:
    - The surface water drainage introduced in advance of construction will include interceptor drains for surface water flows. The interceptor drains will include areas for the settlement of sediment (sediment traps). Sediment traps are locally wider/deeper areas of the drains that will encourage passive sediment deposition.
    - Sediment traps will be monitored weekly (visual inspection) during the trenchless crossing works (with increased monitoring during inclement weather). If required these traps can be pumped via settling tanks to remove sediment, based on a pre-defined level / depth of sediment.
    - Where water enters the construction areas, this will be pumped via settling tanks or ponds to remove sediment before being discharged into local ditches or drains via the interceptor drains in order to prevent increases in fine sediment supply to the watercourses.
    - When the interceptor drains and associated sediment traps are decommissioned any standing water within the drains would be pumped out to settling tanks as described above. Sediment that has settled out within the interceptor drain would be left in place. Soils would be replaced in the reverse order that they were removed and turf reinstated.

- Existing tracks and roadways will be utilised for access where possible. Temporary construction accesses within the functional floodplain are required if the third trenchless crossing compound (north of Penny Spot Beck) is used. Any topsoil removal and subsequent post-construction reinstatement will follow the steps outlined above.

Sediment management – measures to be applied throughout the onshore work areas *(as detailed within section 11.1.1 of the outline CoCP – document ref: 8.1)*

- The area of open ground at any one time within one sub-catchment will be restricted, across a notional 5 km length, to 2 working areas (configured as 45m x 300m strips); with the assumptions that 50% of one mobilisation area, 50% of one set of trenchless crossing compounds and 25% of 5km running track will be open ground. This represents a maximum area of disturbed open ground of 0.068 km^2 per 5km of cable at any one time.
- Topsoil would be stripped from the entire width of the onshore cable route for the length of each approximately 150m workfront, and stored and capped to minimise wind and water erosion within the onshore cable route.
- Once all the trenching is completed and back-filled within each workfront, the stored topsoil will be re-distributed over the area of the workfront, with the exception of the running track and any associated drainage.
- Mobilisation areas within the onshore project area will comprise hardstanding of permeable gravel aggregate underlain by geotextile, or other suitable material.
- Subsoil exposure will be minimised and strips of undisturbed vegetation will be retained on the edge of the working area where possible.
- Where surface vegetation has been removed (with the exception of arable crops), this will be reseeded to prevent future runoff. (Where surface vegetation is located within the functional floodplain this will be removed using a turf cutter and stored as rolls to improve reinstatement success).
- On-site retention of sediment will be maximised by routing all drainage through the site drainage systems.
- The drainage system will include silt fences at the foot of soil storage areas to intercept sediment runoff at source. Where practicable, runoff will be routed into swales, which incorporate check dams to further intercept sediment and/or attenuation ponds which incorporate sediment forebays. Suitable filters will be used to remove sediment from any water discharged into the surface drainage network.
- Additional silt fences will be included in parts of the working area that are in proximity to surface drainage channels. It is not intended that silt fences will be used where works are located in the functional floodplain as spoil will not be stored in these locations. Sediment traps would be incorporated into the design of the surface water drainage.
- Soil and sediment will not be allowed to accumulate on roads. Traffic movement would be restricted to minimise the potential for surface disturbance.

Pollution prevention

- The working methodology will follow construction industry good practice guidance, as detailed in the Environment Agency's Pollution Prevention Guidance (PPG) notes (including PPG01, PPG05, PPG08 and PPG21)22, and CIRIA's 'Control of water pollution from construction sites – A guide to good practice' (2001), including:
    - Spill kits will be available on site at all times and staff will be trained in their use
    - Sand bags or stop logs will also be available for deployment on the outlets from the site drainage system in case of emergency spillages.
    - Equipment will be regularly checked to ensure leakages do not occur.

- Refuelling of construction plant will be restricted to designated impermeable areas.
- All fuels, oils, lubricants and other chemicals will be stored in an impermeable bund with at least 110% of the stored capacity.
- Suitable biosecurity protocols (such as those outlined by the Non-Native Species Secretariat (NNSS)) would be put in place during the works in order to minimise the risk of contamination and the spread of the invasive non-native species.

Bentonite breakout

Bentonite is an inert clay based material used as a lubricant at the drill head during trenchless crossing techniques – comprising 95% water and 5% clay. It does not represent a pollutant but can cause smothering of habitats if not contained.

For small breakouts it may cause more damage to the sensitive habitats to attempt to contain the breakout and remove the escaped material, i.e. trampling of grassland associated with responding to the breakout and the potential for exposing bare ground. A break-out contingency plan will be developed and will be included in the final CoCP, which will define the approach for responding to breakouts. The steps of the contingency plan will include:

- Measures to ensure drilling stops once a breakout is reported (there will be a drop in pressure at the drill head).
- Measures to contain the breakout, for example sand bags, to minimise the extent of any smothering.
- Measures to remove the released bentonite if a significant volume of material is contained – for example pumped back to the bentonite lagoon within the trenchless crossing compound, or pumped to the interceptor drains, or pumped to the mobile settling tanks that will be used for managing sediment traps.
- The exact specification for the contingency plan will be informed by further ground investigation and the specific design of the trenchless crossing.

3.3 Residual Effects and Securing Measures

The mitigation measures set out in section 3.2 for minimising the risk of sediment / pollutant release into areas functionally connected to the River Wensum will reduce impacts down to a negligible level. These measures will be fully captured within an updated outline CoCP and submitted to the Norfolk Vanguard examination.

In light of the negligible risk of sediment / pollutant release into the River Wensum and Penny Spot Beck following implementation of these mitigation measures, no potential adverse effect on the integrity of the River Wensum SAC has been identified in relation to the conservation objectives (as set out within the Information to Support Habitats Regulations Assessment - document reference 5.3).

No stage of the onshore transmission works may commence until for that stage a CoCP has been submitted to and approved by the relevant planning authority, in consultation with the Environment Agency. This is secured through Requirement 20 of the draft DCO.

No stage of the onshore works, involving the crossing of any watercourse, may commence until a scheme is submitted and approved setting out the design of that crossing, mitigation measures and details of reinstatement/restoration. The scheme will be submitted to the relevant planning authority in consultation with Natural England. This is secured through Requirement 25 of the draft DCO.

Clarification Note: Norfolk Vanguard
Other outstanding issues raised by Natural England

HaskoningDHV UK Ltd.

1 Unresolved issue: Sand martins at Happisburgh

1.1 Natural England's position

Sand martin are known to nest in Happisburgh Cliffs which may be affected by noise, vibration and 24hr working (i.e. works involving lighting). The stated distance between nest sites and landfall (130m), Chapter 25 Onshore Noise and Vibration Table 25.17 Predicted distances at which vibration levels may occur shows that some vibration may be felt at this distance. Therefore, an assessment of potential vibration effects and the significance of this for birds should be evaluated.

We agree that lighting should follow good practice guidance for wildlife.

1.2 Applicant's response

The potential impacts upon nesting sand martins arising from vibration effects generated during horizontal direction drilling (HDD) and other construction activities at the landfall have been considered as part of Environmental Statement (ES) Chapter 23 Onshore Ornithology. The first level of assessment was to consider whether there is any potential pathway for vibration to give rise to potential effects. Chapter 25 Noise and Vibration (section 25.4.1.2) considered the potential for different activities to give rise to vibration effects during the construction and operation phases of the project. Following BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites*, Chapter 25 Noise and Vibration identified the following activities as potentially giving rise to vibration effects along the onshore cable route (which were confirmed through consultation feedback on the PEIR received in March 2018):

- Vibratory Compaction (Start-up) (associated with running track installation)
- Vibratory Compaction (Steady State) (associated with running track installation)
- Percussive Piling (associated with onshore substation)
- HGV Movement on uneven Haul Route (activities along the running track)

None of the activities potentially giving rise to a vibration effect are anticipated within the landfall works area – the running track will lead up to the landfall compound approximately 450m from the cliff edge. HDD was not considered to be an activity which in itself is likely to give rise to noticeable vibration effects. This was due to the following reasons:

1. Based on the calculations used in BS 5228-1:2009+A1:2014, HDD was not considered to be over the threshold for which vibration energy (measured as pea particle velocity) would give rise to noticeable effects. This includes boring below ground (the HDD activity will be located approximately 18m below the sand martin nests at its closet point).
2. The landfall area is underlain by sandy clay and sand to a depth of approximately 18m below ground level (as shown in Chapter 19 Ground Conditions and Contamination, section 19.6.1.1). HDD through this loose material would generate limited vibration effects; in addition, the loose material itself is a poor propagator of vibration effects. Vibration is best propagated through hard surfaces and the looser the material the more any potential vibration effect becomes dampened.

As such, vibration effects arising from HDD activities were screened out from further consideration. Chapter 23 Onshore Ornithology has based its conclusion that there is no pathway for vibration effects to impact upon sand martin nests at the landfall.

2 Unresolved issue: One year of survey data in relation to Broadland SPA / Ramsar site wintering birds

2.1 Natural England's position

Broadland SPA/Ramsar site: This site was scoped out of the HRA on the basis that there was evidence of low levels of wintering birds associated with the SPA/Ramsar using the study area. However, this may have been due to the cropping regime at the time of survey. We requested that this point was taken account of by including additional measures, e.g. survey and/or WeBS data and information about predicted crop patterns at the time of the proposed work. We suggest that the Outline Landscape and Ecological Management Strategy (OLEMS) is amended to include further survey and provide suitable mitigation measures if required.

2.2 Applicant's response

It was agreed with Natural England during the Evidence Plan Process (Norfolk Vanguard - Onshore Wintering Bird Surveys Survey Methodology Approach Update Response February 2017 (Document Reference: PB4476.003.038 – attached to this note) that one year of baseline surveys was appropriate, and as such the Applicant has not planned further surveys for wintering birds.

As part of this agreement Natural England recommended considering reviewing local cropping patterns to provide evidence as to how this may have influenced the survey findings and in turn whether this was representative for the available habitat during construction. The potential for local cropping patterns to influence the findings of the surveys was considered. Whilst some fields were recently ploughed, the majority of crops in place over winter within the wintering bird survey area (winter crop, fallow (grass)) would still provide suitable foraging habitat for pink-foot geese, and as such the survey results recorded over winter in 2016/2017 provided a robust estimate of the use of these habitats by qualifying features of the Broadland SPA and Ramsar site, i.e. that there are low levels of wintering birds associated with the SPA / Ramsar using the study area . These conclusions are based on the findings of the Wintering bird surveys conducted in Winter 2016/2017 (Document reference: 6.2.23.1).

Mitigation measures throughout the onshore project area have already been proposed to account for changes in cropping patterns for wintering birds to use different habitats for foraging and resting on an interannual basis and are set out in Paragraph 224 and 225 of the Outline Landscape and Ecological Management Strategy (Document Reference: 8.7). This includes a commitment to not undertake winter works in any one area in consecutive years. The area of arable land located within 5km of the Broadland SPA and Ramsar site and within the onshore project area is approximately 20ha, which represents a less than 0.5% of the available arable land within 5km of the SPA and

Ramsar (see paragraph 196 of Chapter 23 Onshore Ornithology for further information), and therefore the use of the mitigation measures set on in the Outline Landscape and Ecological Management Strategy (Document Reference: 8.7) are considered appropriate.

3 Unresolved issue: Use of the 300m disturbance buffer in relation to designated sites

3.1 Natural England's position

For the assessment of noise disturbance on birds which are features of designated sites, Natural England suggest designated sites within 500m are screened in for assessment. namely River Wensum SSSI; Dereham Rush Meadow SSSI; Dillington Carr, Gressenhall SSSI.

We advise that a detailed noise assessment is carried out for sites within 500m of the project area and mitigation provided for any impacts identified or evidence is provided to demonstrate that there will be no additional noise experienced from construction at the designated site boundary.

3.2 Applicant's response

A 300m buffer zone for potential noise impacts to birds which are features of designated sites was proposed and agreed with Natural England in February 2017. This was agreed in *Onshore Wintering Bird Surveys Survey Methodology Approach Update* (Document Reference: PB4476.003.038), is attached for reference.

Subsequent to this, the 300m disturbance buffer for potential effects upon designated sites was set out within Chapter 23 Onshore Ornithology of the Project's Preliminary Environmental Assessment Report (Document reference: PB4476-004-023). As these sites were beyond 300m they were screened out from the assessment. No further comments were received on the use of this buffer as part of stakeholder responses to the use of the 300m buffer.

The assessment provided within the application has been undertaken on the basis of this formal agreement of the methodology. The 300m buffer was is based on an average of the disturbance buffers detailed in Ruddock and Whitfield (2007) and is considered to be an appropriate distance for the basis of the assessment.

4 Unresolved issue: Grade 3 Agricultural Land Classification (ALC) soils need to be split to allow an assessment of impact to Best and Most Versatile (BMV) to be undertaken

4.1 Natural England's position

Grade 3 ALC soils need to be split into Grade 3a and Grade 3b, so that the assessment of loss of BMV land can be properly made (Table 21.10). The amount of BMV land that would be permanently lost to the development, i.e. by buildings etc., and the time it would take for the recovery of soils that are disturbed by the construction should be quantified in the ES.

We note that the total permanent land take for the footprint of the onshore project substation and National Grid substation extension zone is approximately 10.5ha according to the worst case scenario (Table 21.16). These will be on ALC grades 2 and 3 land; the amount of BMV land should be estimated.

4.2 Applicant's response

The Natural England dataset for this part of Norfolk is no longer broken down into ALC Grades 3a and 3b soils.

The Applicant has calculated the total extent of land that will be permanently lost within Chapter 21 Land use and Agriculture; that is 7.5ha for the onshore project substation (ALC Grade 3) and 3ha for the National Grid extension works (ALC 2 and 3) - 10.5ha in total. There is no permanent loss of land along the onshore cable route.

Within the assessment presented within ES Chapter 21 Land Use and Agriculture the Applicant identified the 3ha of land associated with the National Grid extension (ALC Grade 2 and 3) to be a receptor of high value (due to the presence of Grade 2 land); and the 7.5ha of land associated with the onshore project substation (ALC Grade 3) to be a receptor of medium value. However, in the absence of a dataset splitting up Grade 3a and 3b a precautionary approach should have been taken and all 10.5ha classed as Grade 2 and 3 should have be assessed as BMV land.

This was addressed in the errata document submitted to the examination in December 2018 (document reference - Pre-ExA; Errata; 9.4). The errata document updated the assessment presented within Chapter 21 and concluded that residual effects to BMV land remain non-significant but have been elevated from negligible to minor adverse.

The approach to mitigation remains unchanged to that reported at section 21.7.6.2.4, i.e. private agreements for compensation will be sought between Norfolk Vanguard Limited and relevant landowners/occupiers regarding any permanent loss of land incurred as a direct consequence of the operation phase of the project.

5 Unresolved Issue: Topsoil should be reinstated where it originated

5.1 Natural England's position

Topsoil should be reinstated where it originated. There are significant differences between topsoil in arable and grassland, valley bottom and valley sides and natural, semi natural and managed land. This will need clearly addressing in the Soil Management Plan (SMP).

5.2 Applicant's position

The onshore cable duct installation will be conducted in a sectionalised approach in order to minimise impacts. Construction teams would work on a short length (approximately 150m section) with topsoil stored adjacent to the excavated trench. Once the cable ducts have been installed, the 150m section would be back filled and the top soil replaced before moving onto the next section. This would minimise the amount of land being worked on at any one time and would also minimise the duration of works on any given section of the route. This is set out as embedded mitigation within the Outline Code of Construction Practise (OCoCP) (section 2.5.1).

Section 8 (soil management) of the OCoCP will be updated to confirm that topsoil will be stored adjacent to the excavated trench and will be reinstated where it originated. The SMP will be produced post-consent in accordance with the principles set out in section 8 of the OCoCP.

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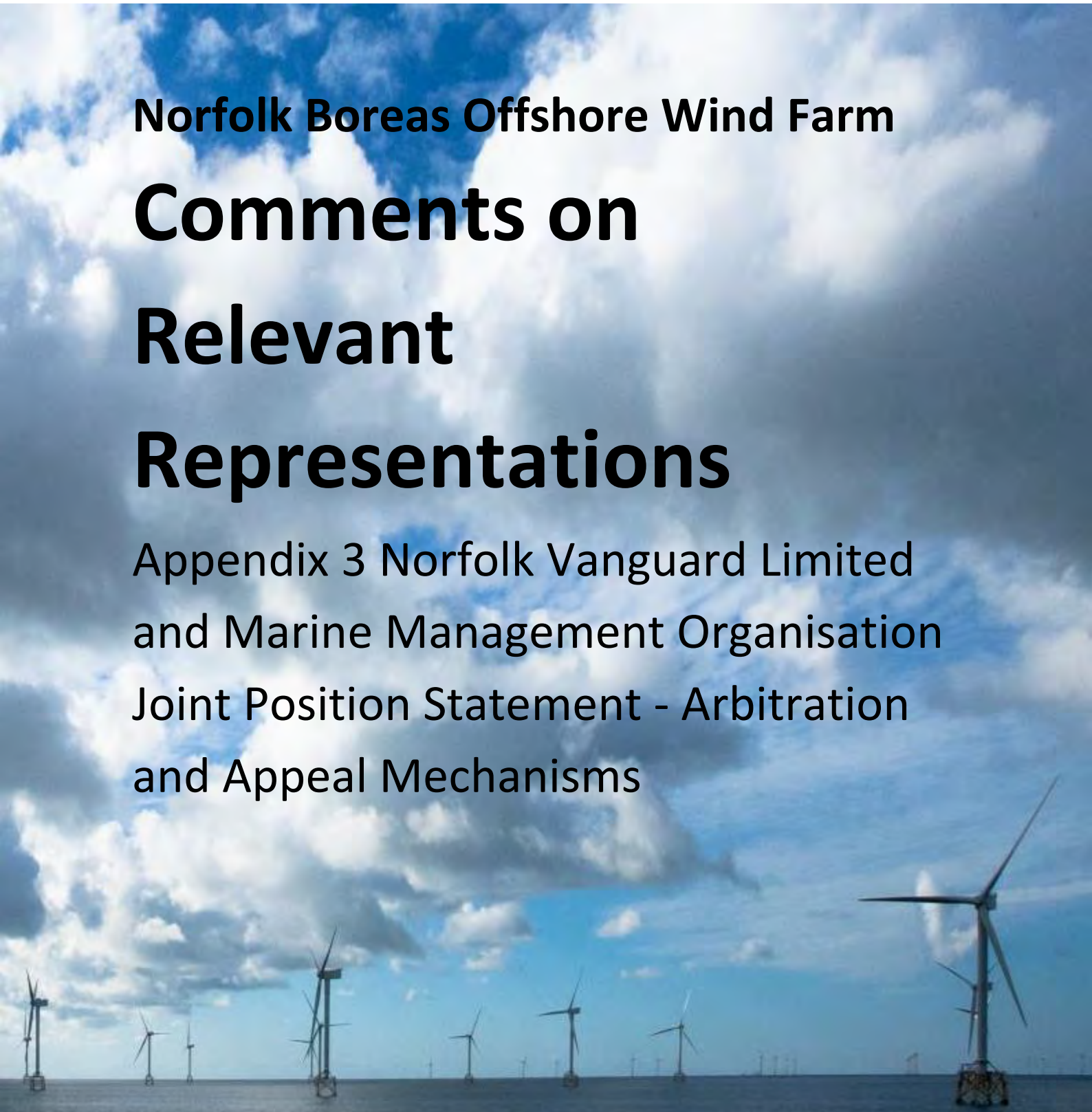
Norfolk Boreas Offshore Wind Farm

Comments on Relevant Representations

Appendix 3 Norfolk Vanguard Limited and Marine Management Organisation Joint Position Statement - Arbitration and Appeal Mechanisms



Applicant: Norfolk Boreas Limited
Document Reference: ExA.RR.D5.V2
Deadline: 5
Date: February 2020
Revision: Version 2
Author: Royal HaskoningDHV

Photo: Ormonde Offshore Wind Farm

Appendix 3 Norfolk Vanguard Limited and Marine Management Organisation Joint Position Statement - Arbitration and Appeal Mechanisms

This Appendix contains the following document:

- Norfolk Vanguard Limited and Marine Management Organisation Joint Position Statement - Arbitration and Appeal Mechanisms (submitted at Deadline 9 of the Norfolk Vanguard Examination

Royal HaskoningDHV
Enhancing Society Together

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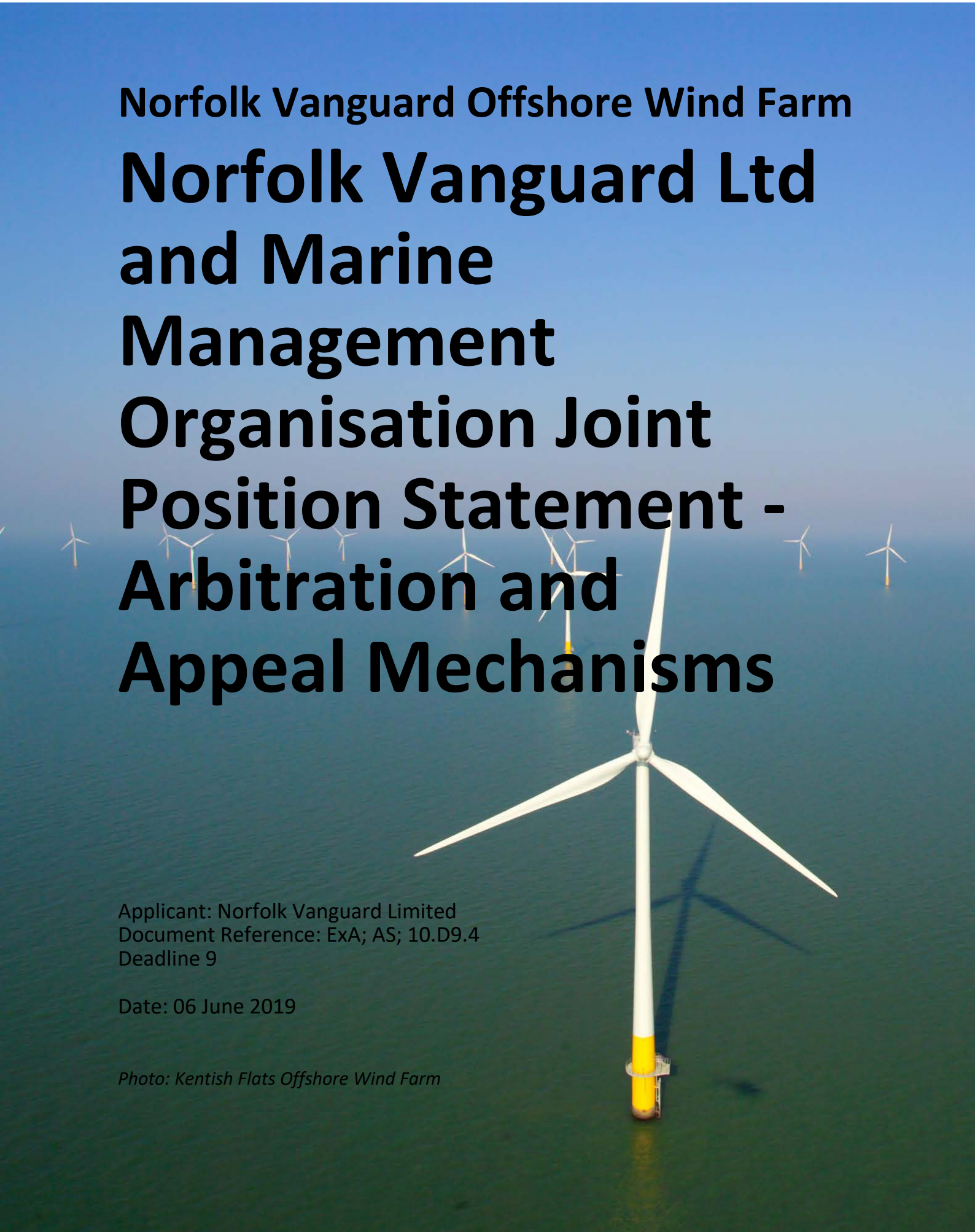
Norfolk Vanguard Offshore Wind Farm

Norfolk Vanguard Ltd and Marine Management Organisation Joint Position Statement - Arbitration and Appeal Mechanisms



Applicant: Norfolk Vanguard Limited
Document Reference: ExA; AS; 10.D9.4
Deadline 9

Date: 06 June 2019

Photo: Kentish Flats Offshore Wind Farm

Introduction

1. Norfolk Vanguard Limited (the Applicant) is proposing to develop the Norfolk Vanguard Offshore Wind Farm (OWF). The OWF comprises two distinct areas, Norfolk Vanguard (NV) East and NV West ('the OWF sites'), which are located in the southern North Sea, approximately 70km and 47km from the nearest point of the Norfolk coast respectively. The location of the OWF sites is shown in Chapter 5 Project Description Figure 5.1 of the Application. The OWF would be connected to the shore by offshore export cables installed within the offshore cable corridor from the OWF sites to a landfall point at Happisburgh South, Norfolk. From there, onshore cables would transport power over approximately 60km to the onshore project substation and grid connection point near Necton, Norfolk (the Project).

Background engagement between the parties

2. The Marine Management Organisation (the MMO) and the Applicant (together, the parties) are in regular dialogue and this has been the case throughout the pre-application process, both in terms of informal non-statutory engagement and formal consultation carried out pursuant to Section 42 of the Planning Act 2008, and has continued post submission of the Application, particularly during the Examination process.

3. An updated Statement of Common Ground between the Applicant and the MMO will be submitted at Deadline 9. It is anticipated that at that point, the majority of outstanding points will be agreed between the parties. However, there is one significant difference which it is anticipated will remain outstanding between the parties at the close of examination. This relates to the appropriateness of including a mechanism to deal with disputes under the Deemed Marine Licences (DMLs), specifically in relation to refusal or non-determination of approvals for the discharge of DML conditions.

Current position of the parties

4. The parties have prepared this joint position statement to explain to the Examining Authority (ExA) their respective positions in relation to this area of disagreement.

5. In summary, the current position of the MMO is that any matter in relation to the DMLs should not be subject to arbitration or appeal. The MMO's position is that the Applicant should rely on judicial review as a means to challenge any decision of the MMO. The MMO recognise that the Applicant would like greater certainty regarding the timeframe for discharge of conditions, and have proposed that the DMLs are drafted to give rise to a deemed refusal if not determined within a specified period. The MMO also propose, that any non-determination could be subject to an internal escalation process if the applicant requested this. Full details of the MMO's submissions are set out in the MMO's response of 30 May 2019 (REP8-102).

6. In summary, the current position of the Applicant is to expressly exclude the MMO from the arbitration article in the draft DCO (dDCO), but only on the basis that an appeal mechanism is included within the DMLs for the refusal or non-determination of the discharge of the DML conditions. This is reflected in the dDCO submitted at Deadline 8 and the Applicant considers that this approach reflects the guidance within the Planning Inspectorate's Advice Note 15 (Good practice point 3) which states that:

   "It is recommended that a mechanism for dealing with any disagreement between the Applicant and the discharging authority is defined and incorporated in a draft DCO Schedule. For example, including arrangements for when the discharging authority refuse an application made pursuant to a DCO Requirement, or approve it subject to conditions or fail to issue a decision within a prescribed period. The mechanism could also address the fees payable for discharging the Requirements."

7. In relation to the Applicant's view on the Planning Inspectorate's Advice Note 15 (Good practice point 3) the MMO's position is that a DCO Requirement is not the same as conditions as these are on the DML, although the Applicant notes that a DCO Requirement is only given in the Advice Note as an 'example'.

Background to arbitration article

8. Section 120 of the Planning Act 2008, by reference to part 1 of Schedule 5, prescribes that *"The submission of disputes to arbitration"* may be included in a DCO (see paragraph 37 of Part 1, Schedule 5). Section 120 is not qualified or conditioned and does not exclude any party.

9. The Infrastructure Planning (Model Provisions) (England and Wales) Order 2009 (Model Provisions), whilst no longer in force, included an arbitration article which applied to any difference and all parties under the DCO. Article 42 of the Model Provisions states:

   Arbitration

   42. Any difference under any provision of this Order, unless otherwise provided for, shall be referred to and settled by a single arbitrator to be agreed between the parties or, failing agreement, to be appointed on the application of either party (after giving notice in writing to the other) by the [insert appropriate body].

10. The Planning Inspectorate's revised Advice Note AN13 (version 3) issued in February 2019 states the following in relation to the Model Provisions:

    "Model provisions"

    2.11 Model provisions were set out in the Infrastructure Planning (Model Provisions) (England and Wales) Order 2009 (SI 2009/2265). They included provisions which could be common to all NSIPs, others which relate to particular infrastructure development types, in

particular railways and harbours, and model provisions in respect of requirements. The Localism Act 2011 removed the requirement for the decision-maker to have regard to the prescribed model provisions in deciding an application for development consent.

2.12 Model provisions were intended as a guide for developers in drafting orders, rather than a rigid structure, but aided consistency, and assisted developers to draft a comprehensive set of lawful provisions.

2.13 There is no longer a requirement to submit a tracked changed version of the draft DCO which compares the wording against The Infrastructure Planning (Model Provisions) (England and Wales) Order 2009.

11. Following Model Article 42, numerous DCOs have applied the concept of arbitration, including offshore wind farm projects which contain deemed marine licences (DMLs), by including an arbitration article in the same form as that contained in the Model Provisions.

12. However, there is disagreement between the parties as to whether the arbitration article in this form is effective against the MMO in relation to determinations made under DMLs. As the arbitration article refers to 'any difference', the MMO's position is that 'a determination' (including a non-determination) is not caught by the arbitration article, as this would not amount to a 'difference'.

13. As a matter of principle, the MMO's position is that arbitration should not apply to the MMO. In summary, the MMO's concerns relate to the private nature of the arbitration process which does not align with the public functions and duties of the MMO. The MMO consider that the removal of the MMO's decision–making function and its placement into the hands of a private arbitration process is inconsistent with the MMO's legal function, powers and responsibilities, which was never intended by Parliament in enacting the Planning Act 2008 or the Marine and Coastal Access Act 2009 (MCAA 2009). The MMO also consider that arbitration would not be consistent with p.4 of Annex B of the PINS Guidance Note 11, which states that *"the MMO will seek to ensure wherever possible that any deemed licence is generally consistent with those issued independently by the MMO"*. Including a mechanism for determination of disputes in respect of DMLs would not be consistent with Marine Licences issued independently by the MMO.

14. The Applicant's position is that arbitration (or an alternative mechanism) is necessary to provide a swift, clear and open process for resolution of disputes under DMLs in respect of Nationally Significant Infrastructure Projects (NSIPs). The Applicant's view is that the "wherever possible" (Guidance Note 11) indicates that there is scope for DMLs (as they have done previously) to depart from those issued independently by the MMO and, in the case of renewable energy NSIPs, it is appropriate to distinguish DMLs from Marine Licences in this respect.

15. It is the MMO's position that the scale and importance of NSIPs mean that sufficient time is required to make a correct decision and that decision should be made by the public body tasked with doing so, not a private third party.

16. In seeking to apply a mechanism to resolve matters of disagreement between the parties, the Applicant's position is that this will not remove the MMO's decision making powers, because the MMO will still be able to make a decision within the timescales defined for determination. In this respect, the Applicant considers that the MMO would have a reasonable period to consider the issues in dispute and to reach a conclusion on their position. The Applicant considers that the proposal for a mechanism to deal with DML disputes will not have the effect of dis-applying statutory provisions in this regard. It should also be noted in this context that arbitration is applied to statutory undertakers such as National Grid and Network Rail who both have important public duties to discharge including the safe operation of electricity apparatus and railways.

17. However the MMO does not agree with this. The MMO is concerned that key statutory functions may be exercised by private third parties, who are not susceptive to judicial review or the same statutory requirements as the MMO. This will remove from both parties the right of appeal.

18. It is also the MMO's position that providing for disagreements to be resolved by arbitration in private sits uneasily with the general presumption regarding transparency and public participation in environmental decision making.

19. The MMO considers that the practical result of allowing the arbitration process in Article 38 to expressly apply to the MMOs decisions would be establishing a new procedure and would replace the review of the MMOs decision making on conventional public law grounds (via the process of judicial review) (for discharge of conditions under an expressly granted licence) with a merits review undertaken by an arbitrator.

20. The MMO's position is that this is a fundamental departure from what Parliament intended, and the MMO can see no justification whatsoever for such a fundamental change – particularly where the purpose of the deemed licence regime under the Planning Act 2008 is intended to remove the need for a separate application for a licence alongside or following the making of the Order and not to fundamentally change the regulatory regime that applies.

21. The MMO draws the ExA's attention to the clear and well-established principle that the Courts will be very slow to conclude that an "expert and experienced decision-maker assigned the task by statute has reached a perverse scientific conclusion": Mott v Environment Agency [2016] 1 W.L.R. 4338 (CA). In light of this, the MMOs view is that it would require clear and compelling evidence as to why it is necessary and appropriate (and/or what had been intended by Parliament) to conclude that that heightened level of

discretion given to decisions of a statutory body in the technical/environmental field be displaced by a decision, on the merits, by a private third party arbitrator.

22. To entrust the final decision in the event of a dispute to an arbitrator, who is not susceptible to the same public scrutiny (not just by the MMO and Applicant but affected members of the public) or appeal is in the MMO's opinion inconsistent with the objectives of the 2008 Planning Act and MCAA 2009.

23. The Applicant's position is that arbitration in the Model Provisions is expressly referenced in respect of the determination of technical disputes, for example regarding consents or licences, and/or disputes which involve the public interest. For instance, paragraph 31 of Schedule 1 of the Model Provisions makes application for arbitration in the context of statutory undertakers (and this mechanism is adopted in the agreed form protective provisions with statutory undertakers at Schedule 16 of the Applicant's dDCO (document reference 3.1). It is the Applicant's position that if Parliament had intended to exclude the MMO from arbitration, it would have included a saving provision (or similar) accordingly. It is also the Applicant's view that the provisions of the Arbitration Act 1996 ("AA 1996") would apply to an arbitration under the DCO by virtue of section 94(2), which provides that "the provisions of Part 1 apply to every arbitration under an enactment …subject to the adaptations and exclusions specified in sections 95 to 98 [AA 1996] [which the Applicant does not consider are relevant in these circumstances]" and here "enactment" includes orders (and other forms of subordinate legislation) by virtue of section 94(3)(a) AA 1996 and the Interpretation Act 1978.

24. In addition, the Applicant considers that including an appeal mechanism for the MMO is no different to the inclusion of an appeal mechanism for other public bodies who determine applications, such as the Local Planning Authority, who have similar public functions and statutory duties. The Applicant sees no reason why the MMO should be treated any differently in this respect.

25. The MMO believe that any additional appeal route should be provided for though legislation and applied evenly across the marine licensing regime. The appeals route should not be applied to individual NSIPs via the DCO/DML, as to do so would mean inconsistency to the MMO customers.

DCO precedents in relation to arbitration

26. The application of the arbitration provision has been considered in previous offshore wind farm DCO decisions, specifically in the context of its application to Natural England and the MMO.

27. In relation to the Triton Knoll Offshore Wind Farm Order 2013 and the Burbo Bank Extension Offshore Wind Farm Order 2014, the Secretary of State considered that it was appropriate for the arbitration article to apply to Statutory Nature Conservation Bodies

(SNCBs). It should be noted that the SNCBs were in this situation acting as consultees rather than a regulator (the MMO is acting as a regulator in relation to DMLs).

28. Paragraph 7.3 of the Secretary of State's decision letter for Triton Knoll Offshore Wind Farm states:

    "The Panel also asked the Secretary of State to consider whether SNCBs should be removed from the provisions for arbitration covered by Article 12 of the draft Order at Appendix E (headed "Arbitration") [ER 5.11.20]. To maintain consistency with other offshore wind farms approved under the Planning Act 2008 since the close of the Panel's Examination, the Secretary of State has decided that the arbitration provisions should apply to SNCBs and has therefore modified the article in the Order accordingly."

29. Natural England had been excluded from the arbitration article in the dDCO for the Burbo Bank Extension Offshore Wind Farm, but following the Secretary of State's decision that Natural England should not be excluded from the arbitration article in the Triton Knoll Offshore Wind Farm Order; this exclusion was subsequently removed.

30. In his Report to the Secretary of State, the Examiner appointed to examine the Burbo Bank Extension Offshore Wind Farm Order stated at paragraph 7.45 and 7.46:

    Article 13 - Arbitration

    "This draft article provides for the appointment of an arbitrator if a dispute arises in respect of any provision of the DCO. Early draft DCOs excluded NE from the operation of the provision, pursuant to an opinion provided by NE to the Triton Knoll Offshore Wind Farm Examining Authority that the exercise of its statutory powers should not be subject to arbitration and should only be adjudicated upon by the court. However, the Secretary of State in the Triton Knoll decision decided not to exclude NE from the arbitration provision in that DCO, on the basis that all issues and parties should be equally subject to arbitration on the same basis.

    I proposed to delete the exclusion of NE from the arbitration provision in my draft DCO. The applicant and NE did not object to this revision which was sustained in the applicant's draft DCO Version 6 [APP-099]. I am content with the current drafting of this article."

31. However, in contrast to the position with Natural England, the MMO's position is that the Triton Knoll applicant accepted that the MMO were not subject to arbitration during the Triton Knoll Issue Specific Hearing held on 8 November 2012, where the audio of the hearing (at Part 2 from approx. 7 minutes 50 seconds) records:

    "As far as the MMO is concerned, we will probably come on to this later with their letter, but it seems to me that the way the way DCO is drafted is to make it clear that the deemed licence is drafted under the 2009 Act, the Marine and Coastal Access Act, and therefore by

implication the provisions of that act apply in respect of the marine licence, and that would apply to resolution of disputes and to such things as splitting orders and splitting licences."

32. The MMO believes that this shows that the applicant for Triton Knoll accepted that the DMLs were not subject to arbitration. This is also noted as the MMO's position within the Examining Authority's report for Triton Knoll at paragraph 5.11.20 which states:

    "……The MMO pointed out that in relation to the DML separate provisions under the Marine and Coastal Access Act applied……"

33. The application of arbitration to the MMO was also considered in the recent Tilbury 2 Order. The MMO was not expressly excluded from the arbitration article, which states:

    "Arbitration

    60. Except where otherwise expressly provided for in this Order and unless otherwise agreed in writing between the parties, any difference under any provision of this Order (other than a difference which falls to be determined by the tribunal) must be referred to and settled by a single arbitrator to be agreed between the parties or, failing agreement, to be appointed on the application of either party (after giving notice in writing to the other) by the President of the Institution of Civil Engineers."

34. However, the Examining Authority for Tilbury 2 recommended that an express condition applying arbitration in the DML should be removed, and this was not included in the final Tilbury 2 Order. The express condition stated as follows:

    "Arbitration

    27.—(1) Subject to condition 27(2) any difference under any provision of this licence must, unless otherwise agreed between the MMO and the licence holder, be referred to and settled by a single arbitrator to be agreed between the MMO and the licence holder or, failing agreement, to be appointed on the application of either the MMO or the licence holder (after giving notice in writing to the other) by the President of the Institution of Civil Engineers.

    (2) Nothing in this condition 27 is to be taken, or to operate so as to, fetter or prejudice the statutory rights, powers, discretions or responsibilities of the MMO."

35. In the Examining Authority's recommendation Report (page 233) to the Secretary of State (SoS). The Examining Authority found in favour of the MMO noting:

"…The MMO stated that it strongly opposed the inclusion of such a provision, based on its statutory role in enforcing the DML. According to the MMO, the intention of the PA2008 was for DMLs granted as part of a DCO in effect to operate as a marine licence granted under the MCCA2009. There was nothing to suggest that after having obtained a licence it

should be treated any differently from any other marine licence granted by the MMO (as the body delegated to do so by the SoS under the MACAA).

Having considered the arguments of the Applicant and the MMO, the Panel finds in favour of the MMO in this matter for the reasons stated in the paragraph above.

Accordingly, the Panel recommends that paragraph 27 is deleted from the DML at Schedule 9 of the draft DCO."

The Applicant's position is that the Tilbury 2 decision can be distinguished. This is because it is of a wholly different scale of project to an offshore wind farm. The Tilbury 2 project is for the development of a new port terminal and associated facilities. Offshore, only new berthing facilities are proposed. There is a 6 week period for the discharge of plans under the DML, which clearly emphasises the difference in scale and complexity of the schemes, given the 6 month period sought by the MMO for discharge of plans for offshore wind farm projects. Finally, the project is a transport project, not an energy project for which the Applicant considers that special considerations should apply as set out below.

36. The MMO's position is that the complexity of the scheme further supports the arbitration provisions not being applicable to the DML. In complex schemes it is often the case that difficult and complex decisions need to be made. The considerable and long lasting impacts of large development, such as a new port terminal and associated facilities, will be felt by a wide range of individuals for a long time to come. In order to make the correct decision there needs to be sufficient time to deal with all issues. In the MMO's opinion, allowing such important decisions to be made by a private third party in any event is inappropriate, but especially after the imposing of an arbitrary time period. In the MMO's opinion, given the lack of an appeal route for the MMO against the decisions of an arbitrator, this would be very concerning and insufficient justification has been put forward to justify such a fundamental change in the regime.

37. It is also the MMO's view that the content of previous DMLs do not determine the content of future DMLs. In reality the different approaches mentioned above have not been tested, because the MMO works collaboratively with applicants in a timely and flexible manner. However it is the MMO's opinion that if there is a time when a dispute arises it is likely to have the potential for significant consequences (both on users of the infrastructure and the environment). The appropriate body to make decisions in the circumstances is the MMO, with scrutiny from the courts by a judicial review, if necessary.

Approaches to arbitration in dDCOs for Hornsea Project Three and Thanet Extension

38. In relation to approaches to arbitration on other development consent applications for offshore wind farms currently or recently at examination, various approaches have been taken.

39. In relation to Hornsea Project Three, the Applicant in Hornsea Project Three has set out that it is their preference for the MMO to be subject to the arbitration provision set out at Article 37 of the dDCO and this is reflected in the final version of the dDCO submitted by the Applicant as part of the Hornsea Project Three examination. However, the Applicant in Hornsea Project Three has also inserted alternative drafting into the dDCO which, in the event that arbitration is not recommended by the Examining Authority, will include within the DML an alternative appeal route for dealing with differences between the parties that may arise in the discharging of conditions, which is based on a modified version of the 2011 Regulations but with shortened timeframes; and, in the further alternative, apply a deemed approval mechanism.

40. The MMO does not agree with the approach being put forward by the Applicant in Hornsea Project Three and has made the same submissions as to why what is proposed in Hornsea Project Three is not appropriate or acceptable.

41. In the case of Thanet Extension, the Applicant's preferred approach is that the MMO is made subject to the arbitration provision included at Article 37 and if necessary to amend the wording of that article to make it clear that it extends to the MMO. Whilst this is Thanet Extension's preferred approach, they have, as an alternative, proposed that an appeal mechanism be incorporated into the DMLs as Part 5 of the DML, this appeal is not an appeal mechanism based around a modified version of the 2011 Regulations, but is a bespoke appeal process involving the Secretary of State. The applicant has also proposed a deemed approval process should apply where the MMO fails to determine an application to discharge a condition of the DML within the timescale required. This provision does not extend to plans for securing mitigation to avoid adversely affecting the integrity of an European site. The MMO are aware of the provisions the applicant proposes for inclusion in Thanet Extension and have resisted their inclusion for the same reasons as are explained in this summary.

42. The parties agree that there is merit in ensuring that appropriate provisions relating to arbitration and/or mechanisms for appeal/deemed discharge in the DMLs, are applied consistently across any offshore wind farm DCOs granted in the future.

43. The MMO would also highlight that during the examination period for Hornsea Project Three the ExA schedules of changes to the draft DCO showed that the ExA were inclined to amend Article 37 to exclude the MMO from the arbitration process, noting:

    "…Any matter for which the consent or approval of the Secretary of State or the Marine Management Organisation is required under any provision of this Order shall not be subject to arbitration."

44. The applicant in Hornsea Project Three, however, resisted this change and considers that the MMO should be subject to arbitration as demonstrated by the final draft of the Hornsea Project Three Development Consent Order.

Appeals under the marine licensing regime

45. An appeals process already exists in respect of Marine Licences granted under Part 4 of the Marine and Coastal Access Act 2009 (MCAA 2009). The appeals process is set out in the Marine Licensing (Licence Application Appeals) Regulations 2011 (the 2011 Regulations). However, the appeals process does not apply to any non-determination or refusal to approve conditions under a Marine Licence (or DML) and, under Regulation 4 of the 2011 Regulations, is limited to appeals concerning:

    - the grant of a marine licence subject to conditions;
    - refusal to grant a marine licence;
    - the time period for which activities are authorised; and/or
    - the applicability of the licence conditions to transferees.

46. Therefore, the parties agree that the 2011 Regulations will not automatically apply to non-determination or refusal to discharge conditions under the DMLs, and would need to be expressly applied in the DMLs to take effect. To the extent that the 2011 Regulations are applied, the Applicant's position is that some modifications to the 2011 Regulations will be required, particularly to provide clearly defined timeframes within which the appeal process will need to be commenced and completed.

47. The Applicant also suggests that a bespoke appeals mechanism, which does not adopt the process contained in the 2011 Regulations, could be included within the DMLs. The Applicant suggests that this could take a similar approach to the bespoke appeals process for discharge of Requirements under the dDCO which is included in Schedule 16 of the dDCO (as applied by article 39 of the dDCO).

48. The MMO does not consider it necessary to introduce such an appeals mechanism into the DMLs. This is because it will create a separate process, which differs from the process for Marine Licences issued by the MMO outside of the DCO/DML process. In addition there is the availability of judicial review which ensures that public bodies reach rational decisions that are based upon following the correct process.

49. It is also the MMO's position that an appeals process is unacceptable and not necessary as the MMO works closely with applicants to resolve issues in a timely fashion. Since its inception the MMO has undertaken licensing functions on ~130 DCOs[1] comprising some of the largest and most complex renewable energy operations globally. The MMO is not aware of an occasion whereby any dispute which has arisen in relation to the discharge of a

1 MMO (May 2019), figures obtained from the Marine Case Management System.

condition under a DML has failed to be resolved satisfactorily between the MMO and the applicant, without any recourse to an 'appeal' mechanism.

50. It is the MMO's position that if an appeals procedure is required this should be considered by Parliament and introduced by way of statutory instrument. This will allow all stakeholders to have their views known and the wider impacts considered. It should be noted that when introducing the 2011 Regulations Parliament decided not to extend the appeal provisions to the discharge of conditions.

51. The MMO would also raise that introducing an appeals process out with that intended under the MCAA 2009 will open up the possibility of further Judicial Reviews from our other stakeholders. These stakeholders have a legitimate expectation that our decision making will be transparent, fair and use a consistent process for all applicants.

52. The Applicant does not agree with the MMO's position in this regard. Under section 120 of the Planning Act 2008, Development Consent Orders may:

    (a) apply, modify or exclude statutory provisions;

    (b) amend, repeal or revoke statutory provisions of local application; and

    (c) include any provision that appears to the Secretary of State to be necessary or expedient for giving full effect to any other provision of the order.

53. The draft Development Consent Order is drafted as a Statutory Instrument, which itself has involved in-depth consultation and scrutiny from stakeholders, and already seeks to modify and dis-apply certain statutory provisions, as set out at article 7, article 23, and Schedule 7 of the dDCO. To the extent that this is a concern, additional drafting could be included in the dDCO at article 7 to apply the modified 2011 Regulations (as set out in Part 5 of the DMLs) or a bespoke appeals process could be used, such that the 2011 Regulations are not modified. In any event, including an appeal mechanism for the DMLs within the dDCO does not alter the Marine Licensing process, or the way that decisions are determined under that process. The MMO's stakeholders have no legitimate expectation in how DMLs are dealt with and, as is agreed between the MMO and the Applicant, it is proposed that a consistent approach is taken in respect of all future offshore wind farm DCOs/DMLs in this respect.

Judicial Review

54. To the extent that the MMO are excluded from arbitration, and there is no express inclusion of an appeal process for the discharge of conditions under the DMLs, the only recourse available to the Applicant would be to challenge any decision made by the MMO by way of judicial review.

55. As set out above, the Applicant and the MMO disagree as to whether judicial review is a suitable remedy in such circumstances.

56. The Applicant has a number of concerns in relying on the judicial review process in this regard, including that:

- Judicial review can only be brought once a decision has been made. It cannot be brought in relation to the MMO's non-determination of an application to discharge a condition. This leaves the Applicant in a state of limbo and unable to move matters forward where there is no determination of a discharge application.

- Even if a decision has been made to refuse to discharge a condition, and which is therefore capable of judicial review, the court would not be able to consider the merits of the determination but only the extent to which the decision had been lawfully made. Even if the Applicant was successful in judicially reviewing the MMO's decision, the remedy would be only to remit the decision back to the MMO for its re-determination. To be effective, the Applicant considers that a process is required in which the merits of a decision can also be considered and a determination made as part of that process.

- The judicial review process is time consuming and costly for all parties. The Applicant's position is that this is not appropriate for NSIPs, and particularly for offshore wind projects in the context of meeting Contract for Difference (CfD) milestones. The Applicant is already in the early stages of engaging key partners in the supply chain for the anticipated construction programme for the Project. The offshore construction work for the Project has to be agreed with suppliers well in advance of construction to deliver the scale of work required. In practice, as a result of the timings required for pre-construction surveys and other requirements relating to the discharge of conditions, the Applicant will have a short window to seek to discharge the DML conditions. If the timeframes for discharge are unreasonably extended, this could have a significant knock-on effect to the construction programme, providing uncertainty and risk for construction contracts (leading to significant cost implications) and also for the timely delivery of the project and to meet CfD milestones.

57. In relation to the Applicant's position on judicial review as set out above, the MMO do not agree with the Applicant that judicial review is not available as a remedy in the case of non-determination. In these circumstances, the MMO consider that it is open to the Applicant to write to the MMO explaining the concerns and request the MMO to make a determination by a specific date. Should the MMO fail to make the decision then the applicant would be able to judicially review that failure to make a decision. The MMO would also note that although remitting a decision for re-determination is the most likely, it is not the only one. There are a variety of remedies that could include, for example, prohibiting orders, mandatory orders, a declaration, an injunction and damages.

58. The MMO considers that judicial review is an appropriate remedy. Judicial review is the main way that the courts supervise bodies exercising public functions to ensure that they act lawfully and fairly. It is the MMO's position that in relation to DML's there is nothing in the current matter which justifies removing the safeguards of judicial review.

59. It is the MMO's positon that it is required to make a lawful decision pursuant to the DML. It has been given this function by Parliament. If the Applicant considers that the MMO has not made a lawful decision then it may challenge that decision by way of judicial review. If it disagrees with the decision of the High Court, it can ultimately progress to the Supreme Court. The same option is available to the MMO. This is appropriate, especially considering the scale and importance of NSIP projects.

60. However, the Applicant notes that including an appeal mechanism does not remove the ability for the Applicant, the MMO or interested third parties to judicially review any decision following determination of the appeal. In addition, the appeal process itself would be a public process and open to third parties to participate in.

61. The Applicant considers that the judicial review process is timely and costly and should be used as a last resort rather than as an alternative to appeal proceedings, even noting that the planning court may expedite significant cases. The Applicant is also concerned about the effect that delays can have on the delivery of projects.

62. The MMOs view is that the appeal mechanism put forward by the Applicant is likely to take longer and be more costly as they require a consideration not only of the lawfulness of the decision, but the merits of the decision.

63. The MMO note the Applicant's concerns but also consider it important to ensure that projects of this scale and importance are implemented not just quickly but correctly as per the statutory functions with the aim of protecting the environment and other legitimate users of the sea.

64. As set out above, it is also the MMO's position that as the judicial review process also applies to discharge of conditions under a Marine Licence, there should not be a system in which DMLs and Marine Licences operate differently.

65. In order to address the Applicant's concerns the MMO is prepared to include deemed refusal after a certain time period. This would make the start of the judicial review period clear, and would set clear timeframes for making decisions, however wouldn't force the MMO to make a decision if it wasn't in a position to make the correct decision.

Internal Escalation Procedure

66. The MMO has also proposed an internal escalation procedure in the event of non-determination, followed by a deemed refusal if no decision is subsequently made within the timescales set out. The MMO considers that this would enable the Applicant to engage

with the decision makers within the MMO to review whether (and how) any disagreement between the parties might be resolved within reasonable timescales.

67. The MMO note the applicant has put forward potential wording for this proposal within Appendix 4. The MMO do not accept that this internal escalation process should be included within the DCO any more so than should the detail.

68. The Proposal is set out below:
    - MMO fail to make a determination by a specific date.
    - Applicant sends a notice to the case team advising they require a decision within 2 months.
    - Delegated Director is chosen and makes contact with the applicant.
    - Initial meeting is set up to discuss the concerns.
    - Delegated director reviews the documents from all interested parties.
    - Meeting with interested parties and further information requested.
    - Final resolution meeting by the final week of the 2 month time frame

69. Once this decision was made the applicant would be able to challenge the refusal or decision via the JR process.

70. In its Deadline 6 submissions, the MMO acknowledged that the undertaker is likely to incur significant costs in the event that there are delays to determination of conditions. It is the Applicant's view that, in the case of energy applications, these costs may ultimately be borne by the consumer through the cost of energy. This is because any risk to delivery will need to be reflected in the Applicant's CfD bid price. Given this, as well as the national benefits in relation to security of energy supply, the Applicant considers that it is appropriate that DMLs for nationally significant energy projects are treated differently to Marine Licences and that a mechanism other than judicial review is therefore included within the DMLs.

71. The MMO disagrees with this position, as although it does not anticipate delays, if on a project, especially an NSIP, the MMO requires more time to make a lawful and considered decision, then this should be allowed. This is especially true in environmental matters, where the cost of a poor decision could have long reaching effects.

Flexibility for discharge applications

72. The MMO is willing to work with undertakers to determine conditions in timescales appropriate to their construction programmes and considers that there are significant benefits of being able to adapt flexibly, which may be lost in the event that a more rigid timetable for determination of conditions is applied.

73. The Applicant is concerned that if the MMO's resources become constrained, the MMO may not be able to offer the levels of flexibility which a project may require. In any event, the Applicant's position is that the imposition of clear timescales can allow effective programming for both the Applicant and the MMO, and promotes a clear and fair process for all users of the MMO's service. In the Applicant's view this is considered preferable to the uncertainty of the existing approach.

74. The Applicant's proposed drafting also refers to refusals and non-determination (as opposed to a deemed refusal) which allows the parties to agree an extension of time for the MMO to determine conditions if and where appropriate to do so.

75. The MMO maintains that experience in discharging conditions for consented wind farms have informed the MMO's position that unexpected operational situations lead to change requests to post consent documentation regularly. If this precedent is adopted across the board, the resulting restriction in flexibility to respond to such requests will prove problematic for all parties.

76. The MMO always endeavours to allocate resource to meet the needs to our applicants and there has been no general situations where a wind farm has not been consented nor significant delays encountered because of resources or staff issues. Resource constraints are parameters all parties have to work within as a matter of course and the imposition of restrictive timescales would, as this is incorporated into more DCO's, provide an advantage to no one.

Timescales

77. The MMO believe the timescales for both submission of documents and any determination timescales needs to be 6 months and not 4 months. The MMO believe that a 4 month pre-construction submission date is unrealistic and even counterproductive, as the pre-construction sign off process is not always straight forward.

78. The MMO has made it clear on their reasoning for this request. Due to:

    - the nature of the detailed documents,
    - the size of the wind farms coming forward; and
    - the possibility that substandard final documents are provided to the MMO

    could lead to multiple amendments required by an applicant which in turn leads to multiple rounds of consultations. The 4 month timescale could not account for these additional rounds of consultation and queries with an applicant.

79. The MMO believes by giving the MMO and its consultees 6 months as a matter of course for determination, there is more time to reach a conclusion, and less risk of any need for extension or delay. The MMO will always make any determination as soon as is reasonably

practicable in any event, and if it is able to determine the application to discharge a condition more quickly then it will do so.

80. The Applicant has concerns over a 6 months' time frame and proposes that the timescales remains at 4 months. For the reasons previously outlined during the course of examination, in particular in response to ExA WQ 6.8 at Deadline 1 (document reference ExA; WQ; 10.D1.3) and ExA WQ 20.135 and 20.139 at Deadline 4 (document reference: ExA; FurtherWQ; 10.D4.6), the Applicant's position is that four months is well-established as an appropriate timeframe for offshore wind farm schemes and one that ensures a balance is struck between the expedient discharge of the relevant conditions attached to the DML whilst allowing a reasonable period of time for consideration by the MMO and relevant consultees.

81. This four month time period is contained on a number of other offshore wind farm DCOs (including The East Anglia Three Offshore Wind Farm Order 2017, Hornsea Two Offshore Wind Farm Order 2016, and the final draft of the Hornsea Project Three Order), and a swift decision making process is vital in order to minimise delays and allow the Applicant to meet key Contracts for Difference milestones (as explained further in response to WQ 20.135 (ExA; FurtherWQ; 10.D4.6).

82. The Applicant therefore considers that a 4 month timescale, which is also subject to extension by agreement, is acceptable as this maintains flexibility, is consistent with existing/ previous decisions and provides certainty for all parties.

Ranking of dDCO drafting preferences

83. The Applicant's order of preference for the options proposed during the Examination process is set out in the table below, and the MMO's response in relation to each of these options is set out against each option.

Preference	Applicant's position	MMO's response
First	Inclusion of an appeal process for non-determination/ refusal to discharge DML conditions (see drafting at Appendix 1a in relation to application of the modified 2011 Regulations, as included in the dDCO submitted at Deadline 8, and Appendix 1b in relation to the application of a bespoke appeals process)	The MMO position is that judicial review is the appropriate remedy. The MMO does not believe the inclusion of appeal process for non-determination/ refusal to discharge DML conditions is appropriate (as stated throughout the document and highlighted in comment 84 & 85)

Second	Inclusion of arbitration provisions, which expressly apply to DMLs (see drafting at Appendix 2)	The MMO position is that judicial review is the appropriate remedy. The MMO does not believe the inclusion of arbitration provisions, which expressly apply to DMLs are appropriate (as stated throughout the document and highlighted in comments 84 & 85)
Third	Deemed approval of DML conditions (see drafting at Appendix 3)	The MMO position is that judicial review is the appropriate remedy. The MMO does not believe the inclusion of deemed approval of DML conditions is appropriate (as stated throughout the document and highlighted in comment 84 & 85)
Last	Deemed refusal of DML conditions following an internal escalation process (Appendix 4)	The MMO position is that judicial review is the appropriate remedy. However in order to address the hypothetical concerns of the Applicant (no current issues have been identified) the MMO is willing to accept deemed refusal of DML conditions following an internal escalation process, this process should not be set out in the DML. (Appendix 4).

84. For the reasons outlined above and during the course of the examination, the Applicant's preference is that there should be a clear and transparent appeals procedure as included in the final version of the draft of the DCO, and attached at Appendix 1a.

85. The MMO position remains that its decisions ought not to be made subject to any arbitration process (whether through a general arbitration provision or via an arbitration condition set out in the DML) nor should there be any appeal process based on a modified version of the 2011 Regulations be included within the DML. The appropriate public law challenge to these issues remains judicial review.

86. The MMO has stated above and in previous representations that these proposals go against the statutory functions laid out by parliament. The removal of this decision–making

function and their placement into the hands of a private arbitration process, appeal process or a deemed approval process is inconsistent with the MMO's legal function, powers and responsibilities.

87. However, the Applicant does not agree that an appeal mechanism is inconsistent with the MMO's legal function, powers and responsibilities because it does not remove the MMO's decision making powers.

88. In the event that the ExA is minded to include within the DCO a deemed refusal process (which is not the Applicant's preference), , the Applicant's position is that the deemed refusal should only occur where a resolution cannot be found following a defined internal escalation process. Clear timescales for determination would need to be set, and for the internal escalation process to be completed where these timescales have not been met, before the deemed refusal occurred. In this case, the Applicant's position is that the internal escalation process must be set out in the DMLs so that it is not subject to change.

89. The parties agree that whichever mechanism is chosen, it is essential that there is certainty and clarity as to the approach to be adopted in the event that there is non-determination or refusal to discharge DML conditions, so that the construction and operation of nationally significant energy projects is not unreasonably or unnecessarily delayed, and that a consistent approach is adopted across all future made DCOs.

APPENDIX 1A: APPEALS UNDER THE (MODIFIED) MARINE LICENSING REGULATIONS 2011

Interpretation

—a) In this Order—

[…]

"the 2011 Regulations" means the Marine Licensing (Licence Application Appeals) Regulations 2011(**2**);

Arbitration

23.— (1) Subject to Article 41 (saving provisions for Trinity House), any difference under any provision of this Order, unless otherwise provided for, must be referred to and settled in arbitration in accordance with the rules at Schedule 14 of this Order, by a single arbitrator to be agreed upon by the parties, within 14 days of receipt of the notice of arbitration, or if the parties fail to agree within the time period stipulated, to be appointed on application of either party (after giving written notice to the other) by the Secretary of State.

(1) Any matter for which the consent or approval of the Secretary of State or the Marine Management Organisation is required under any provision of this Order shall not be subject to arbitration.

Should the Secretary of State fail to make an appointment under paragraph (1) within 14 days of a referral, the referring party may refer to the Centre for Effective Dispute Resolution for appointment of an arbitrator.

***Deemed Marine Licences**: Part 4, Condition 15, Part 5 (Schedules 9-10) and Part 4, Condition 10 and Part 5 (Schedules 11-12)*

15.

…

(3) Each programme, statement, plan, protocol or scheme required to be approved under condition 14 must be submitted for approval at least *[four]* months prior to the intended commencement of licensed activities, except where otherwise stated or unless otherwise agreed in writing by the MMO.

(4) No licensed activity may commence until for that licensed activity the MMO has approved in writing any relevant programme, statement, plan, protocol or scheme required to be approved under condition 14 or approval has been given following an appeal in accordance with sub-paragraph (6).

(5) Unless otherwise agreed in writing with the undertaker, the MMO must use reasonable endeavours to determine an application for approval made under condition 14 as soon as practicable and in any event within a period of *[four]* months commencing on the date the application is received by the MMO.

(6) Where the MMO fails to determine an application for approval under condition 14 within the period referred to in sub-paragraph (5) or refuses the application for approval, the undertaker may appeal to the Secretary of State in accordance with the procedure in Part 5 of this licence.

PART 1

Procedure for appeals

1. Where the MMO refuses an application for approval under condition 14 and notifies the undertaker accordingly, or fails to determine the application for approval in accordance with condition 15 the undertaker

(**2**) S.I. 2011/934

may by notice appeal against such a refusal or non-determination and the 2011 Regulations shall apply subject to the modifications set out in paragraph 2 below.

2. The 2011 Regulations are modified so as to read for the purposes of this Order only as follows—

(a) In regulation 6(1) (time limit for the notice of appeal) for the words "6 months" there is substituted the words "4 months".

(b) For regulation 4(1) (appeal against marine licensing decisions) substitute—

"A person who has applied for approval under condition 15 of Part 4 of Schedule 9; condition 15 of Part 4 of Schedule 10; condition 10 of Part 4 of Schedule 11; or condition 10 of Part 4 of Schedule 12 to the Norfolk Vanguard Offshore Wind Farm Order 201[ ] may by notice appeal against a decision to refuse such an application or a failure to determine such an application."

(c) For regulation 7(2)(a) (contents of the notice of appeal) substitute—

"a copy of the decision to which the appeal relates or, in the case of non-determination, the date by which the application should have been determined; and"

(d) In regulation 8(1) (decision as to appeal procedure and start date) for the words "as soon as practicable after" there is substituted the words "within the period of 2 weeks beginning on the date of".

(e) In regulation 10(3) (representations and further comments) after the words "the Secretary of State must" insert the words "within the period of 1 week"

(f) In regulation 10(5) (representations and further comments) for the words "as soon as practicable after" there is substituted the words "within the period of 1 week of the end of".

(g) In regulation 12(1) (establishing the hearing or inquiry) after the words "("the relevant date")" insert the words "which must be within 14 weeks of the start date".

(h) For regulation 18(4) substitute— "Subject to paragraphs (1) and (3), each party should bear its own costs of a hearing or inquiry held under these Regulations."

(i) For regulation 22(1)(b) and (c) (determining the appeal—general) substitute—

"(b) allow the appeal and, if applicable, quash the decision in whole or in part;

(c) where the appointed person quashes a decision under sub-paragraph (b) or allows the appeal in the case of non-determination, direct the Authority to approve the application for approval made under condition 15 of Part 4 of Schedule 9; condition 15 of Part 4 of Schedule 10; condition 10 of Part 4 of Schedule 11; or condition 10 of Part 4 of Schedule 12 to the Norfolk Vanguard Offshore Wind Farm Order 201[ ]."

(j) In regulation 22(2) (determining the appeal—general) after the words "in writing of the determination" insert the words "within the period of 12 weeks beginning on the start date where the appeal is to be determined by written representations or within the period of 12 weeks beginning on the day after the close of the hearing or inquiry where the appeal is to be determined by way of hearing or inquiry".

APPENDIX 1B: BESPOKE APPEAL PROCESS

Interpretation

2.—b) In this Order—

[…]

"the appeal parties" means the MMO, the relevant consultee and the undertaker;

"business day" means a day other than Saturday or Sunday which is not Christmas Day, Good Friday or a bank holiday under section 1 of the Banking and Financial Dealings Act 1971;

Arbitration

38.— (1) Subject to Article 41 (saving provisions for Trinity House), any difference under any provision of this Order, unless otherwise provided for, must be referred to and settled in arbitration in accordance with the rules at Schedule 14 of this Order, by a single arbitrator to be agreed upon by the parties, within 14 days of receipt of the notice of arbitration, or if the parties fail to agree within the time period stipulated, to be appointed on application of either party (after giving written notice to the other) by the Secretary of State.

(2) Any matter for which the consent or approval of the Secretary of State or the Marine Management Organisation is required under any provision of this Order shall not be subject to arbitration.

(3) Should the Secretary of State fail to make an appointment under paragraph (1) within 14 days of a referral, the referring party may refer to the Centre for Effective Dispute Resolution for appointment of an arbitrator.

***Deemed Marine Licences**: Part 4, Condition 15, Part 5 (Schedules 9-10) and Part 4, Condition 10 and Part 5 (Schedules 11-12)*

15.

…

(3) Each programme, statement, plan, protocol or scheme required to be approved under condition 14 must be submitted for approval at least *[four]* months prior to the intended commencement of licensed activities, except where otherwise stated or unless otherwise agreed in writing by the MMO.

(4) No licensed activity may commence until for that licensed activity the MMO has approved in writing any relevant programme, statement, plan, protocol or scheme required to be approved under condition 14 or approval has been given following an appeal in accordance with sub-paragraph (6).

(5) Unless otherwise agreed in writing with the undertaker, the MMO must use reasonable endeavours to determine an application for approval made under condition 14 as soon as practicable and in any event within a period of *[four]* months commencing on the date the application is received by the MMO.

(6) Where the MMO fails to determine an application for approval under condition 14 within the period referred to in sub-paragraph (5) or refuses the application for approval, the undertaker may appeal to the Secretary of State in accordance with the procedure in Part 5 of this licence.

PART 2

Procedure for appeals

1. The undertaker must submit to the Secretary of State, a copy of the application submitted to the MMO and any supporting documentation which the undertaker may wish to provide ("the appeal documentation").

2. The undertaker must on the same day provide copies of the appeal documentation to the MMO and any relevant consultee.

3. As soon as is practicable after receiving the appeal documentation, but in any event within 20 business days of receiving the appeal documentation, the Secretary of State must appoint a person and forthwith notify the appeal parties of the identity of the appointed person and the address to which all correspondence for that person's attention should be sent.

4. The MMO and any relevant consultee must submit written representations to the appointed person in respect of the appeal within 20 business days of the date on which the appeal parties are notified of the appointment of a person under paragraph 3 and must ensure that copies of their written representations are sent to each other and to the undertaker on the day on which they are submitted to the appointed person.

5. The appeal parties must make any counter-submissions to the appointed person within 20 business days of receipt of written representations pursuant to paragraph 4 above.

6. The appointed person must make his decision and notify it to the appeal parties, with reasons, as soon as reasonably practicable. If the appointed person considers that further information is necessary to enable him to consider the appeal he must, as soon as practicable, notify the appeal parties in writing specifying the further information required, the appeal party from whom the information is sought, and the date by which the information is to be submitted.

7. Any further information required pursuant to paragraph 6 must be provided by the party from whom the information is sought to the appointed person and to other appeal parties by the date specified by the appointed person. Any written representations concerning matters contained in the further information must be submitted to the appointed person, and made available to all appeal parties within 20 business days of that date.

8. On an appeal the appointed person may—

(1) allow or dismiss the appeal; or

(2) reverse or vary any part of the decision of the MMO (whether the appeal relates to that part of it or not), and may deal with the application as if it had been made to the appointed person in the first instance.

9. The appointed person may proceed to a decision on an appeal taking into account only such written representations as have been sent within the time limits prescribed, or set by the appointed person, under this paragraph.

10. The appointed person may proceed to a decision even though no written representations have been made within those time limits, if it appears to the appointed person that there is sufficient material to enable a decision to be made on the merits of the case.

11. The decision of the appointed person on an appeal is final and binding on the parties, and a court may entertain proceedings for questioning the decision only if the proceedings are brought by a claim for judicial review.

12. If an approval is given by the appointed person pursuant to this Schedule, it is deemed to be an approval for the purpose of Part 4 of Schedule 9 as if it had been given by the MMO. The MMO may confirm any determination given by the appointed person in identical form in writing but a failure to give such confirmation (or a failure to give it in identical form) may not be taken to affect or invalidate the effect of the appointed person's determination.

13. Save where a direction is given pursuant to paragraph 14 requiring the costs of the appointed person to be paid by the MMO, the reasonable costs of the appointed person must be met by the undertaker.

14. On application by the MMO or the undertaker, the appointed person may give directions as to the costs of the appeal parties and as to the parties by whom the costs of the appeal are to be paid. In considering whether to make any such direction and the terms on which it is to be made, the appointed person must have regard to the Planning Practice Guidance on the award of costs or any guidance which may from time to time replace it.

APPENIDX 2: ARBITRATION

Arbitration

38.—(1) Subject to Article 41 (saving provisions for Trinity House), any difference, dispute or decision under any provision of this Order, unless otherwise provided for, must be referred to and settled in arbitration in accordance with the rules at Schedule 14 of this Order, by a single arbitrator to be agreed upon by the parties, within 14 days of receipt of the notice of arbitration, or if the parties fail to agree within the time period stipulated, to be appointed on application of either party (after giving written notice to the other) by the Secretary of State.

(2) Any matter for which the consent or approval of the Secretary of State is required under any provision of this Order must not be subject to arbitration.

(3) Should the Secretary of State fail to make an appointment under paragraph (1) within 14 days of a referral, the referring party may refer to the Centre for Effective Dispute Resolution for appointment of an arbitrator.

Deemed Marine Licences *Part 5 – Condition 15 and 23 (Schedules 9-10) and Condition 10 and 18 (Schedules 11-12):*

15

…

(5) Unless otherwise agreed in writing with the undertaker, the MMO must determine an application for approval made under condition 14 within a period of *[four]* months commencing on the date that the application is received.

(6) Where the MMO fails to determine the application for approval under condition 14 within the period referred to in sub-paragraph (5), the undertaker may refer the matter to arbitration in accordance with condition 23.

23. (1) Subject to condition 23(2), any difference, dispute or decision under any provision of this licence must, unless otherwise agreed between the MMO and the licence holder, be referred to and settled by a single arbitrator to be agreed between the MMO and the licence holder following the process set out in article 38 and schedule 14 of this Order.

(2)Nothing in this condition 23 is to be taken, or to operate so as to, fetter or prejudice the statutory rights, powers, discretions or responsibilities of the MMO.

APPENDIX 3: DEEMED APPROVAL

Articles

Arbitration

38.— (1) Subject to Article 41 (saving provisions for Trinity House), any difference under any provision of this Order, unless otherwise provided for, must be referred to and settled in arbitration in accordance with the rules at Schedule 14 of this Order, by a single arbitrator to be agreed upon by the parties, within 14 days of receipt of the notice of arbitration, or if the parties fail to agree within the time period stipulated, to be appointed on application of either party (after giving written notice to the other) by the Secretary of State.

(2) Any matter for which the consent or approval of the Secretary of State or the Marine Management Organisation is required under any provision of this Order shall not be subject to arbitration.

(3) Should the Secretary of State fail to make an appointment under paragraph (1) within 14 days of a referral, the referring party may refer to the Centre for Effective Dispute Resolution for appointment of an arbitrator.

Deemed Marine Licences *Part 4 – Condition 15 (Schedules 9-10) and Condition 10 (Schedules 11-12):*

15 (5) Unless otherwise agreed in writing with the undertaker, the MMO must determine an application for approval made under condition 14 within a period of *[four]* months commencing on the date that the application is received.

(6) Save in respect of any plan which secures mitigation to avoid adversely affecting the integrity of a relevant site, where the MMO fails to determine the application for approval under condition 14 within the period referred to in sub-paragraph (5), the programme, statement, plan, protocol or scheme is deemed to be approved by the MMO.

(7) The licensed activities must be carried out in accordance with the approved plans, protocols, statements, schemes and details approved under condition 14 or deemed to be approved under sub-paragraph (5) above, unless otherwise agreed in writing by the MMO.

APPENDIX 4: MMO'S INTERNAL ESCALATION PROCEDURE

Arbitration

38.— (1) Subject to Article 41 (saving provisions for Trinity House), any difference under any provision of this Order, unless otherwise provided for, must be referred to and settled in arbitration in accordance with the rules at Schedule 14 of this Order, by a single arbitrator to be agreed upon by the parties, within 14 days of receipt of the notice of arbitration, or if the parties fail to agree within the time period stipulated, to be appointed on application of either party (after giving written notice to the other) by the Secretary of State.

(2) Any matter for which the consent or approval of the Secretary of State or the Marine Management Organisation is required under any provision of this Order shall not be subject to arbitration.

(3) Should the Secretary of State fail to make an appointment under paragraph (1) within 14 days of a referral, the referring party may refer to the Centre for Effective Dispute Resolution for appointment of an arbitrator.

***Deemed Marine Licences**: Part 4, Condition 15, Part 5 (Schedules 9-10) and Part 4, Condition 10 and Part 5 (Schedules 11-12)*

15.

…

(3) Each programme, statement, plan, protocol or scheme required to be approved under condition 14 must be submitted for approval at least *[four]* months prior to the intended commencement of licensed activities, except where otherwise stated or unless otherwise agreed in writing by the MMO.

(4) No licensed activity may commence until for that licensed activity the MMO has approved in writing any relevant programme, statement, plan, protocol or scheme required to be approved under condition 14 or approval has been given following the MMO's internal escalation procedure in accordance with sub-paragraph (6).

(5) Unless otherwise agreed in writing with the undertaker, the MMO must use reasonable endeavours to determine an application for approval made under condition 14 as soon as practicable and in any event within a period of *[four]* months commencing on the date the application is received by the MMO.

(6) Where the MMO fails to determine an application for approval under condition 14 within the period referred to in sub-paragraph (5), the undertaker may invoke the MMO's internal escalation procedure in Part 5 of this licence.

PART 3

Procedure for internal escalation

[Notwithstanding that this is the Applicant's least preferred approach, in the Applicant's view this procedure would need to be secured in the DMLs in order to ensure consistency and to avoid a unilateral withdrawal of the internal escalation procedure post-consent. The MMO, however, consider that the procedure should not be secured in the DMLs as it is subject to change.]

1. (1) Where the MMO fails to determine an application for approval under condition 14 within the period referred to in paragraph 15(5), the undertaker may notify the MMO case team requesting a decision within 2 months from the date of such notification.

(2) On receipt of the undertaker's notification under sub-paragraph 1, the MMO must, as soon as practicable, arrange a meeting with the undertaker to discuss the non-determination, at which a director of the MMO must

be present and, as soon as practicable following the meeting must provide the undertaker with the MMO's decision on the application including its reasons for the decision.

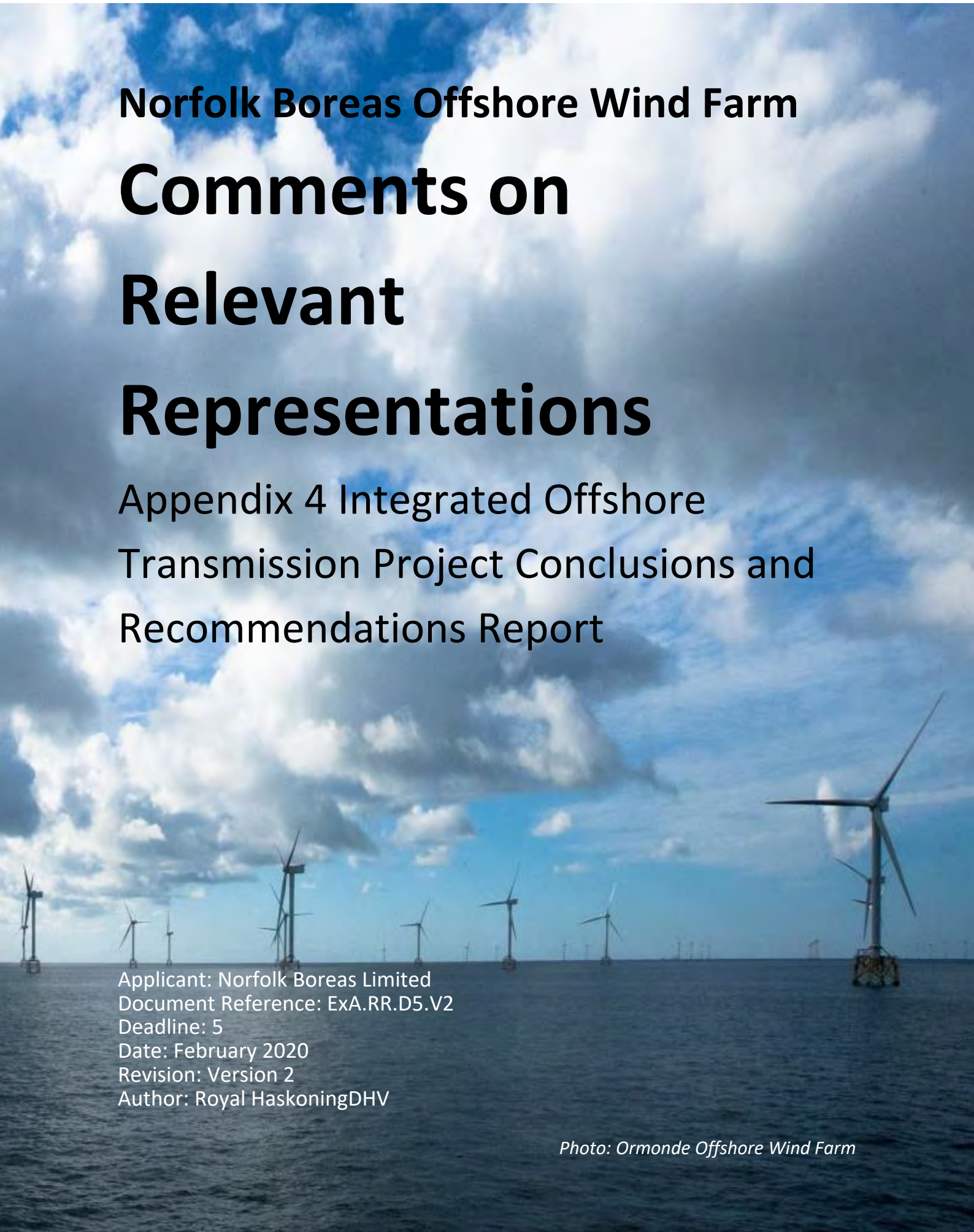
(3) Unless otherwise agreed between the parties, in the event that the MMO fail to determine the application within 2 months from the date of the undertaker's notice under sub-paragraph (1) the application is deemed to be refused by the MMO.

VATTENFALL

Norfolk Boreas Offshore Wind Farm

Comments on Relevant Representations

Appendix 4 Integrated Offshore Transmission Project Conclusions and Recommendations Report



Applicant: Norfolk Boreas Limited
Document Reference: ExA.RR.D5.V2
Deadline: 5
Date: February 2020
Revision: Version 2
Author: Royal HaskoningDHV

Photo: Ormonde Offshore Wind Farm

Appendix 4 Integrated Offshore Transmission Project Conclusions and Recommendations Report

This Appendix contains the following document:

- Integrated Offshore Transmission Project Conclusions and Recommendations Report

Integrated Offshore Transmission Project (East)

Final Report

Conclusions and Recommendations

August 2015

nationalgrid VATTENFALL

SCOTTISHPOWER RENEWABLES SMart Wind FOREWIND

Executive Summary

In 2011 the Crown Estate and National Grid published a report titled Offshore Transmission Network Feasibility Study[1] (OTNFS). This report detailed the initial consideration of using a coordinated design approach to provide connections for Round 3 offshore wind farms. This report concluded that savings for the GB consumer of between £2.4bn and £5.6bn could potentially be possible.

In order to ensure that the GB electricity transmission system continues to be developed in the most economic and efficient way possible, National Grid sought to build on the OTNFS findings to examine in more detail if an alternative approach to the development and connection of offshore generation could provide benefits.

The three large offshore wind zones located off the east coast of England – Dogger Bank, Hornsea, and East Anglia, were used as a basis to assess the potential benefits of alternative design approaches.

In 2012 a project team was formed made up of National Grid and the developers of these offshore wind zones: Forewind – Dogger Bank, SMart Wind and DONG Energy – Hornsea, and Scottish Power Renewables and Vattenfall – East Anglia.

Four individual work-streams (Technology, System Requirements, Commercial, and Cost Benefit Analysis) were formed to focus on each of these topics.

The Technology work-stream concluded that there are no major technical barriers that would definitely prohibit the development of integrated offshore networks to facilitate the connection of offshore wind generation.

The System Requirements work-stream identified a range of potential reinforcement strategies:

- A fully integrated design – offshore wind generation zones are inter-connected via offshore HVDC links to deliver both generation connections and wider system capacity.

- A hybrid design – offshore wind generation zones have some limited inter-connection but connections are generally direct to shore. Wider system capacity is provided by stand-alone offshore reinforcements i.e. an offshore link between two existing points on the onshore system.

- A standard radial design – offshore wind generation is connected directly to shore. There is no inter-connection between wind generation zones. Significant reinforcements are required on the onshore transmission system to provide wider system capacity. This approach is the one specified by the current regulatory and commercial frameworks.

The Commercial work-stream identified that, at the time the review of commercial issues was carried out, the existing regulatory and commercial arrangements would not adequately facilitate all aspects of the development and delivery of an integrated design solution for offshore wind generation. The project acknowledges that several of these concerns have since addressed by subsequent industry developments such as ITPR and the offshore

[1] http://www.thecrownestate.co.uk/media/5506/km-in-gt-grid-092011-offshore-transmission-network-feasibility-study.pdf

gateway process. The main report clearly identifies area where commercial concerns have been resolved.

The cost benefit analysis methodology sought to identify the least worst regret reinforcement strategy, i.e. across the range of generation scenarios assessed, which reinforcement strategy exposes the GB consumer to the minimum risk of over or under investment.

The cost benefit analysis showed that if the contracted levels of generation were delivered by 2030 then savings could be achieved by pursuing an integrated design.

However, since the OTNFS study there have been significant developments in the electricity industry and the wider economy, most notably Electricity Market Reform (EMR), which have impacted on the expected development rate of offshore wind generation.

It is now the view of the project members that offshore wind generation capacity is unlikely to reach the current contracted levels in the timescales required to make an integrated design approach beneficial.

The project now views the current contracted 17.2GW offshore wind generation scenarios as being unrealistic within the timeframe being considered. It therefore has set aside results based on 17.2GW being operational by 2030 from these the zones alone in the drawing final conclusions. A second scenario based around 10GW of offshore wind generation was also assessed. This 10GW scenario is considered to be a more likely top end scenario and the project acknowledges that there is a possibility that actual development may be lower even than this.

Under the Gone Green and Slow Progression variants of the 10GW scenario the CBA results show no clear least worst regret strategy. The differentials are well within the margin of error for this type of analysis.
The project acknowledges the possibility that the level of offshore wind generation delivered may be lower than the 10GW. Should this transpire then the non-integrated designs would perform better and would become the least worst regret reinforcement strategy.

By pursuing a non-integrated design both National Grid and the offshore generation developers can maintain closer control over the scope and programme of their individual works and hence minimise risks for consumers and investors alike.

As a result the project team does not believe it would be economic and efficient to progress with the development of an integrated design philosophy or delivery of anticipatory assets at this time.

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1. Introduction and Background

In 2009 the Crown Estate concluded its tendering process for Round 3 offshore wind farm development zones. The potential generation capacity of these zones represented a step change in the scale of offshore wind farms compared with the Round 1 and 2 developments.

All previous offshore wind farm connections in Great Britain have been radial in design, i.e. a single direct link is provided between the wind farm and the point of connection on the onshore transmission system (using either alternating current – a.c. or direct current – d.c. technology). This radial connection is owned by a separate Offshore Transmission Owner. Although the current industry codes and frameworks do not exclude the possibility of an alternative design approach they were developed primarily to best facilitate the prevailing radial approach.

This radial design approach, when applied to the potential Round 3 developments, would mean significant volumes of generation connecting at single points on the onshore transmission system, in many cases these points of connection would be in close proximity to each other. Additional capacity on the onshore transmission system is likely to be required to accommodate these new generation connections and the resulting increased power flows.

A study was undertaken by National Grid and the Crown Estates (Offshore Transmission Network Feasibility Study – OTNFS), which identified that developing a coordinated approach to the development of offshore transmission infrastructure, focusing on the Round 3 and Scottish Territorial Waters projects, together with possible interconnection, could potentially save around £3.5bn in capital costs compared with a purely radial solution

The three Round 3 development zones located off the east coast of England, Dogger Bank, Hornsea, and East Anglia, are amongst the largest (in terms of potential generation capacity) proposed. These three zones are in relatively close proximity to each other and could drive the need for significant reinforcement of the onshore system.

In order to ensure the development of the most economic and efficient transmission system, National Grid sought to examine the potential for offsetting the need for new onshore infrastructure by establishing an integrated design approach to the connection of these generation zones. This approach would include the use of inter-connection between offshore zones (via offshore transmission assets) and optimising connections to the onshore transmission system.

In order to achieve this National Grid formed a project team including the developers of these offshore wind zones: Forewind – Dogger Bank, SMart Wind and DONG Energy – Hornsea, and Scottish Power Renewables and Vattenfall – East Anglia.

The Integrated Offshore Transmission Project - East (IOTP-E) team would examine different design philosophies for the connection of the three Round 3 offshore wind farms located of the east coast of England.

This summary report gives an overview of the work carried out, the main conclusions reached, and the recommended next steps.

2. Project Scope and Approach

In order to assess the viability of integrated connection designs the project team focused on four key areas: Technology, System Requirements, Cost Benefit Analysis, and Commercial. A dedicated work-stream was set up to study each area.

1. Technology – This work-stream would assess the current state, and expected future development, of technology required to deliver integrated offshore networks (primarily Voltage Source Converter High Voltage Direct Current – VSC HVDC equipment). The work-stream would provide a view as to whether the required technology would be available in the same timescales as the wind farm developments and also provide a forecast estimate of potential costs.

2. System Requirements – This work-stream would assess the impact of the new offshore wind generation connections on the existing onshore transmission system and identify the additional capacity that would be required. The work-stream would also propose connection options ranging from a radial design (in line with the current arrangements) to a fully integrated approach, including intermediate hybrid designs. The work-stream would also determine the additional system capacity provided by each design proposal and, using the information from the technology work-stream, determine a capital cost estimate.

3. Cost Benefit Analysis – This work-stream would use National Grid's established methodology and modelling techniques to carry out an economic analysis of the different design options proposed. This would primarily involve comparing the system operation costs that would result from each option. Operational costs in this context refer to conditions where the power flows across a network boundary exceed the maximum capacity of that boundary and hence generation must be paid not to generate and replaced with generation located elsewhere on the system. These costs are referred to as constraint costs. Using this method the work-stream would make a recommendation on the preferred design options and the optimal delivery time for reinforcements.

4. Commercial – This work-stream would examine the current commercial and regulatory frameworks that govern offshore wind development and recommend the additions or modifications required to facilitate an integrated design approach. This work-stream would consider the requirements of generation developer, offshore transmission owners, and onshore transmission owners.

Each work-stream has prepared a stand-alone report detailing the work carried out and the conclusions reached. Those reports are included here as appendices to this overall summary report.

This summary report describes the main conclusions reached by each work-stream, the overall conclusions reached by the project team, and the recommended next steps.

3. Technology Work-Stream

The work-stream aimed to establish the present state of development of the technologies required for an integrated offshore transmission system and to identify developments required in order for an integrated offshore transmission system to be built.

Due to the location and volume of the offshore generation being considered, HVDC technology would be required to deliver an effective integrated design. The costs of providing equivalent capacities with a.c. cable technology prohibit the use of that technology and hence it was not considered further by this work-stream.

A fully integrated offshore transmission system would require multi-terminal HVDC designs. To date the vast majority of worldwide HVDC applications have been point to point developments where only two converter stations are connected together. A multi-terminal approach would consist of several converters connected together as a meshed network where power could be transferred to several different converters at once. A multi-terminal HVDC design of type required for this project would represent a significant step change in this technology.

HVDC Technology

There are two main HVDC technology types, Line Commutated Converter (LCC – also known as current sourced converter or 'classic' HVDC) and Voltage Source Converter (VSC).

The majority of HVDC schemes currently in service use LCC technology, which has been commercially available since 1954. VSC technology is a newer development, it was first applied commercially in 1997 and significant growth in application and development in the technology have occurred since then. VSC technology offers certain performance advantages over LCC but is yet to achieve the same power ratings. However, significant developments are being made with respect to VSC ratings.

LCC HVDC Technology

The main characteristics of LCC HVDC technology that are relevant to its application in an integrated offshore transmission system are summarised below.

- Based on thyristor valves to control the commutation.
- LCC HVDC technology is able to achieve high power ratings, an example being an HVDC link connecting Jinping and Sunan in China with a power rating of 7200 MW operating at ± 800 kV d.c. which was commissioned in 2013.
- Typical losses for a LCC HVDC converter are around 0.8% of the transmitted power.
- Operation is dependent on an a.c. voltage source (i.e. a connection to the a.c. system).
- Requires high short circuit ratio to ensure stable operation – i.e. the a.c. grid at either end of the HVDC link must be strong.
- Converter operation is accompanied by reactive power absorption, typically in the range 50 to 60% of the transmitted power. Hence reactive compensation plant is required.
- Converters of this type cause harmonic distortion. Therefore additional equipment is required to provide a.c. harmonic filtering in order to keep the harmonic distortion on the a.c. system within permitted levels.

- The space required for reactive compensation plant and a.c. harmonic filters in a LCC HVDC converter station may typically account for 50% or more of the station footprint.
- LCC HVDC converters are susceptible to faults and disturbances in the a.c. system which may cause commutation failure. A commutation failure results in temporary interruption to the power transmission.
- When more than one HVDC converters are in electrical proximity, a single fault or disturbance in the a.c. system may cause simultaneous commutation failures and loss of transmission in all links.
- Power reversal is accompanied by a change in the polarity of the d.c. voltage, which precludes use of LCC HVDC technology with extruded cables.

VSC HVDC Technology

The main characteristics of VSC HVDC technology that are relevant to its application in an integrated offshore transmission system are summarised below.

- Based on semi-conductor technology, VSCs use Insulated Gate Bipolar Transistors
- The highest rated VSC HVDC system in service at present is the 500 MW East–West Interconnector between Ireland and Wales. A number of VSC HVDC systems with higher power transmission capacities are under construction at present, including some at 1000 MW.
- Active and reactive power are controlled independently and both may be controlled rapidly and continuously within the limits of the converter's rating.
- VSC is not dependent on a strong a.c. network. It can be used with weak and passive systems making it ideal for offshore applications.
- VSC HVDC converters are self-commutated, meaning there is no requirement to install additional reactive compensation equipment.
- VSC HVDC converters require little or no a.c. harmonic filtering.
- Since a VSC HVDC converter requires little or no reactive compensation and a.c. harmonic filters, the station footprint is less than that of an equivalent LCC HVDC converter.
- A VSC HVDC converter may continue to transmit power in the event of a fault on the a.c. system. VSC HVDC converters do not suffer commutation failures.
- Losses for the present generation of VSC HVDC converters are less than 1% of the transmitted power per converter.
- Continuous operation at any level of power within its rating is possible.
- Power reversal is achieved by a reversal of the d.c. current, with the d.c. voltage polarity remaining unchanged. Since no reversal of the d.c. voltage polarity occurs, VSC HVDC converters may be used with extruded cables.

LCC vs VSC Comparison

The differences between VSC and LCC HVDC technology may lead to one or the other being better suited to the functional requirements of a given project. VSC HVDC technology tends to be advantageous in the following situations:

- where short circuit levels are low or where a black start capability is required
- where rapid control of power or rapid power reversal is required
- where the use of extruded cables is required
- where limited space is available

VSC HVDC converters are well suited to connection of offshore wind generation and to multi-terminal applications as required for the integrated offshore transmission project. The

use of LCC technology for wind generation and offshore applications would generally require additional investment and would present some additional engineering challenges.

It is the conclusion of the Technology work-stream that the performance characteristics of VSC HVDC technology would be better suited to the integrated connection of offshore wind generation than LCC HVDC technology.

Technology Development

Many of the technologies required for an integrated offshore transmission network are new and developing rapidly.

At the moment the ratings available from VSC HVDC technology are lower than those of LCC alternatives. However, it is expected that by 2016, LCC HVDC systems with cables will no longer offer a greater power transfer capability than VSC HVDC systems.

VSC HVDC converters for offshore application are under construction. Several projects with offshore converters are currently in progress and valuable experience will be gained from these.
There is a clear requirement for reducing the costs of platforms for offshore HVDC converters. It is thought that developments in offshore platform technology would allow a 2000 MW offshore converter to be in service by 2021.

However, the development of offshore platforms required to accommodate 2GW converter stations is considered to represent the largest single technology risk to the delivery of integrated offshore networks.

The first two multi-terminal VSC HVDC systems have recently been commissioned. Both were designed and built as multi-terminal systems in a single stage of construction. To facilitate the wider implementation of multi-terminal HVDC systems, the development of standards to ensure compatibility of the equipment of different suppliers on a common HVDC system is highly desirable. Working Bodies within CIGRE and CENELEC are currently active in this area.

In order to secure integrated HVDC networks against faults to the same standard as an a.c. network, HVDC circuit breakers would be required. An HVDC circuit-breaker has been demonstrated in the laboratory. It is expected that such a device could be in service by 2019. Ongoing developments are envisaged in HVDC circuit-breaker technology in pursuit of increased operating speeds, higher ratings, reduced losses and reduced costs. Integrated HVDC networks can be delivered without this technology but would require different security and design standards.

Unit Cost Estimates

Unit costs have been obtained for each of the technologies required for an integrated offshore transmission network for use in cost benefit analyses.

Costs are influenced by many factors, including the specific requirements of a given project, exchange rates, commodity prices and the balance of supply and demand in the market at the time of tender. Due to a scarcity of current data, the costs were generally obtained by inflating those published in National Grid's 2011 Offshore Development Information statement in line with the Harmonised Index of Consumer Prices (HCIP).

The full details of the unit cost estimates produced by the Technology work-stream are shown in Appendix A.

Protection of HVDC Multi-terminal Networks

Multi-terminal HVDC networks are more vulnerable to faults than an a.c. equivalent. This is due to the fact that there is currently no commercially available d.c. circuit breaker technology. As a result a fault within a d.c. network will result in the loss of the complete d.c. network rather than just the faulty section.

While an integrated offshore network could be delivered without this technology it would potentially be less flexible and robust than an a.c. equivalent.

Staged Delivery of HVDC Assets

VSC HVDC schemes may be constructed in stages to better match investment with system requirements where the potential requirement for a higher transmission capacity it some point in the future is anticipated. Staged construction is described fully in Appendix A.

Technology Work-Stream Conclusion

The review carried out by the technology work-stream has concluded that there are no major technical barriers that would definitely prohibit the development of integrated offshore networks to facilitate the connection of offshore wind generation.

VSC HVDC technology is considered to be best suited to the application of integrated generation connections.

While the ratings currently available for this technology are lower than the LCC equivalent, it is considered that VSC converters and cables at 2GW ratings will be available prior to 2020 and hence would not limit the application of VSC technology.

The Technology work-stream acknowledges that there remains a significant amount of work to develop common VSC HVDC specifications and control philosophies, however indications are that manufacturers are seeking to address this. It is expected that if real demand for integrated VSC HVDC projects was to materialise that manufacturers would facilitate development in this area.

The development of protection equipment for integrated HVDC networks is currently behind that of the a.c. equivalent, particularly with respect to d.c. circuit breakers. While an integrated offshore network could be delivered without this technology, greater flexibility and efficiency could be achieved should they be developed. Indications are that manufacturers would seek to invest in this area if consumer demand materialises.

Estimated capital costs have been developed. While the work-stream acknowledges the degree of uncertainty inherent in these estimates, it concludes that, should integrated offshore HVDC networks be required, costs are unlikely to present a prohibitive factor compared with other design solutions.

The full Technology work-stream report can be found in Appendix A.

4. System Requirements Work-Stream

Assessing Transmission System Capability and Requirements

In order to allow National Grid to assess the capability and requirements of the onshore transmission system the network is divided into series of areas by notional boundaries.

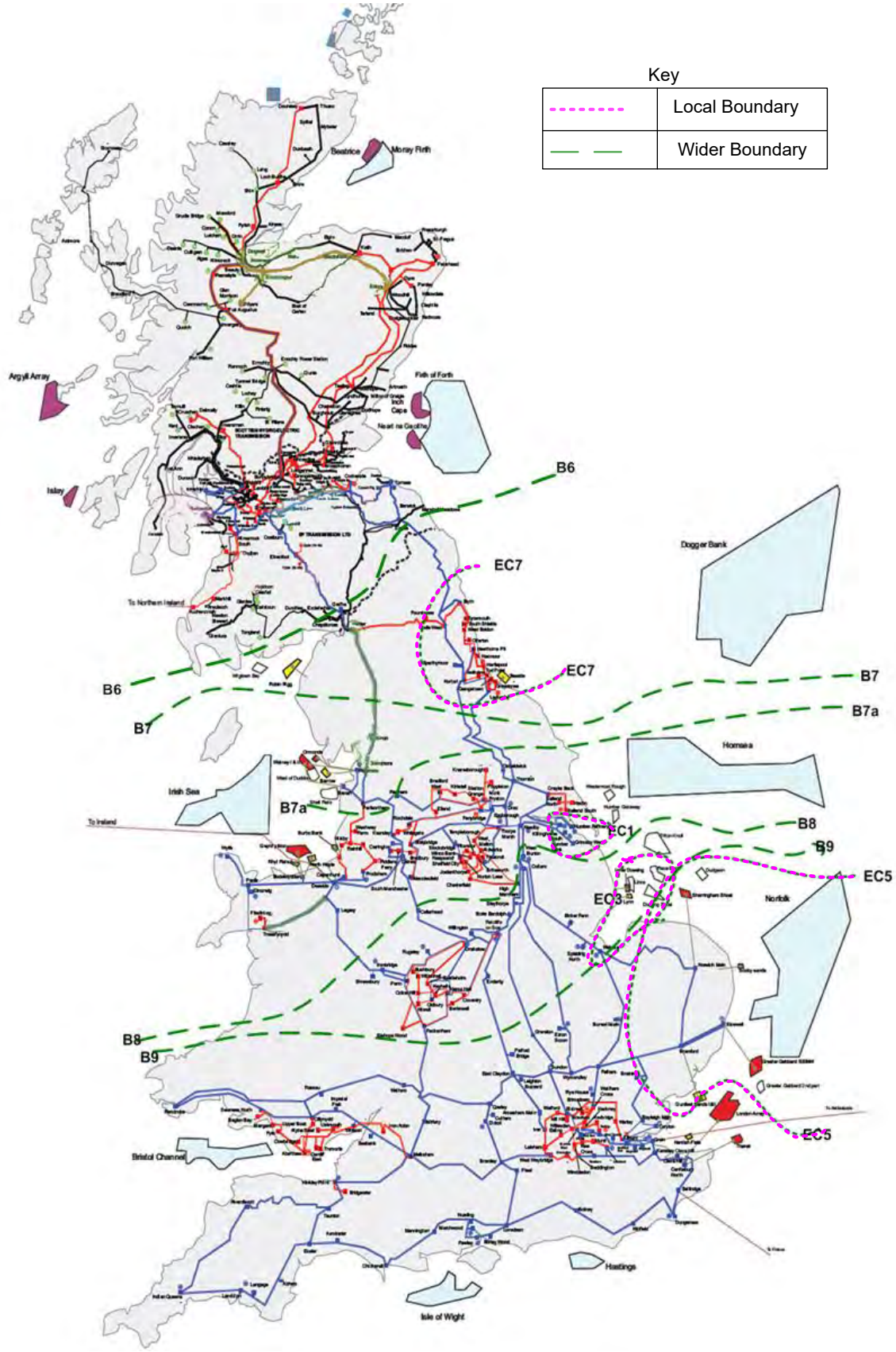
These boundaries define key parts of the network from which power is either exported or imported.

The National Electricity Transmission System Security and Quality of Supply Standards (NETS SQSS) defines the method for calculating the minimum power transfer a boundary must be capable of. Where boundaries are unable to meet this transfer, National Grid may have to constrain generation in that area to reduce power flows, over time this can result in significant costs.

Therefore National Grid seeks to ensure that, where it is economic and efficient to do so, all boundaries have sufficient capacity to meet the requirements of the NETS SQSS.

The main system boundaries that will be affected by the connection the east coast Round 3 offshore wind farms are titled B6, B7, B7a, B8, and B9; these boundaries are concerned primarily with the transfer of power from Scotland and the north of England to demand centres located further south. Some smaller local boundaries were also studied.

The geographic location of the key boundaries considered in this project is shown in the following diagram.


Key
Local Boundary
Wider Boundary
Beatrice
Moray Firth
Argyll Array
Firth of Forth
Islay
B6
EC7
Dogger Bank
To Northern Ireland
B7
B7a
Hornsea
Irish Sea
To Ireland
EC1
B8
B9
EC5
EC3
Norfolk
Bristol Channel
Hastings
Isle of Wight

Future Generation Scenarios and Boundary Requirements

New generation connections can increase the transfer requirements across boundaries in that area. If this additional capacity requirement exceeds the maximum limit boundary limit then the boundary will need to be reinforced through either upgrading the existing circuits or by delivery new circuits.

As there is uncertainty around the exact volumes of offshore wind generation that will be delivered, the System Requirements work-stream has used a number of different future generation scenarios to determine a range of possible future requirements.

The 2013 versions of the National Grid Future Energy Scenarios (FES) were used as the basis of the more specific scenarios developed for this project.

The 2013 FES comprised of two core scenarios: Gone Green (GG) and Slow Progression (SP). The GG scenario is design to represent a case where the GB 2020 carbon and renewable energy targets are met. The SP scenario illustrates the case where the 2020 targets are missed and not achieved until around 2025.

In addition to these wider scenarios the work-stream considered two main sensitivities specific to the development of the offshore wind generation in the Dogger Bank, Hornsea, and East Anglia zones. These were:

Sensitivity	Description	Total Volume of Offshore Wind Generation
Contracted Position	The contracted volume of offshore wind generation across the three zones is delivered.	17.2GW
Central View	Wind generation across the three zones is lower than the currently contracted position.	10GW

The central view was intended to represent a case where, for any given reason, the offshore generation developers chose to deliver a level of generation lower than the maximum capacity of the zone. Changes to the originally agreed contracted position are not uncommon in generation development project (onshore or offshore).

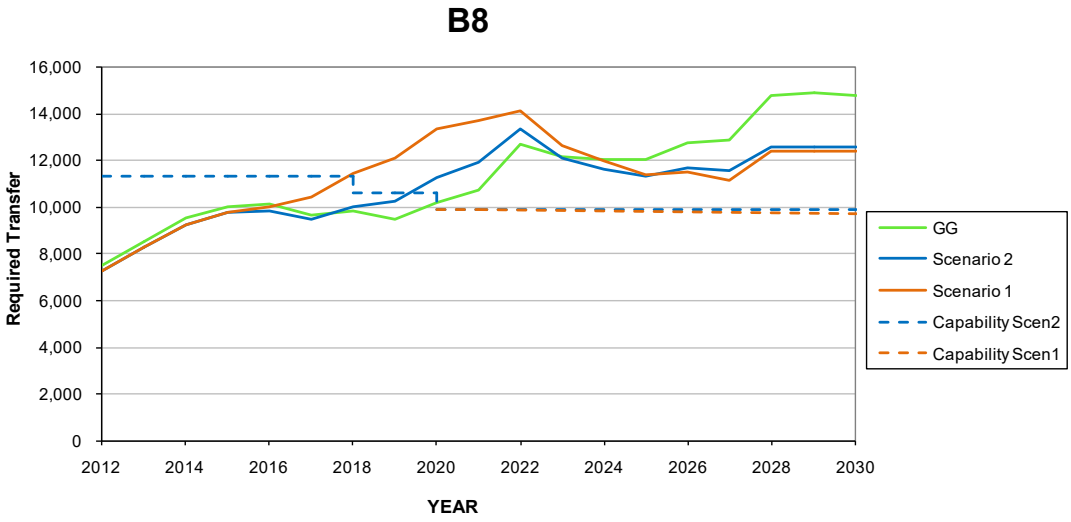
Each of these local sensitivities was then coupled with the both the core GG and SP scenarios, giving four overall background scenarios.

Core Scenario	Local Sensitivity
Gone Green	Contracted Position
Gone Green	Central View
Slow Progression	Contracted Position
Slow Progression	Central View

The System Requirements work-stream has assessed the future boundary requirements that will be driven by the connection of the three Round 3 wind farms off the east coast of England.

An example of the boundary transfer requirements calculated is shown below. The graph shows that, against all variants of the core GG scenario, the power transfer requirements for

the B8 boundary will exceed the existing capability of the boundary sometime between 2016 and 2020.



The full details of the boundary analysis carried out and the future transfer requirements calculated are given in Appendix B.

The boundary analysis has shown that there will be a need to deliver additional capacity across the boundaries assessed under all combinations of scenarios considered. The requirement is greater and materialises earlier under the GG based scenarios.

Proposed Design Options

The Systems Requirements work-stream developed a range of different design options that could be used to provide both a connection for the offshore wind generation and additional boundary capacity across the key B6, B7, B7a, and B8 boundaries.

In order to determine the merits of an integrated offshore solution the work-stream also developed options that focused on standard radial offshore connections with additional boundary capacity being provided by reinforcements to the existing onshore system.

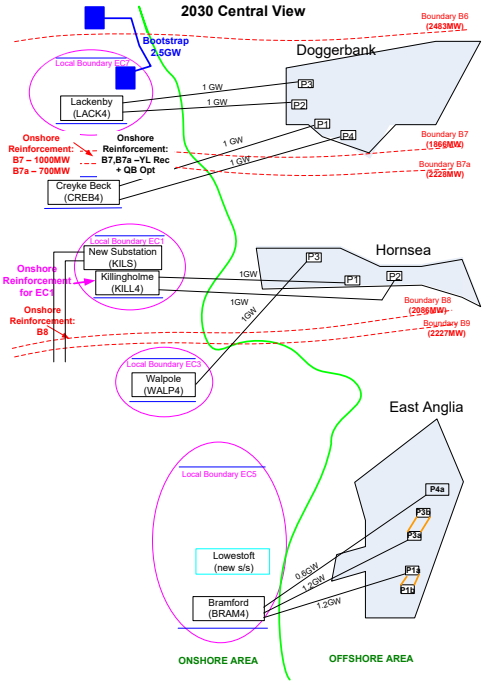
The work-stream also considered hybrid solutions that combined elements of offshore integration with stand-alone boundary reinforcements.

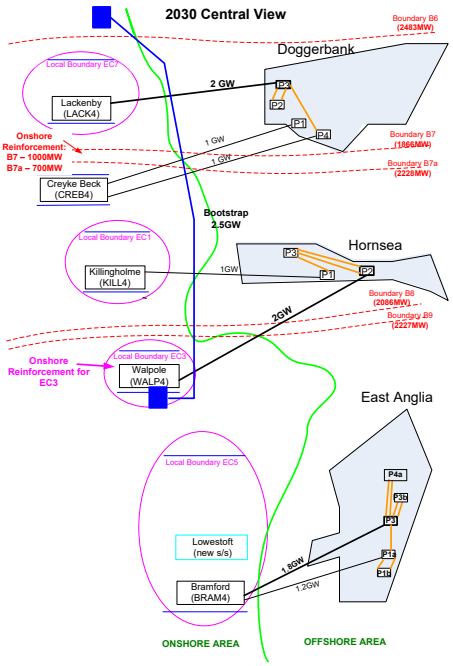
The technology types used to develop these design options was governed by the findings of the Technology work-stream and hence are based around VSC HVDC links with ratings up to 2GW.

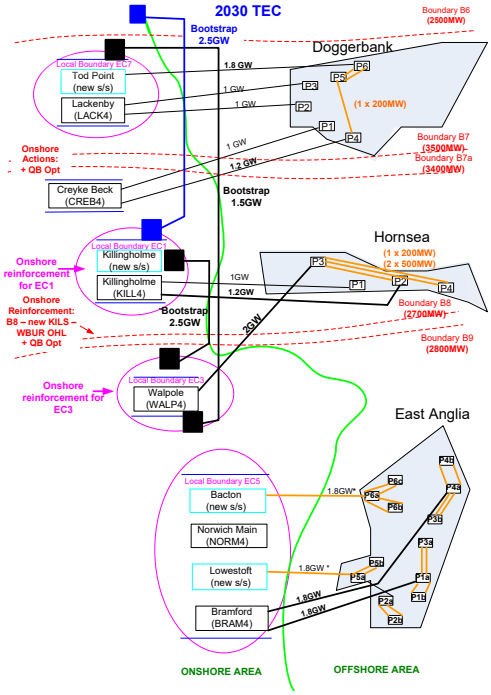
The System Requirements work-stream assessed the additional boundary capacity that would be delivered by each design option proposed.

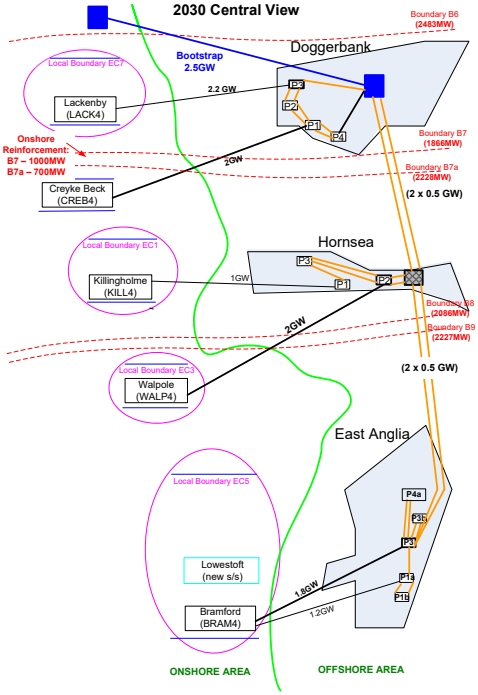
Cost estimates for the design options were also calculated using the unit cost assumptions prepared by the Technology work-stream.

Over 15 design options (and variants thereof) were developed by the System Requirements work-stream, examples of these are shown below.









The full details of the complete range of designs proposed, the capital cost estimates, and the boundary capacity delivered can be found in Appendix B.

5. Commercial Work-Steam

Note for the Reader

Much of the analysis work carried out as part of this project took place prior to and then in parallel with Ofgem's Integrated Transmission Planning Review (ITPR) project. As such some of the key concerns raised by the Commercial work-stream have now been addressed, particularly with regards to the process through which anticipatory investments would be identified and assessed by Ofgem. Instances where an issue raised by the work-stream has now been resolved will be specifically highlighted in this report.

Existing Frameworks

The current commercial and regulatory frameworks in place were primarily designed and developed to support the delivery of the Round 1 and 2 offshore wind farms. Due to the size and location of these developments, all were connected using a radial approach.

Prior to the announcement of the proposed Round 3 developments there was not considered to be any driver to examine an integrated design approach. Therefore, while the existing commercial and regulatory arrangements did not exclude the potential of an integrated design approach they had been designed and developed to best facilitate radial connections.

As a result, the pre-ITPR arrangements introduced a number of risks and uncertainties to the development of integrated connections that could cause significant barriers, particularly around the ability of offshore wind farm developers to plan and finance projects.

An essential element of any approach to enhance co-ordination is the ability to drive through the identified design solution. All parties will need to be clear as to their accountabilities and those of others, particularly the role of the National Electricity Transmission System Operator (NETSO) need case. Effective collaboration will be an important mainstay of the process of co-ordinating investment.

In order to address this risk, the Commercial work-stream has explored five key areas to determine if changes would be required to allow development of an integrated approach.

- Regulation
- Financing
- Charging
- Consenting
- User Commitment

Regulation

The regulatory issues associated with developing and delivering integrated offshore generation connections are primarily related to the ownership of assets and the relationships and obligations between these different parties – generators, offshore transmission owners (OFTOs), and onshore transmission owners.

An integrated design (especially one delivered through the staged build of anticipatory investments) would introduce uncertainty over the definition of generator connection assets and those assets that are providing wider network benefits. For example, the subsequent delivery of additional assets to provide integrated benefits could interact with the control system configuration of the initial generator connection assets. This could lead to the need to redesign or reconfigure these assets. Clarification would also be needed on how individual

generators could demonstrate ongoing compliance with their Grid Code requirements whilst also delivering wider network benefits. For example, in an integrated system where would the interface points be specified? If the requirement was to remain at the point of connection to the onshore network how would the Grid Code requirements be aggregated and allocated between all connected generators?

Uncertainty around the initial scope or future requirements of any offshore transmission assets could potentially limit the number of parties providing tenders to deliver these works. The scope of work to be delivered could change in response to generators changing their TEC, delivery dates or terminating altogether. This could result in significant changes being made to the specification against which a supplier has tendered and hence require re-design / re-tendering. The work-stream considers it possible that suppliers could favour non-integrated projects in order to increase certainty over their deliverables. This could result in higher costs and hence a poorer outcome for the GB consumer. The work-stream acknowledges that this issue also applies to onshore developments but to a lesser extent. Onshore projects are generally driven by one developer and the design of connection assets dependent almost entirely on their plans. In an integrated offshore environment it is possible that multi-parties could impact on each other design requirements and the potential for significant changes are projects develop is considered to be higher than for "standard" onshore projects.

An integrated offshore design would likely result in a large degree of interdependency between different OFTOs, which has implications for the availability incentive and the co-ordination of outages. While this is not a barrier to progressing integration it must be acknowledged that it would add an additional layer of complexity to the existing arrangements and hence would need a robust process put in place to ensure these relationships would be managed.

The availability incentive mechanism should be enhanced to ensure that the incentives are appropriately weighted, and that an OFTO that is dependent on another OFTO's assets to route power to shore is not penalised for an inability to export if the fault occurs on the other OFTO's assets. There should further be a requirement for all interconnected OFTOs to coordinate outages in the best possible way to ensure that the disruption to generators is minimised.

Financing

The Commercial work-stream has concluded that any regulatory arrangement that increases the risk profile currently carried by offshore wind developers is likely to dissuade investment in this area.

If greater certainty cannot be achieved as to how the risks around potential asset stranding would be managed then it is the view of the Commercial work-stream that offshore wind farm developers will focus on project where the risk profile can be minimised, e.g. smaller scale, radially connected developments.

Due to the timescales and stranding risk it seems more likely that anticipatory investments that are relatively cheap have a chance of being made. Even with these investments it will be important to analyse the benefits to ensure that the party contemplating making the investment and taking the risk is the party getting the reward. This is by no means a given in the current regulatory environment. Furthermore, the party making the anticipatory investment and taking the risk should be the decision maker as to whether the investment is made. If another party seeks to influence the investment decision or direct that it is made there would need to be a clear transfer of risk to that other party.

Some of the anticipatory investments with the potential to save the biggest amounts of capital require high up front anticipatory investment and are risky. They probably only be managed by making bigger financial investment decisions. A 2GW wind farm FID to match with a 2GW HVDC transmission link is an example of what may be needed. While such 2GW wind farm FID decisions have not yet been ruled out for the later phases of the development of the southern North Sea Round 3 wind farm zones, no developer is currently developing projects greater than 1.2GW for the projects that are in active development at the moment. One of the developers has put some thought into larger links for the later stages of zone development, but deployment would be well into the future.

The concerns raised in this section accurately represent the concerns of the project work-stream at the time of writing. However, the Offshore Gateway process was developed and implemented in a parallel with this work and addresses the key areas of these concerns, particularly around anticipatory assets and potential stranding risks. The work-stream acknowledges that these risks should be adequately managed through the offshore gateway process.

Charging

If an integrated design approach were to be applied to the east coast Round 3 development is it possible that some anticipatory investments (e.g. oversizing of platforms and HVDC links) would have to be put in place well before the period 2025 – 2030 when the bulk of the gernation capacity would be delivered.
Charging arrangements for offshore generators had been introduced into the charging methodology by modification GB-ECM08. These arrangements did not consider the possibility of an integrated, coordinated or interconnected offshore network, but rather offshore generators connected radially to the main onshore network.

Under this arrangement offshore assets were assumed to be dedicated investments for specific projects, and the cost would be carried mainly by those projects.

In 2012, National Grid initiated an industry workgroup to look at the issues around charging for an integrated offshore transmission system, and identify potential developments to the charging methodology that could be taken forward. The group concluded in summer 2013 and a report was published on National Grid's website. The report noted three main areas where change was required:

1. The link between offshore tariffs and OFTO revenue could result in the cost of integrated offshore transmission assets being reflected disproportionately on offshore users, as their tariff would be calculated on the assumption that the assets were sole use.
2. The attribution of flows on offshore transmission networks does not reflect the different standards used to design those networks, which could result in wider system reinforcements being unduly assigned to offshore generators.
3. The impact of sequential co-ordination could have a significant impact on the volatility of charges (and implications for certainty under Contracts for Difference strike prices), and act as a first mover deterrent.

The group identified a number of potential solutions which could be developed through a Connection and Use of System Code (CUSC) modification proposal to address these issues.

Any Transmission Charging Methodology modifications should be progressed through the normal forum to eliminate the identified unacceptable level of tariff volatility that can be seen with integration.

Consenting

It is likely that the different elements of an integrated offshore network would require individual consents which would be obtained through separate existing processes.

The commercial work-stream does not expect that it will be possible to obtain consent for the complete scope of an integrated offshore network through a single planning application.

Certain works may be more difficult or take longer to obtain consent than other works. Broad assumptions can be made, for example obtaining consent for a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008 is likely to take considerably longer than only seeking a marine licence for an electricity cable.

However, it can reasonably be assumed that if new onshore transmission circuits were required, then gaining consent for these would represent the most challenging element of any project in terms of risk, cost and time.

Despite this the Commercial work-stream does not believe that there are any barriers in the consenting process over and above those already faced by large scale electricity infrastructure projects.

User Commitment

There are two main types of integrated offshore investments that on which user commitment could impact.

The first is when additional interconnection is provided between wind farms to provide wider system boundary capacity. In this case, the Gateway process to allow Ofgem the opportunity to approve the rationale behind the project has to provide full confidence for whoever is progressing the investment.

There is currently no obvious financial incentive on an offshore developer to undertake a project with such a limited direct benefit. Indeed, the additional financing costs that would be required to construct a project of this type could be a barrier to a developer agreeing to undertake such work. An OFTO build approach would mitigate the developer carrying the additional financing requirement. However, there have yet to be any examples of the OFTO build approach being adopted for any Round 1 or 2 wind farms and the work-stream does not see any indication of why this would change for Round 3 developments.

The second case is where additional anticipatory capacity is provided to facilitate the connection of future offshore wind developments. In this case the work-stream finds that the existing industry framework for user commitment could be applied.

Commercial Work-Stream Conclusions

The Commercial work-stream concluded that, at the time of project commencement, the existing regulatory and commercial arrangements would not adequately facilitate the development and delivery of an integrated design solution for offshore wind generation. This was due to there being a perception that there was too a great a level of uncertainty around roles and responsibilities in the development process and also with regards to who would deliver and own certain assets.

It was considered that the current arrangements resulted in too great a level of uncertainty around project scope and cost when applied to integrated designs. In particular the arrangements around funding and charging would need to be clarified to ensure that offshore wind developers can successfully secure investments.

If those levels of uncertainty were not addressed, there was a risk that offshore developers will be discouraged from progressing large scale far shore projects that may be subject to integration requirements and hence focus on smaller, less complex developments.

The Commercial work-stream acknowledges that several of the key concerns identified during this project have now been addressed by the offshore gateway process and ITPR, particularly with regards to the process with which anticipatory investments would be identified and assessed by Ofgem.

There remain a number of uncertainties regarding specific issues around allocation of charging and treatment of asset unavailability. However these are not considered to present material barriers to the progression of integrated designs.

6. Cost Benefit Analysis Work-Stream

Study Objectives and Scope

The work undertaken by the Cost Benefit Analysis (CBA) work-stream was designed to compare the scale of forecast network constraint cost savings versus the investment cost of more sophisticated network designs.

The current transmission network capabilities coupled with the range of generation projected to connect/disconnect over the next 20 years will impact on operational costs. These operational costs will increase in the absence of any further network reinforcements.

The CBA work-stream had the following key objectives:

- To present economic justification for the preferred designs and an explanation of how they compare with the alternative counterfactual case.
- To present evidence on expected long-term value for money for consumers considering a range of sensitivities, and
- To present evidence on optimal timing of the preferred reinforcement option.

To meet these objectives, the CBA work-stream agreed the following scope of work:

- To establish the reference case position in terms of constraint costs forecasts associated with the 'do minimum' network state, across two generation background scenarios.
- To model the economic impact, measured as constraint cost savings, for a range of designs, across a range of scenarios.
- To undertake a CBA by:
    - Appraising the economic case of the options by adopting the Spackman approach and determining respective Net Present Values (NPVs) across the studied generation scenarios and sensitivities.
    - Establishing worst regrets associated with each design/technology appraised.
    - Identifying the Least Worst Regret option overall.
    - Assessing the impact of key sensitivities: increase in capital expenditure, and delays in delivery timeframes.
- Make recommendations for the preferred option i.e. the Least Worst Regret solution, taking into consideration the impact of sensitivities.

Future Generation Scenarios

As described in the System Requirements section, the project assessed the requirements of the two core Future Energy Scenarios (as were available in 2013): Gone Green and Slow Progression.

In addition to these two core scenarios the work-stream also considered two sensitivities related specifically to the development of wind generation in the three zones (Dogger Bank, Hornsea, East Anglia). These sensitivities were the contracted position – giving a total wind generation capacity of 17.2 GW, and the central view – which gave a total installed capacity of 10 GW across the three zones.

In addition to these overall scenarios, the work-stream also made assumptions around the load factor of the three offshore wind generation zones and the output correlation between

these zones. The load factor information was based on information from the Metrological Office.

Methodology and Modelling

Constraint costs are incurred when the desired power transfer across a transmission system boundary exceeds the maximum operational capability of that boundary. When this occurs, it is necessary to pay generation behind that boundary to reduce production (constrain their output) and replace this energy with generation located in an unconstrained area of the network to balance the system.

Under current arrangements, constraint payments are made to onshore Generators, but not to offshore generators. Renewable Obligation Certificates (ROCs) / Contracts for Difference (cfd) are not paid when Generators are not delivering energy. Consequently the consumer will pay less when offshore wind generation is constrained, as the reduced ROC / cfd payments outweigh the cost of bringing on onshore generation. However, established practice in cost benefit assessment of offshore wind is to assume that higher availability brings consumer benefit through its contribution to meeting renewable energy targets, and its potential to offset the need to develop further offshore generation to ensure that targets are met. In the analysis described in this report this benefit is represented by applying constraint costs to offshore generation. The applied constraint cost includes the value of ROCs / cfds that would be paid if the energy was provided.

The Electricity Scenario Illustrator (ELSI) is National Grid's in-house model used to prepare medium to long term constraint forecasts on the transmission network. The model is our preferred tool to inform long term investment decisions.

ELSI is a Microsoft Excel based model which utilises Visual Basic linear programming to perform optimisations. Additionally, unlike most tools, ELSI adopts a transparent modelling approach, where all input assumptions and algorithms are accessible to the user.

ELSI represents the GB electricity market, in which the energy market is assumed to be perfectly competitive; i.e. there is perfect information for all parties, sufficient competition so that suppliers contract with the cheapest generation first, and that there are no barriers to entry and exit.

The electricity transmission system is represented in ELSI by a series of zones separated by boundaries. The total level of generation and demand is modelled such that each zone contains specific generation capacity by fuel type (CCGT, Coal, Nuclear etc.) and a percentage of overall demand.

Zonal interconnectivity is defined in ELSI to reflect existing and future boundary capabilities. The boundaries, which represent the transmission circuits facilitating this connectivity, have a maximum capability that restricts the amount of power which can be securely transferred across them.

ELSI models the electricity market in two main steps:

- The first step looks at the short run marginal cost (SRMC) of each fuel type and dispatches available generation from the cheapest through to the most expensive, until the total level of GB demand is met. This is referred to as the 'unconstrained dispatch'. The network is assumed to have infinite capacity and so does not impinge on the unconstrained dispatch.

- The second step takes the unconstrained dispatch of generation and looks at the resulting power transfers across the boundaries. ELSI compares the power transfers with the actual boundary capabilities and re-dispatches generation where necessary to relieve any instances where power transfer exceeds capability (i.e. a constraint has occurred). This re-dispatch is referred to as the 'constrained dispatch' of generation.

The algorithm within ELSI will relieve the constraints in the most economic and cost effective way by using the SRMC of each fuel type. The cost associated with moving away from the most economic dispatch of generation (unconstrained dispatch), to one which ensures the transmission network remains within its limits (constrained dispatch) is known as the operational constraint cost and is calculated using the bid and offer price associated with each action.

Like industry benchmark tools for constraint cost forecasts, ELSI includes various input data including:

- Transmission Network
    - Boundary capability assumptions
    - Seasonal ratings
    - Annual outage plan for each boundary
- Economic Assumptions
    - Fuel costs and price of carbon forecasts
    - Thermal efficiency assumptions by fuel type
    - Bid and Offer price assumptions by fuel type based on historical data
    - Seasonal plant availability by fuel type based on historical data
    - Renewable subsidies
    - Forecasts for base load energy price in Europe and Ireland
    - Forecast SRMCs by fuel type, which defines the merit order
    - Zonal SRMC adjuster
- Generation scenarios and sensitivities
- Demand
    - Demand profile or load duration curve
    - Zonal distribution of peak demand
    - Forecast annual peak demand based on two energy scenarios
- Wind generation
    - Represented by sampling ten years of historical daily wind speed data. Each day studied is defined by season and is divided up into four periods within the day.
    - ELSI model disaggregates the wind data into fifteen zones, with Dogger Bank, Hornsea and East Anglia separately represented. This allows for temporal and locational wind diversity in ELSI
- Reinforcements
    - Onshore reinforcements anticipated in ETYS for both generation backgrounds that are delivered by 2030/31.
    - The offshore integrated capability across each boundary provided by each design from 2030/31.

The full details of the modelling assumptions and methodology used can be found in Appendix D.

Least Worst Regret Analysis

Best practice when undertaking economic appraisals requires a clear definition of the counterfactual for comparison purposes. The counterfactual represents the basis against which the effectiveness of any additional reinforcements will be measured.

For the purpose of this CBA, the counterfactual network state is:

- Radial HVDC links from offshore hubs to onshore connection points utilising 1GW cable technology for the Dogger Bank and Hornsea zones. East Anglia zone utilises a range of cable technologies and includes some within zone links. This offers some redundancy within the zone.
- Limited onshore reinforcements necessary to ensure NETS SQSS compliance. This is based on the wider GB network investment projections identified in the ETYS 2013 out until 2030, and reflects each generation background.

i.e. the counterfactual case represents the current radial design philosophy.

Once constraint costs for the counterfactual and each alternative design option have been calculated by the ELSI model these can then be assessed against the capital costs. If there is an overall net saving in constraint costs then an option can be said to provide a cost benefit. If an option provides a higher net saving than the counterfactual then there would be benefit in delivering this option in preference to the counterfactual.

As the CBA work-stream has considered a range of generation scenarios it is necessary to assess the benefits that an option delivers across all possible outcomes, it may be the case that an option performs well against one possible generation scenario but very poorly against others.

Therefore the work-stream applied a process known as Least Worst Regret (LWR). A “regret” cost is incurred when the costs of the assets delivered outweigh the savings in constraint costs returned and hence there has been an over-investment in the network from which the consumer will receive no benefit.

Under LWR we seek to identify the design option that would result in the lowest worst outcome across the range of scenarios. If this option was selected then the project (and in this case the GB electricity consumer) would be exposed to the minimum level of risk regardless of which generation scenario should materialise.

Under a given scenario the option that delivers the highest net constraint saving is said to have zero regret.

Under LWR it is possible that the preferred solution may be one that does not return the highest cost benefit across any of the given individual scenarios.

CBA Results

The CBA work-stream has assessed the constraint costs incurred for each design option proposed and carried out a least worst regret analysis.

A summary of the results are shown below:

Design & Technology by Scenarios: Regrets in (£m)	Gone Green		Slow Progression		
	10GW	17.2GW	10GW	17.2GW	Worst Regret
Base Case plus onshore	1947	2911	1833	1966	2911
Bootstrap 1 GW	25	7289	619	4166	7289
Hybrid bootstrap 2 GW	1102	1268	81	615	1268
Hybrid offshore 1 GW	999	1003	1381	3444	3444
Hybrid offshore 2 GW	N/A	353	N/A	1581	1581
Integrated 1 GW	**0**	**0**	1180	448	1180
Integrated 2 GW	741	134	0	0	741

The work-stream assessed the performance of reinforcement strategies against the two agreed levels of offshore wind generation (10GW and 17.2GW) and also against two wider generation development scenarios, giving four scenarios in total.

The cost benefit analysis methodology sought to identify the least worst regret reinforcement strategy, i.e. across the range of generation scenarios assessed, which reinforcement strategy exposes the GB consumer to the minimum risk of over or under investment?

It can be seen that an integrated design (either 1GW or 2GW) offers the least worst regret reinforcement strategy across all generation scenarios considered.

Interpretation of Results

Since the IOTP project was commenced in 2012 there have been significant developments in the electricity industry and the wider economy, most notably Electricity Market Reform (EMR), that have impacted on the expected development rate of offshore wind generation.

It is now the view of the project members that offshore wind generation capacity is unlikely to reach the current contracted levels in the timescales required to make an integrated design approach beneficial. It is expected that offshore wind development will likely consist of smaller projects being delivered separately over a longer period of time.

As such the project views the 17.2GW offshore wind generation scenario as now being unrealistic and has discounted these results in drawing final conclusions. The 10GW scenario is considered to be more likely but the project acknowledges that there is a possibility that actual development may be lower even than this.

Under the Gone Green + 10GW scenario the CBA results show that a 1GW integrated design offered the least worst regret strategy. However, the 1GW bootstrap (a hybrid type design) showed a regret cost of only £25m. This is well within the margin of error for this type of analysis.

By pursuing a non-integrated design, e.g. the 1GW bootstrap, both National Grid and the offshore generation developers can maintain closer control over the scope and programme of their individual works and hence minimise risks for consumers and investors alike.

Under the Slow Progression + 10GW scenario the 2GW integrated design performed best. However, the gap between that and the nearest non-integrated design (hybrid bootstrap 2GW) was small, only £81m. Again this is not a sufficient margin to consider the result a clear indictor to pursue an integrated approach.

The project acknowledges the possibility that the level of offshore wind generation delivered may be lower than the 10GW. Should this transpire then the non-integrated designs would perform better and would become the least worst regret reinforcement strategy.

7. Overall Conclusions and Next Steps

Conclusions and Recommendations

The Integrated Offshore Transmission Project team make the following conclusions:

- The technology required to deliver integrated offshore networks is in development and can reasonably be expected to be available, at the ratings required, by around 2020.

- The commercial and regulatory frameworks in place at the time of project commencement did not properly support the development of integrated design solutions. Modifications would be required, particularly to clarify the roles and responsibilities of the parties involved and also to reduce the risk around financing for offshore generation developers. The most material of these concerns have now been addressed by the Offshore Gateway process and ITPR.

- Technically feasible integrated design solutions can be developed if required and it is possible for these networks to operate in a safe and secure way with the existing onshore a.c. transmission system.

- Integrated design solutions could offer benefits for the GB consumer but only when the installed capacity of offshore wind generation is very high.

- Current market indicators show that development of offshore wind generation in the zones considered will not reach the required levels of capacity in near term timescales that would be required to make the implementation of an integrated design economic and efficient.

- As a result the project team does not believe it would be economic and efficient to progress with the development of an integrated design philosophy or delivery of anticipatory assets at this time.

The Integrated Offshore Transmission Project team make the following recommendations:

- Although the project team does not believe integration is required at this stage it believes that consideration of the development of the codes, frameworks and charging arrangements required to facilitate such an approach is vital to maintaining integration as a viable design option. The project team acknowledges that many of the key concerns identified during this work have been addressed by the Offshore Gateway process and ITRP.
- Responsibility for assessing the growth in offshore wind generation developments and hence the potential need for integration should sit with a single body – the GB system operator.

- No further material work is required is required at this time and the Integrated Offshore Transmission Project team should now be stood down.

8. Lessons Learned

The Integrated Offshore Transmission Project (IOTP) brought together National Grid and offshore wind farm developers, in both their roles as generator and offshore TO, to assess the most economic and efficient way of progressing connections.

A project team with this membership and scope of responsibility has not previously been formed, and many important learning points were recorded throughout the course of this work.

This section records the areas of success that the project members would propose as representing best practice for future projects, and also the lessons learned where improvements could be made.

Successes

- The project team membership included the appropriate range of industry stakeholders.
    - The inclusion of offshore wind farm developers complemented the Knowledge already held by National Grid and allowed the project to consider issues from all perspectives. The involvement of the developers was particularly important to the success of the commercial work-stream.
- The project benefited from including the regulator, Ofgem, throughout the process.
    - Working closely with the regulator allowed the project team to discuss and agree key assumptions and to move forward with confidence that we were meeting the needs of this key stakeholder.
- The structure of the project team was based around four independent work-streams who reported into a single Project Management Committee.
    - This structure allowed the most appropriate expertise to be assigned to each work-stream and allowed them to focus on a specific area. This structure made best use of the resources available.

Lessons Learned

- Due to the wide scope of the project and the number of project team members it is important that a clear programme, milestones, and outputs are agreed up front.
    - The detailed nature of the analysis, and debates over approach (see next point), resulted in the timescales for the work extending beyond the originally expected deadlines. Clear deliverables and timescales should be agreed prior to analysis commencing to ensure that project momentum is maintained.
- The key assumptions and methodology to be used in the course of the project must be agreed up front by all parties.
    - Although specific terms of reference were prepared and agreed for all work-streams the key assumptions and methodology of analysis was not. This lead to some confusion and debate over the approach taken, particularly with respect to the designs proposed and the cost benefit analysis. This resulted in delays and

re-working. In future any project team made up of several separate industry parties should ensure that agreement is reached on the specific nature of the analysis being carried out prior to work commencing.

- Multi-party projects of this nature should be co-ordinated through a single party.
    - In this case National Grid acted as project co-ordinator in its role as combined transmission owner / system operator. For future projects that include multiple TOs and / or generator developers co-ordination should be the responsibility of the GB system operator with the roles of the contributing parties clearly defined at the outset.