Norfolk Boreas Offshore Wind Farm

Appendix 4.8

Identification of Cable Relay Station Locations

Environmental Statement

Volume 3

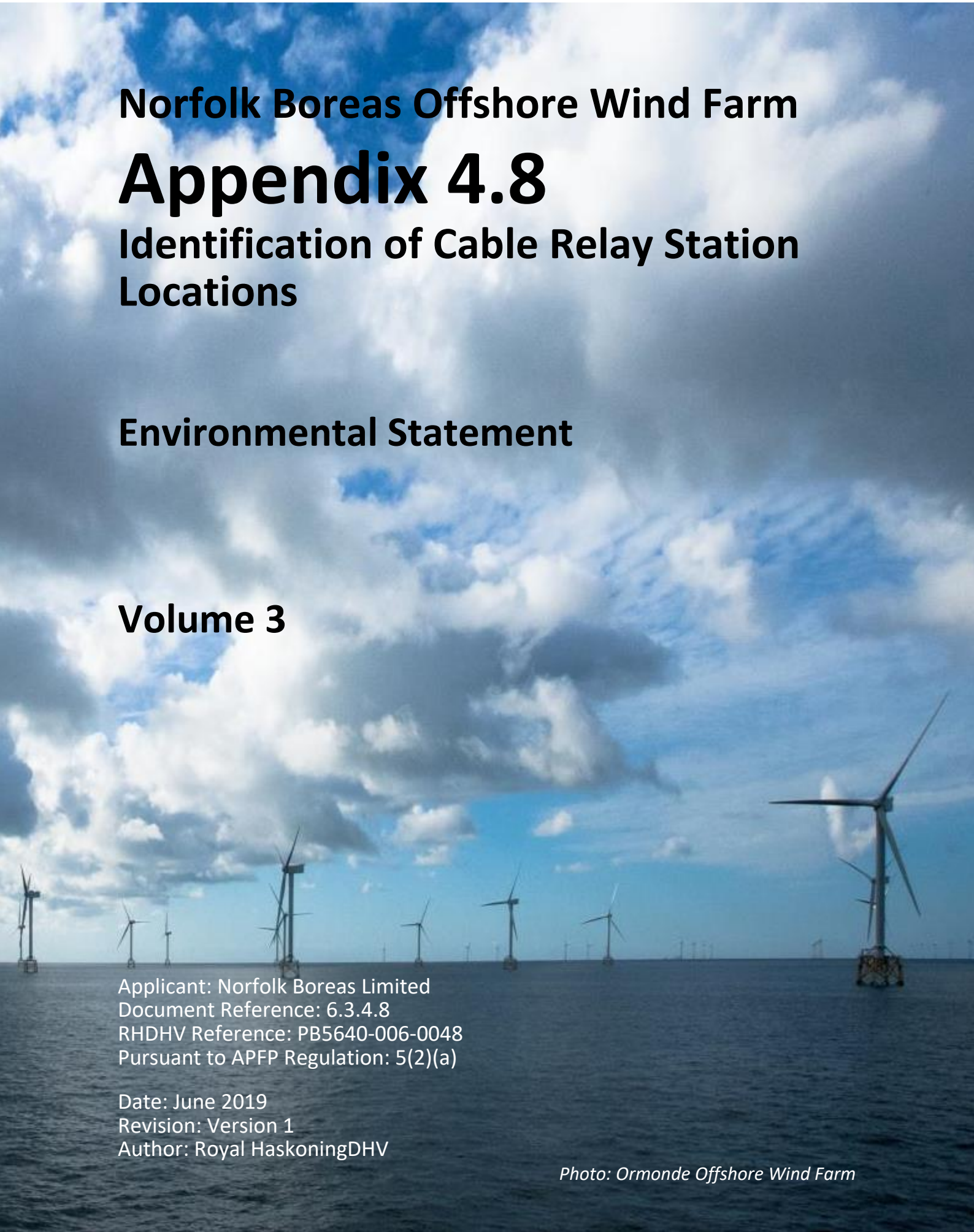

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Photo: Ormonde Offshore Wind Farm

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REPORT

Cable Relay Station Site Selection

Client: Norfolk Vanguard and Norfolk Boreas Limited

Reference: PB5640

Revision: 0.1/Final

Date: 24 October 2017

Royal HaskoningDHV

Enhancing Society Together

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Classification
Project related

1 Purpose

Following the Norfolk Vanguard PEIR consultation, Norfolk Vanguard Limited and Norfolk Boreas Limited took the decision to use High Voltage Direct Current (HVDC) technology for Norfolk Vanguard and Norfolk Boreas Offshore Wind Farms; this removed the need for a Cable Relay Station (CRS). As CRS were part of the onshore project infrastructure up to the Norfolk Vanguard Preliminary Environmental Information Report (PEIR) stage, identifying appropriate locations for them formed part of the overall site selection process. As such the purpose of this note is to present the outcomes of site selection process that has been carried out by Royal HaskoningDHV in order to support Norfolk Vanguard Limited and Norfolk Boreas Limited in their CRS site selection process.

2 Risk Assessment Methodology

In order to identify the most appropriate location to site the CRS, National Grid's Guidelines on Substation Siting and Design (The Horlock Rules) were taken into consideration. These guidelines document National Grid's best practice for the consideration of relevant constraints associated with the siting of substations are shown in Table 1.

Table 1 Application of Horlock Rules to CRS

National Grid's Approach to Design and Siting of Substations (Overall System Options and Site Selection)	Norfolk Vanguard and Boreas CRS considerations
In the development of system options including new substations, consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements for new developments against the consequential environmental effects. in order to keep adverse effects to a reasonably practicable minimum	Environmental constraints and opportunities are being considered throughout the development phase of the project and reported within the Norfolk Vanguard PEIR.
Amenity, Cultural or Scientific Value of Sites	
The siting of new National Grid Company substations, sealing end compounds and line entries should as far as reasonably practicable seek to avoid altogether internationally and nationally designated areas of the highest amenity, cultural or scientific value by the overall planning of the system connections.	Internationally and nationally designated sites have been avoided and the options for the CRS are not located within a: - National Park; - Area of Outstanding Natural Beauty (AONB); - Heritage Coast; - World Heritage Site; - Ramsar Site; - Sites of Special Scientific Interest (SSSI); - National Nature Reserve; - SPA; and/or - Special Area of Conservation (SAC). Consideration is being given to historic sites with statutory protection. See Chapter 28 Onshore Archaeology and Cultural Heritage of the Norfolk Vanguard PEIR
Local Context, Land Use and Site Planning	
Areas of local amenity value, important existing habitats and landscape features including ancient woodland, historic hedgerows, surface and ground water sources and nature conservation areas should	Areas of local amenity value within the vicinity of the CRS have been protected as far as reasonably practicable as part of the site selection process. See Chapter 30 Tourism and

National Grid's Approach to Design and Siting of Substations (Overall System Options and Site Selection)	Norfolk Vanguard and Boreas CRS considerations
be protected as far as reasonably practicable.	Recreation of the Norfolk Vanguard PEIR Consideration is being given to existing habitats and landscape features including woodland historic hedgerows, surface and ground water sources and nature conservation areas (e.g. County Wildlife Sites). See Chapter 22 Onshore Ecology and Chapter 20 Water Resources and Flood Risk of the Norfolk Vanguard PEIR.
The siting of substations, extensions and associated proposals should take advantage of the screening provided by land form and existing features and the potential use of site layout and levels to keep intrusion into surrounding areas to a reasonably practicable minimum.	The CRS 5a site is relatively exposed owing to the limited extent of enclosure such as land form and existing screening, and would therefore require substantial new planting to create a setting and ultimately provide screening. The CRS 6a site sits close to mature hedgerow planting, which would create a setting and afford partial screening in views from certain directions. There is also a belt of mature trees to the south-west of CRS 6a which would provide substantial screening from this direction. Mitigation planting for the CRS sites would comprise the establishment of woodland belts in strategic locations around the compounds. These would complement existing tree cover and hedgerows, increasing their depth and extent to ensure robust screening, and eventually form enclosure from almost all visual aspects. See Chapter 29 Landscape and Visual Impact Assessment of the Norfolk Vanguard PEIR.
The proposals should keep the visual, noise and other environmental effects to a reasonably practicable minimum	Visual impacts, noise and other environmental effects e.g. on ecology and archaeology, have been minimised as far as possible through the site selection process. For example, consideration was given to existing screening and location away from built up areas. See Chapter 29 Landscape and Visual Impact Assessment and Chapter 25 Noise and Vibration of the Norfolk Vanguard PEIR. Further mitigation may be required through design and this will be considered further ahead of the final application.
The land use effects of the proposal should be considered when planning the siting of substations or extensions.	The effects on land use have been considered as part of the site selection process. The impacts on land use are considered within Chapter 21 Land Use and Agriculture of the Norfolk Vanguard PEIR.
Design	
In the design of new substations or line entries, early consideration should be given to the options available for terminal towers, equipment, buildings	Landscape and visual impact will be minimised by avoiding the use of tall structures and buildings wherever possible. Noise emissions

National Grid's Approach to Design and Siting of Substations (Overall System Options and Site Selection)	Norfolk Vanguard and Boreas CRS considerations
and ancillary development appropriate to individual locations, seeking to keep effects to a reasonably practicable minimum.	from reactors and transformers will be mitigated as necessary to achieve acceptable levels at nearby receptors.
Space should be used effectively to limit the area required for development consistent with appropriate mitigation measures and to minimise the adverse effects on existing land use and rights of way, whilst also having regard to future extension of the substation.	Permanent footprints for the CRS are based on preliminary layouts. More space-efficient solutions may be developed during the detailed design process; if so, this would reduce the area required for development.
The design of access roads, perimeter fencing, earthshaping, planting and ancillary development should form an integral part of the site layout and design to fit in with the surroundings.	Access routes and visual screening proposals are being developed for the CRS options.
Line Entry	
In open landscape especially, high voltage line entries should be kept, as far as possible, visually separate from low voltage lines and other overhead lines so as to avoid a confusing appearance.	All cables will be buried underground within ducts.
The inter-relationship between towers and substation structures and background and foreground features should be studied to reduce the prominence of structures from main viewpoints. Where practicable the exposure of terminal towers on prominent ridges should be minimised by siting towers against a background of trees rather than open skylines.	The CRS does not include any additional overhead line towers.

The site selection for the CRS was based on the following requirements:

- An area of 200m x 120m for Norfolk Vanguard and the same for Norfolk Boreas with contingency (see Chapter 5 Project Description of the Norfolk Vanguard PEIR for CRS dimensions);
- Within 5km of the landfall site (as close to the midpoint between the onshore project substation and offshore substation as possible);
- Away from residential properties as far as possible (in order to reduce potential visual and noise impacts); and
- Close proximity to road network to aid delivery of materials during construction.

The development of the CRS siting has taken into account:

- Amenity, cultural or scientific value of the sites;
- The local context, planning policy and guidance;
- Existing land use; and
- Feedback from the community and other stakeholder consultation.

Due to the strategic nature of the development of Norfolk Vanguard and Norfolk Boreas, co-lactation of the two CRS's was a key principle considered in identifying footprint location options.

Site selection work to create indicative CRS location options was initially undertaken using high level, freely available data. This resulted in the areas of search (Plate 1) that were created and consulted upon in the Norfolk Vanguard Scoping Report (Royal HaskoningDHV, 2016) as well as during associated stakeholder, landowner and community consultation.

A more detailed assessment of risks and constraints with regard to site selection for the CRS was undertaken as further information and survey data became available throughout 2017. The assessment and option development were informed by further discussions with stakeholders and landowners.
The CRS search area was initially divided into the following sectors using the existing road infrastructure in the area, see

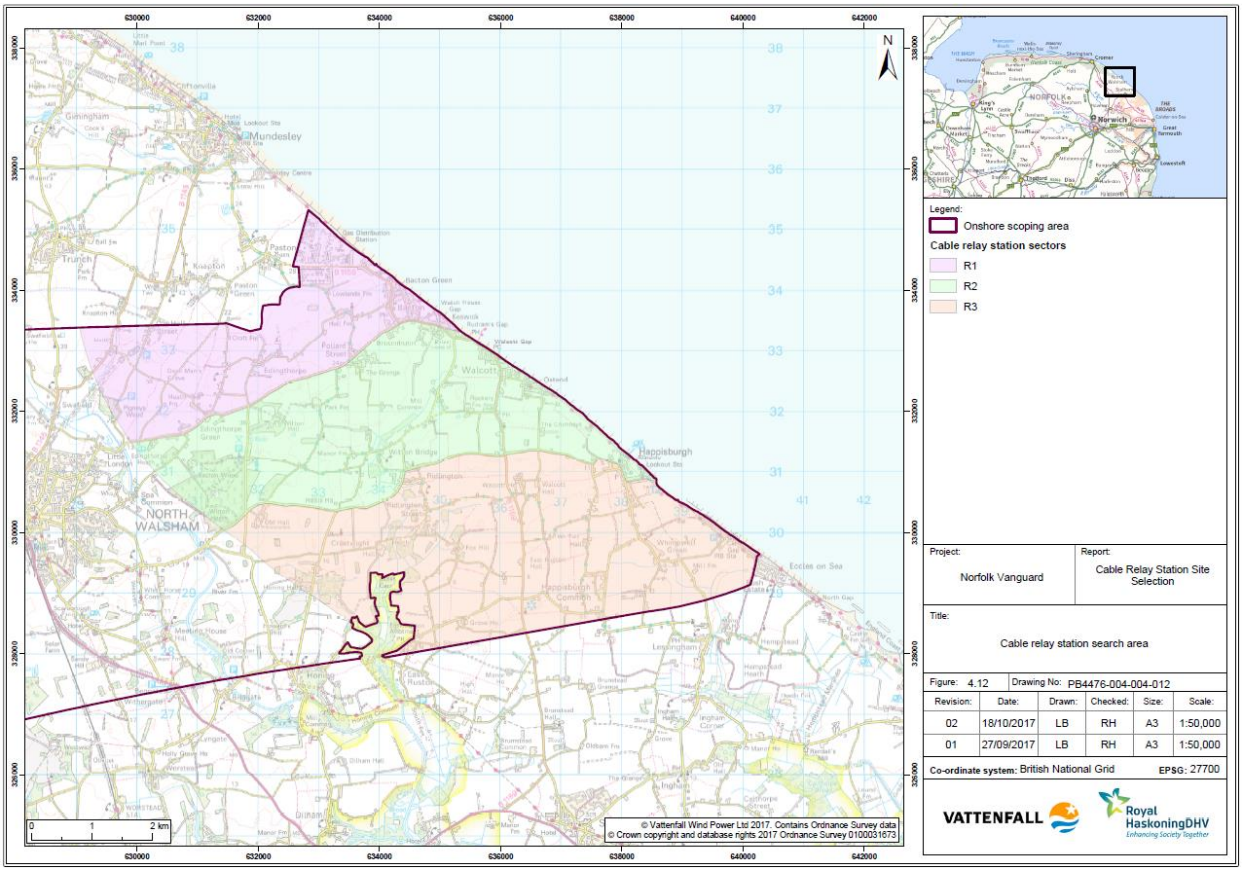

Plate *1*.

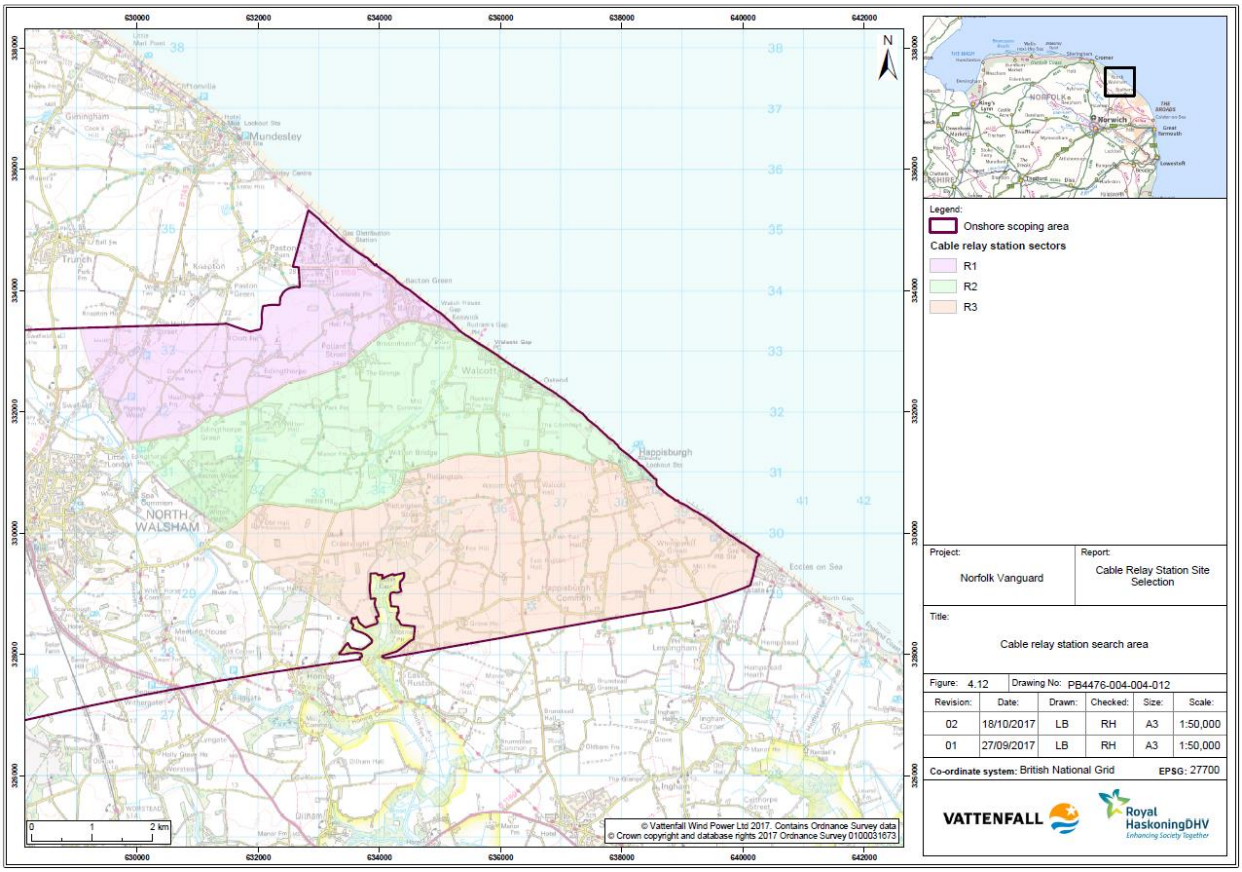

Plate 1 Cable Relay Station Search Area

R1 - north of North Walsham Road/ Bloodslat Lane;
R2 - between North Walsham Road/ Bloodslat Lane and North Walsham Road/ Happisburgh Road; and
R3 - south of North Walsham Road/ Happisburgh Road.

An environmental risk assessment was been carried out on the three CRS sectors. Development considerations used for this risk assessment exercise have been divided into the following categories to aid mapping, discussion and assessment:

- Populated areas;
- Local Authority boundaries;
- Infrastructure and utilities;
- Archaeology and cultural heritage;
- Nature conservation and landscape designated sites;
- Land Use/type;
- Hydrological features and flood risk; and
- Recreation.

These development considerations found within, or immediately adjacent to, the CRS study area sectors only have been identified and are shown on Plate 2.

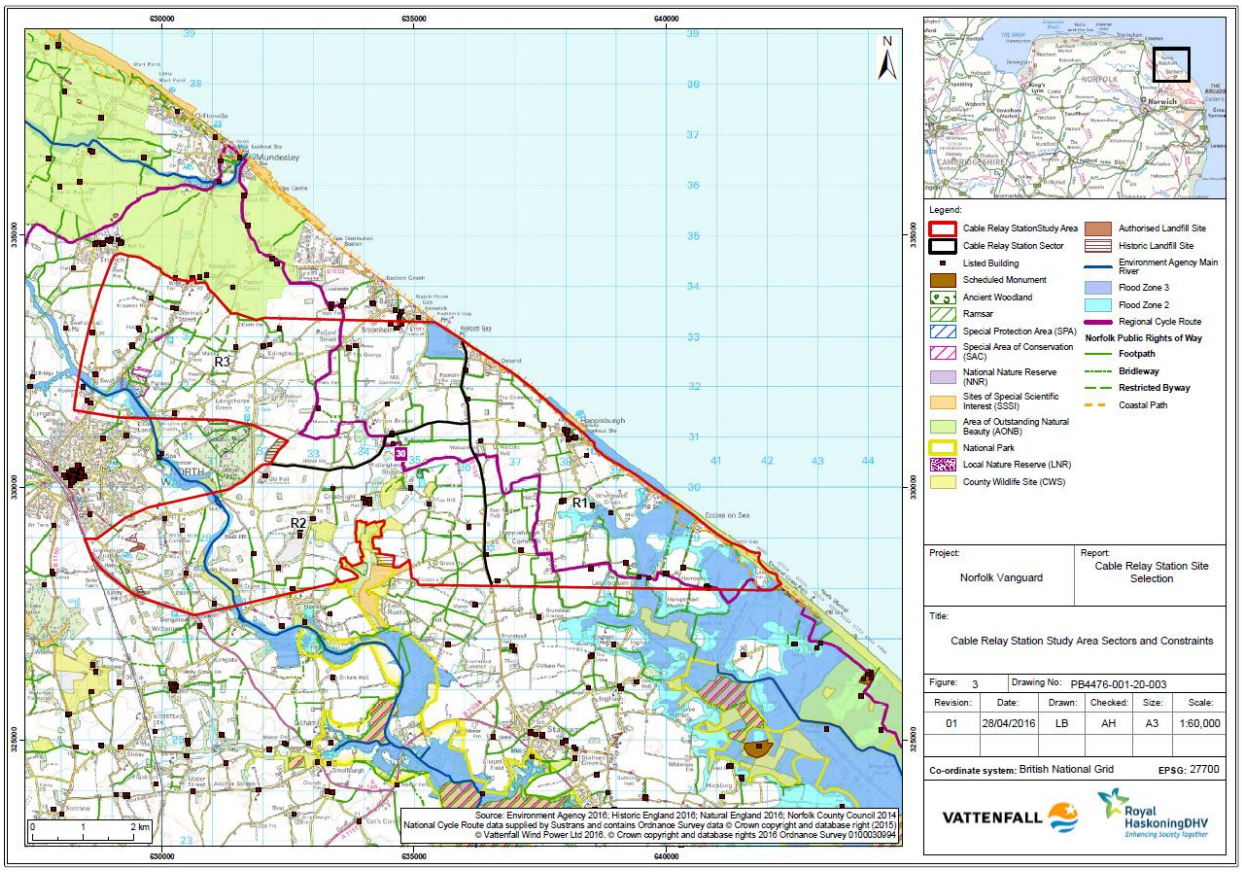

Plate 2 Cable Relay Station Sectors and Constraints

Following this, a risk classification was attributed to each element based on a qualitative assessment and expert judgement. The classification system used is shown in Table 2. Table 3 presents the findings of the assessment, followed by a short description of the initial findings. At this stage, technical input from a landscape specialist or noise consultant have not been included as part of the risk assessment.

Table 2 Classification for development considerations

Grey	Hard constraint / unacceptable risk to the environment
Red	Major risk to the environment
Amber	Minor risk to the environment
Green	Consideration unlikely to pose risk to the environment

Table 3 CRS Study Area Sectors Risk Assessment

Topic	Considerations	CRS Sector R1	CRS Sector R2	CRS Sector R3
Area	Size of available area identified	1462.34Ha (14.62km²)	1757.96Ha (17.58km²)	1945.72 (19.46km²)
Local Planning Authority	Number of LPAs	North Norfolk District Council (NNDC)	NNDC	NNDC
International Nature Conservation Designated Sites	SACs, SPAs, Ramsars	None	None	None
National Nature Conservation Designated Sites	SSSIs, Ancient Woodlands, National Nature Reserves, RSPB Reserves	Happisburgh Cliffs SSSI	1 x Ancient Woodland (Old Lane Carr) (Adjacent to East Ruston Common SSSI)	None
National Landscape Designations	AONB, National Parks	None	(Immediately adjacent to The Broads National Park)	(Immediately adjacent to Norfolk Coast AONB)
Archaeology and Heritage of national importance	Registered Battlefields, Registered Parks and Gardens, Scheduled Ancient Monuments, World Heritage Sites	1 x Registered Parks and Garden (Happisburgh Manor)	1 x Registered Parks and Garden (Honing Hall)	1 x SAMs (Broomholm Priory)
Archaeology and Heritage of local importance	Listed Buildings, Heritage Coast	36 x Listed Buildings (2x Grade I)	23 x Listed Buildings (1x Grade I)	27 x Listed Buildings (4x Grade I)
Local Nature Conservation	Local Nature Reserves, County Wildlife Sites,	Marram Hill CWS	9 x CWS: Land near Old Corner Common	Knapton Cutting LNR

Topic	Considerations	CRS Sector R1	CRS Sector R2	CRS Sector R3
Designated Sites	Forestry Commission Woodland		CWS; Meeting House Hill Fen CWS; Old Corner Common CWS; Dilham Meadows CWS; Crostwight Common CWS; Dyball's Allotment CWS; Fox Hill Allotment & Common CWS; Crostwight Heath CWS; and Ebridge Farm Meadows CWS.	Pigney's Wood LNR Spa Common CWS Paston Way & Knapton Cutting CWS
Main Roads	A roads and B roads	B1159	A149 B1159	B1159 & B1145
Rail Crossings		None	None	None
Main River Crossings	EA designated main rivers	None	North Walsham and Dilham Canal	North Walsham and Dilham Canal
Flood Risk	Flood Zones	Flood Zone 2 & 3 (Tidal)	Flood Zone 2 & 3 (Tidal & Fluvial)	Flood Zone 2 & 3 (Tidal & Fluvial)
Buried Infrastructure	Gas pipelines, electricity cables	Unknown	2 x Gas Pipeline (Other infrastructure unknown)	5 x Gas Pipeline (Other infrastructure unknown)
Urban Areas		Walcott Happisburgh Whimpwell Green Happisburgh Common Eccles on Sea Lessingham Hempstead	Ridlington Crostwight Honing White Horse Common	Bacton Walcott Ridlington Witton Bridge Edingthorpe Knapton Swafield
Land Quality	Active and historic landfills	None	5 x Historic Landfill Sites 1 x Authorised Landfill Site 1 x S4 Conclusive Open Country	1 x Historic Landfill Sites 2 x S4 Conclusive Registered Common Land (CROW Act

Topic	Considerations	CRS Sector R1	CRS Sector R2	CRS Sector R3
			(CROW Act 2000) 4 x S4 Conclusive Registered Common Land (CROW Act 2000)	2000)
Land Use	Agricultural Land Classification	Agricultural Land Classification: Grade 1 (10.49km²/1048.80Ha) Grade 2 (2.09km²/209.03Ha) Grade 3 (2.04km²/204.44Ha)	Agricultural Land Classification: Grade 1 (1.54km²/154.18Ha) Grade 2 (5.42km²/542.07Ha) Grade 3 (10.62km²/1061.67Ha)	Agricultural Land Classification: Grade 1 (5.25km²/524.82Ha) Grade 2 (6.16km²/616.12Ha) Grade 3 (8.05km²/804.79Ha)
Recreation	PRoW, Cycle routes	60 x PRoW Sea Palling to Weybourne Coastal Path 1 x Regional Cycle Route	43 x PRoW 1 x Regional Cycle Route	59 x PRoW Sea Palling to Weybourne Coastal Path 1 x Regional Cycle Route
Risk Summary				

Risk classifications for each element of the connection have been summarised using the following standard procedure, and results can be found in Table 4.

- High Risk (Red): e.g. One or more major risk items identified within the element of the connection;
- Medium Risk (Orange): e.g. Seven or more minor risk items identified; and
- Low Risk (Green): e.g. Six or less minor risk items identified.

Table 4 Environmental Risk Assessment Summary

Risk Summary	R1	R2	R3

CRS Sector R1

The main environmental risks of particular importance to sector R1 come from the presence of Happisburgh Cliffs SSSI, multiple populated urban areas situated along the coastline and a high percentage of Grade 1 agricultural land (excellent quality land with no or very minor limitations to agricultural use) within the sector. There are other considerations relating to tidal flood risk, recreation and listed buildings but these are common across all three sectors.

CRS Sector R2

The main environmental risks of particular importance to sector R2 come from its location being immediately adjacent to The Broads National Park and the presence of multiple County Wildlife Sites and an Ancient Woodland within the sector. Additional risks come from the presence of historic and authorised landfill sites and known buried infrastructure within the sector. There are other considerations relating to flood risk, recreation and listed buildings but these are common across all three sectors.

CRS Sector R3

The main environmental risks of particular importance to sector R3 come from its location being immediately adjacent to The Norfolk Coast AONB and the presence of two County Wildlife Sites and two Local Nature Reserves within the sector. Additional risks come from the presence of a Scheduled Ancient Monument, an historic landfill site, multiple populated urban areas and known buried infrastructure within the sector. There are other considerations relating to flood risk, recreation and listed buildings but these are common across all three sectors.

3 Further Assessment

Based on results from this study, within each of the CRS search areas a number of potential CRS locations were identified which where possible met the site selection criteria and guiding principles. The areas of search were subject to a more detailed assessment of sensitivities and suitability. This process resulted in the identification of seven potential CRS search zones within the search area, see Plate 3

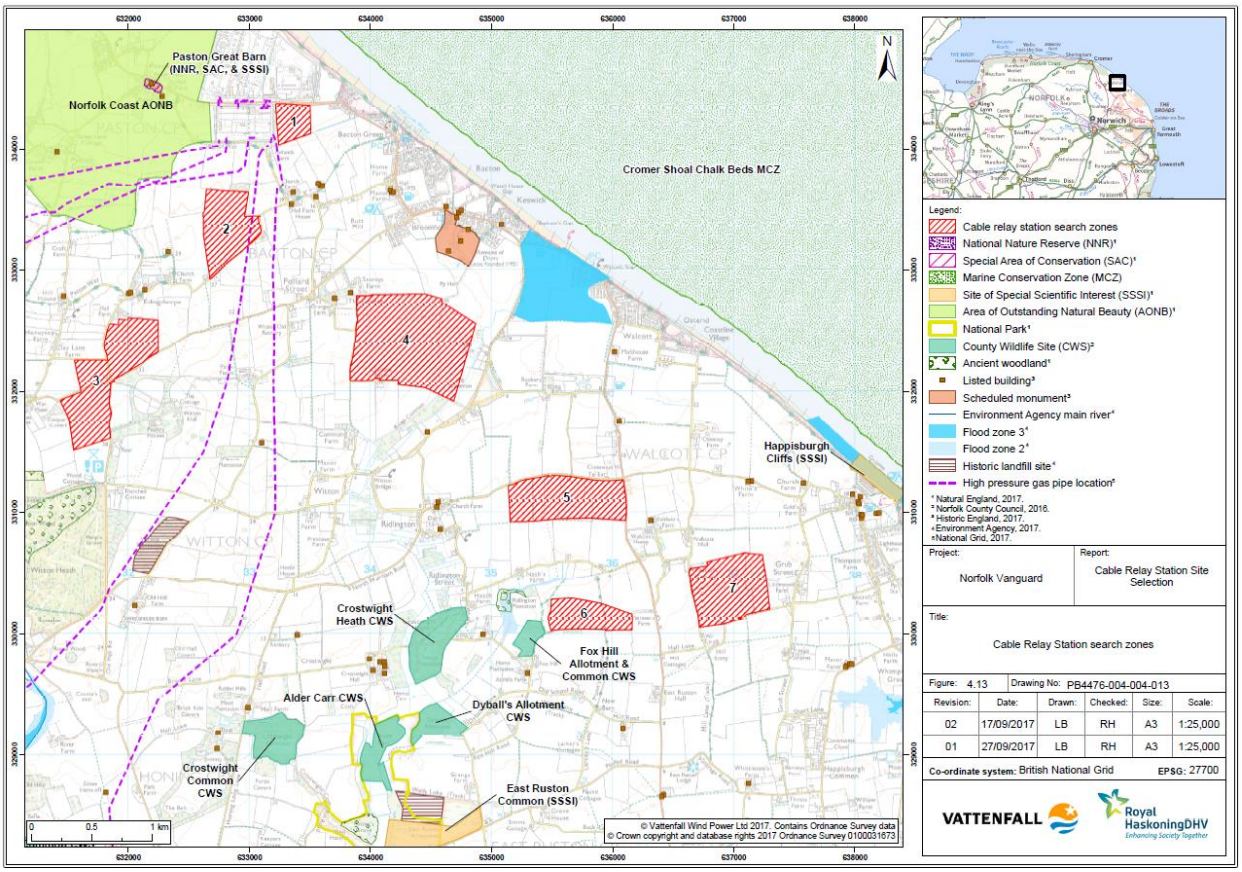

Plate 3 Cable Relay Station Search Zones

The seven potential CRS zones were presented to the community, stakeholders and landowners through the drop in exhibitions in March 2017 and subsequent meetings and discussions.

After March 2017 the seven options were subject to further detailed review.

CRS options within search area R1 were discounted due to distance from the preferred landfall site at Happisburgh South.

CRS Zone 4 was discounted, principally due to the presence of major gas infrastructure which bisects the potential site and renders it unsuitable.

CRZ Zone 7 was discounted primarily due to its location situated on a high point, and visible from many viewpoints. There are limited opportunities for screening and was closest to Happisburgh populated area.

The Landscape Officer at NNDC considered the potential impacts associated with the CRS zones, and the NNDC favoured site location for the CRS was Zone 6.

Therefore, CRS Zones 5 and 6 were judged, at this PEIR stage (for Norfolk Vanguard), to offer the best combination of available space, road access and reduced environmental constraints.

Therefore, location options within Zones 5 and 6 have been identified and the constraints and potential impacts at each site are relatively evenly balanced. Further analysis is ongoing as the EIA, stakeholder consultation, landowner discussions and community consultation progress. Among the aspects currently

being reviewed are cultural heritage and setting; potential impacts upon visual and recreational amenity; potential noise impacts and mitigation; access issues.

Following the initial constraints mapping exercise, as well as consideration of technical constraints and information gathered at site visits and during consultation, one site per project was identified within each zone for further investigation, shown in Plate 4.

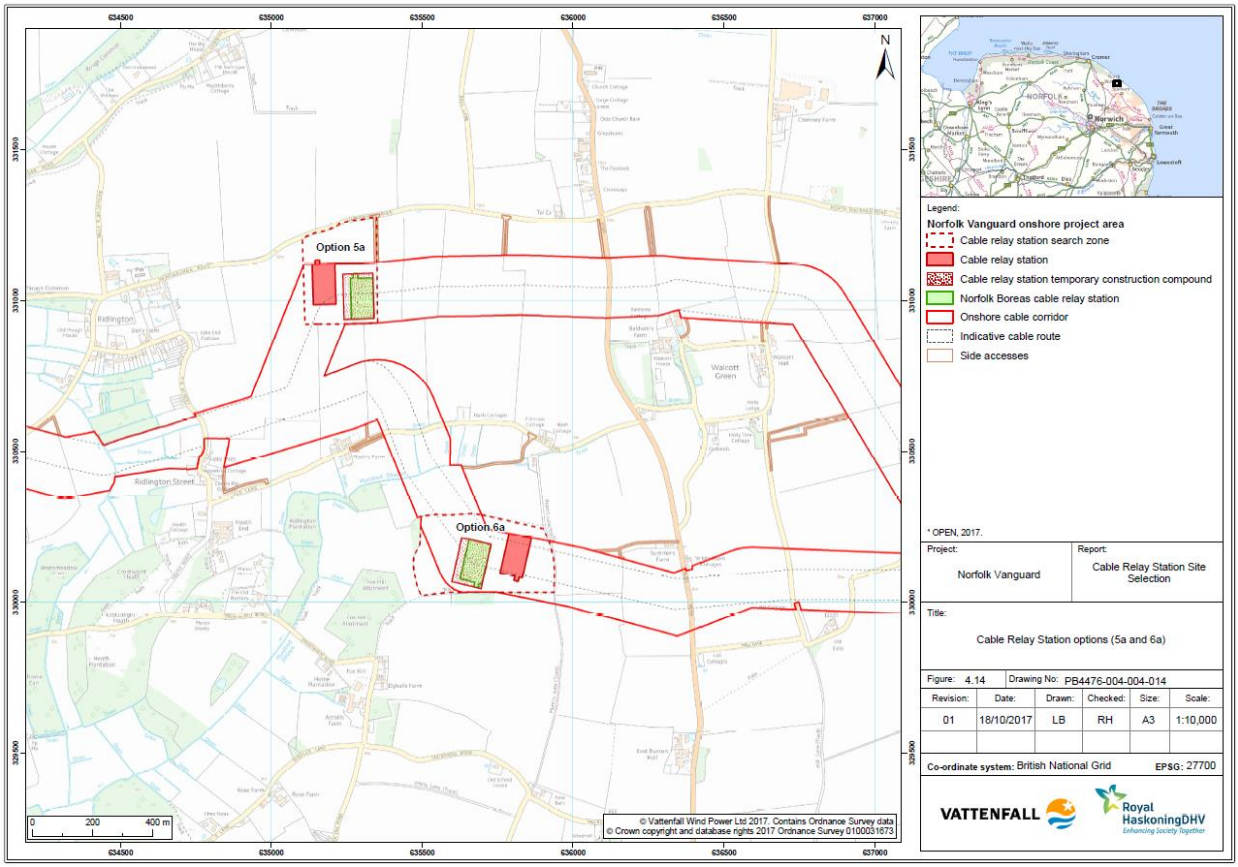

Plate 4 Cable Relay Station Options (5a and 6a)

In July 2017, Norfolk Vanguard Limited held a meeting with local residents and representatives, to present the site options and request their views, including identifying key issues and opportunities associated with each option, and considering ideas that might help to resolve issues. Participants were also shown photomontages which featured examples of the kind of planting schemes that would help reduce visual impacts.

As a result, Option 5a and Option 6a were taken forward for consideration as part of the Norfolk Vanguard Preliminary Environmental Information Report.