

Norfolk Vanguard Offshore Wind Farm

Non-Technical Summary

Environmental Statement

Applicant: Norfolk Vanguard Limited
Document Reference: 6.3
RHDHV Reference: PB4476-005-043
Pursuant to: APFP Regulation 5(2)(a)

Date: June 2018
Revision: Version 1
Author: Royal HaskoningDHV

Photo: Kentish Flats Offshore Wind Farm



Environmental Impact Assessment Environmental Statement

Document Reference: PB4476-005-043

June 2018

For and on behalf of Norfolk Vanguard Limited

Approved by: Rebecca Sherwood and Ruari Lean

Signed:



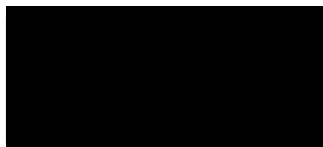
Date: 8th June 2018

For and on behalf of Royal HaskoningDHV

Drafted by: Jon Allen

Approved by: Alistair Davison

Signed:



Date: 7th June 2018



Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
30/05/18	01D	First draft for Norfolk Vanguard Limited review	JA	AD	AD
07/06/18	01F	Final for ES submission	JA	AD	AD

Table of Contents

1	Introduction	1
1.1	About this Document.....	1
1.2	The Developer	15
1.3	The Need for the Project	15
1.4	Site Selection and Consideration of Alternatives.....	16
1.5	The EIA Process	18
1.6	Role of National Policy Statements in the Decision Making Process.....	19
2	Project Description	20
2.1	Offshore Works	20
2.2	Onshore Works.....	23
3	Topics Considered in the Environmental Impact Assessment.....	25
3.1	Offshore	25
3.2	Onshore	30
3.3	Project Wide Impacts.....	37
4	Conclusions	40
5	Contact Us.....	41

Figures

Figure 1 Offshore project area	3
Figure 2 Onshore project area	4
Figure 3 Onshore project substation and extension to National Grid substation	13

Plates

Plate 1 Diagram illustrating the key components of the Norfolk Vanguard project	21
Plate 2 Indicative timeline for Norfolk Vanguard	22
Plate 3 Diagram illustrating ducts installed at the landfall	23

Glossary

DCO	Development Consent Order
DWR	Deep Water Route
EIA	Environmental Impact Assessment
ES	Environmental Statement
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IMO	International Maritime Organisation
kV	Kilovolt
LVIA	Landscape and Visual Impact Assessment
MCZ	Marine Conservation Zone
MOD	Ministry of Defence
MW	Megawatts
NATS	National Air Traffic Services
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NTS	Non-Technical Summary
SAC	Special Area of Conservation
SPR	ScottishPower Renewables
SSSI	Site of Special Scientific Interest

Terminology

Array cables	Cables which link the wind turbines and the offshore electrical platform.
Cable Relay Station	Primarily comprised of an outdoor compound containing reactors (also called inductors, or coils) and switchgear to increase the power transfer capability of the cables under the HVAC technology scenario as considered in the PEIR. This is no longer required for the project as the HVDC technology has been selected.
Landfall	Where the offshore cables come ashore at Happisburgh South
National Grid substation extension	The permanent footprint of the National Grid substation extension
Necton National Grid substation	The existing 400kV substation at Necton, which will be the grid connection location for Norfolk Vanguard.
Offshore accommodation platform	A fixed structure (if required) providing accommodation for offshore personnel. An accommodation vessel may be used instead.
Offshore electrical platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.
Offshore cable corridor	The corridor of seabed from the Norfolk Vanguard OWF sites to the landfall site within which the offshore export cables will be located.
Offshore export cables	The cables which bring electricity from the offshore electrical platform to the landfall.
Offshore project area	The overall area of Norfolk Vanguard East, Norfolk Vanguard West and the offshore cable corridor.
Offshore Wind Farm (OWF) sites	The two distinct offshore wind farm areas, Norfolk Vanguard East and Norfolk Vanguard West.
Onshore cables	The cables which take the electricity from landfall to the onshore project substation
Onshore cable corridor	200m wide onshore corridor within which the onshore cable route would be located as submitted for PEIR.
Onshore project area	All onshore electrical infrastructure (landfall; onshore cable route, accesses, trenchless crossing technique (e.g. Horizontal Directional Drilling (HDD)) zones and mobilisation areas; onshore project substation and extension to the Necton National Grid substation and overhead line modification)
Onshore project substation	A compound containing electrical equipment to enable connection to the National Grid. The substation will convert the exported power from HVDC to HVAC, to 400kV (grid voltage). This also contains equipment to help maintain stable grid voltage.
The project	Norfolk Vanguard Offshore Wind Farm, including the onshore and offshore infrastructure.

This page is intentionally blank.

1 INTRODUCTION

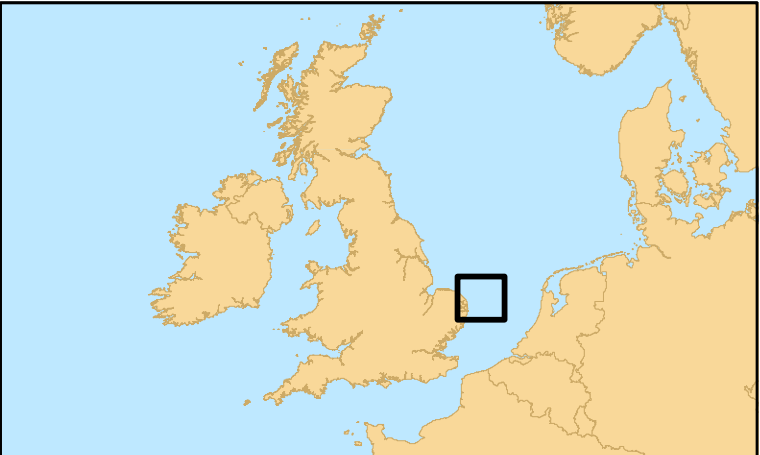
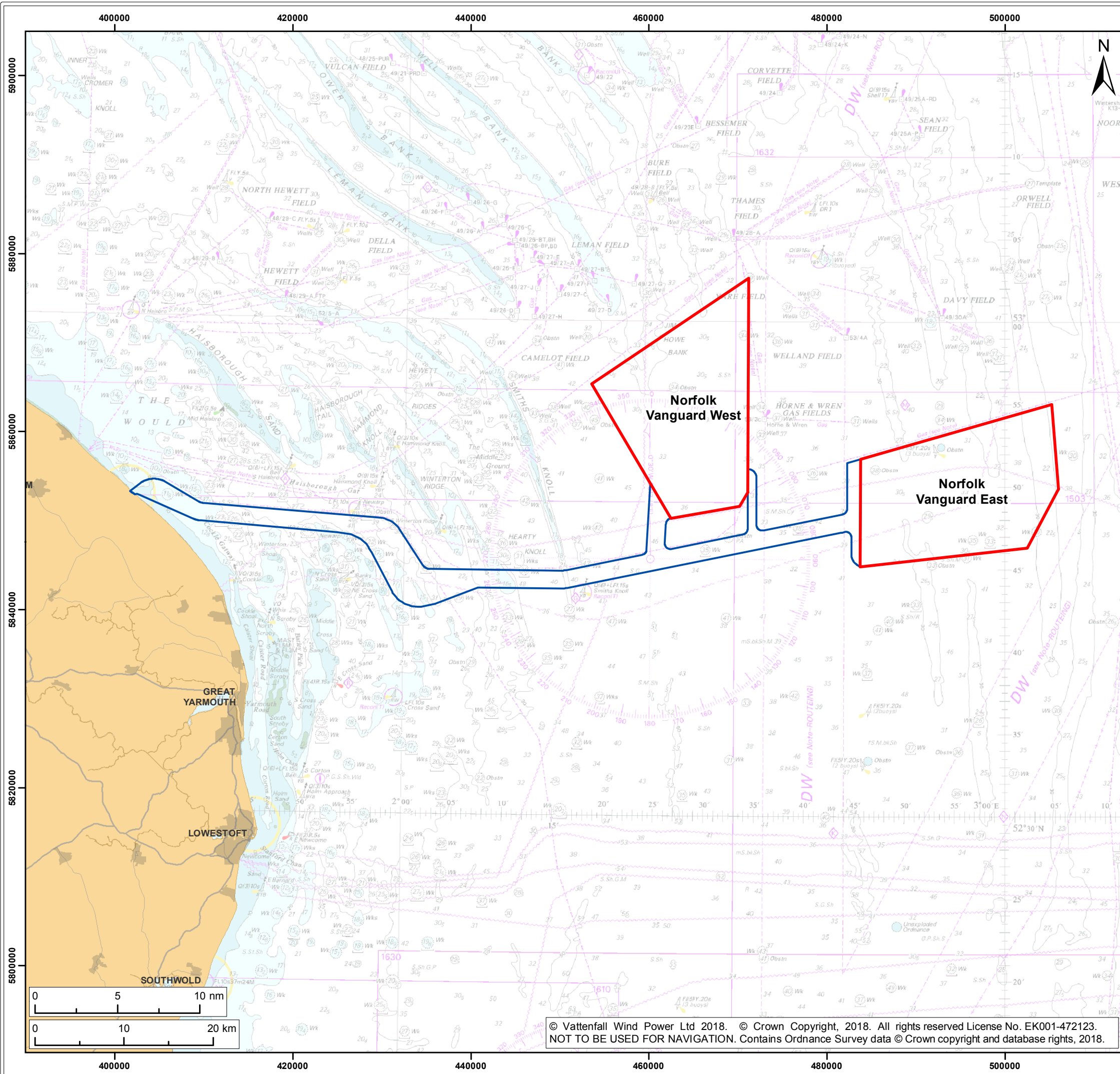
1.1 About this Document

1. This document is the Non-Technical Summary (NTS) of the Environmental Statement (ES) for the proposed Norfolk Vanguard offshore wind farm (henceforth referred to as ‘the project’ or Norfolk Vanguard). It provides a summary of the project, the site selection process and the key findings of the Environmental Impact Assessment (EIA).
2. Norfolk Vanguard is a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008. Consequently, an EIA is required to support a Development Consent Order (DCO) application. The purpose of the EIA is to assess and examine the potential impacts of the project on the environment, from construction, operation and decommissioning. In accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, the findings of the EIA process have been presented in an ES and submitted as part of the DCO application.
3. The project is located in the southern North Sea, with a total capacity of up to 1800 megawatts (MW); which is enough to power approximately 1.3 million UK households. The offshore wind farm comprises two distinct areas, NV East and NV West which are approximately 70km and 47km from the coast of Norfolk, respectively (at the nearest points).
4. The project would comprise offshore wind turbines, offshore electrical platforms, offshore accommodation platforms, offshore export cables, inter-array cables, landfall, onshore cables, an onshore project substation and an extension to the existing National Grid substation at Necton, including associated overhead line modification works. The offshore and onshore project areas are shown in Figure 1 and Figure 2 respectively, and the onshore project substation and extension to the existing National Grid Substation at Necton is shown in Figure 3.
5. This NTS is intended to act as a high level stand-alone document to provide an overview of the environmental impacts of the proposed project in non-technical terms. For further detailed information, the full ES should be referred to. This can be found at:

<https://www.vattenfall.co.uk/norfolkvanguard> or

<https://infrastructure.planninginspectorate.gov.uk>

This page is intentionally blank.



Legend:

Norfolk Vanguard

Offshore cable corridor

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

Title:
Offshore project area

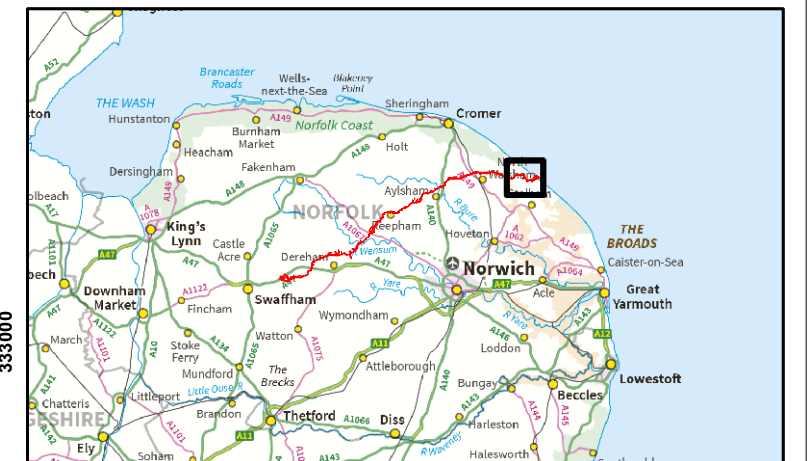
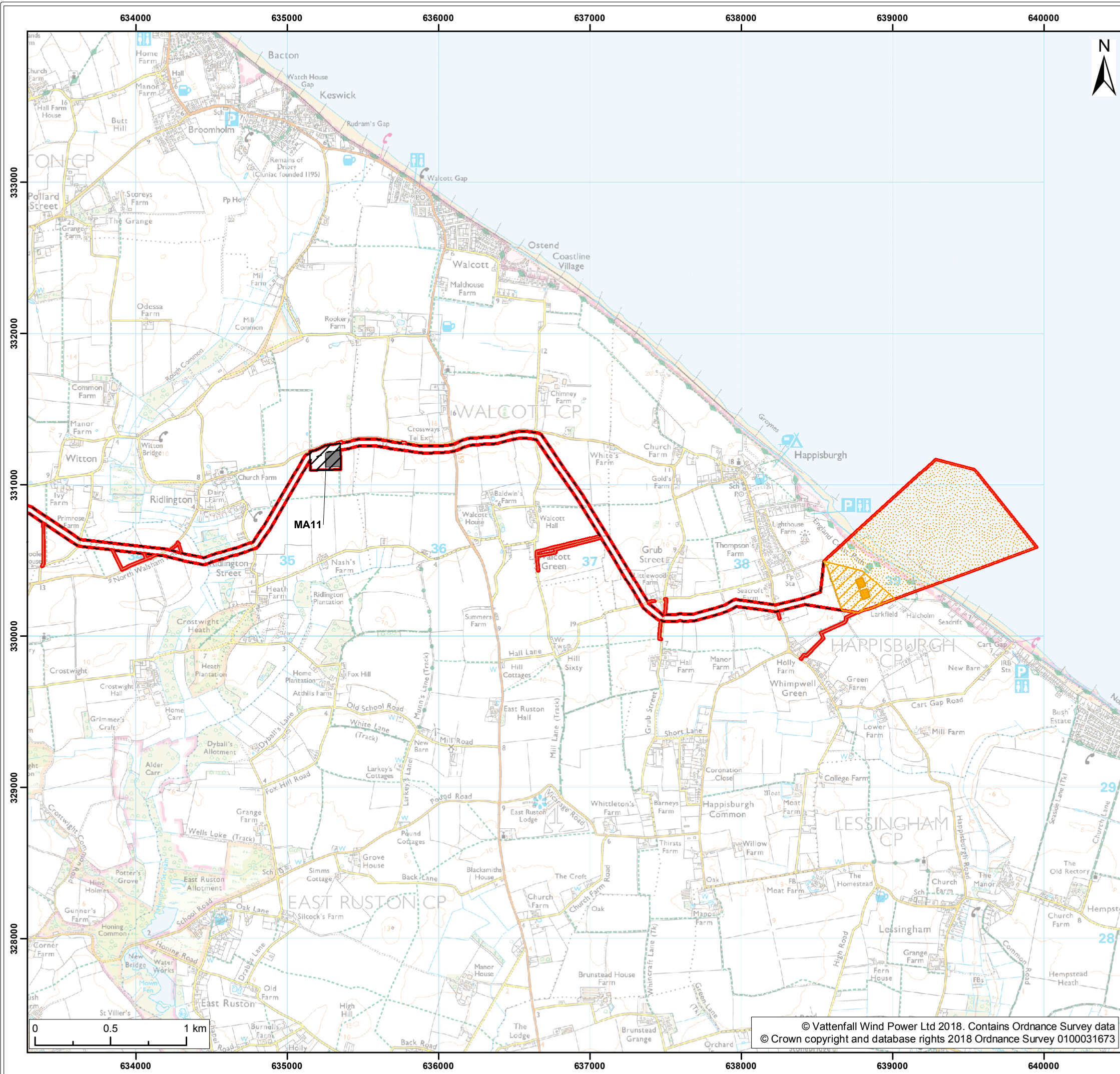
Figure: 1		Drawing No: PB4476-005-000-001			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/06/2018	LB	GK	A3	1:425,000

Co-ordinate system: ETRS 1989 UTM Zone 31N EPSG: 25831

VATTENFALL

**Royal HaskoningDHV**
Enhancing Society Together

© Vattenfall Wind Power Ltd 2018. © Crown Copyright, 2018. All rights reserved License No. EK001-472123.
NOT TO BE USED FOR NAVIGATION. Contains Ordnance Survey data © Crown copyright and database rights, 2018.



- Legend:
- Norfolk Vanguard onshore red line boundary
 - Landfall**
 - Landfall zone
 - Landfall compound zone
 - Indicative landfall compound
 - Onshore cable route**
 - Onshore cable route
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Access**
 - Construction access
 - Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

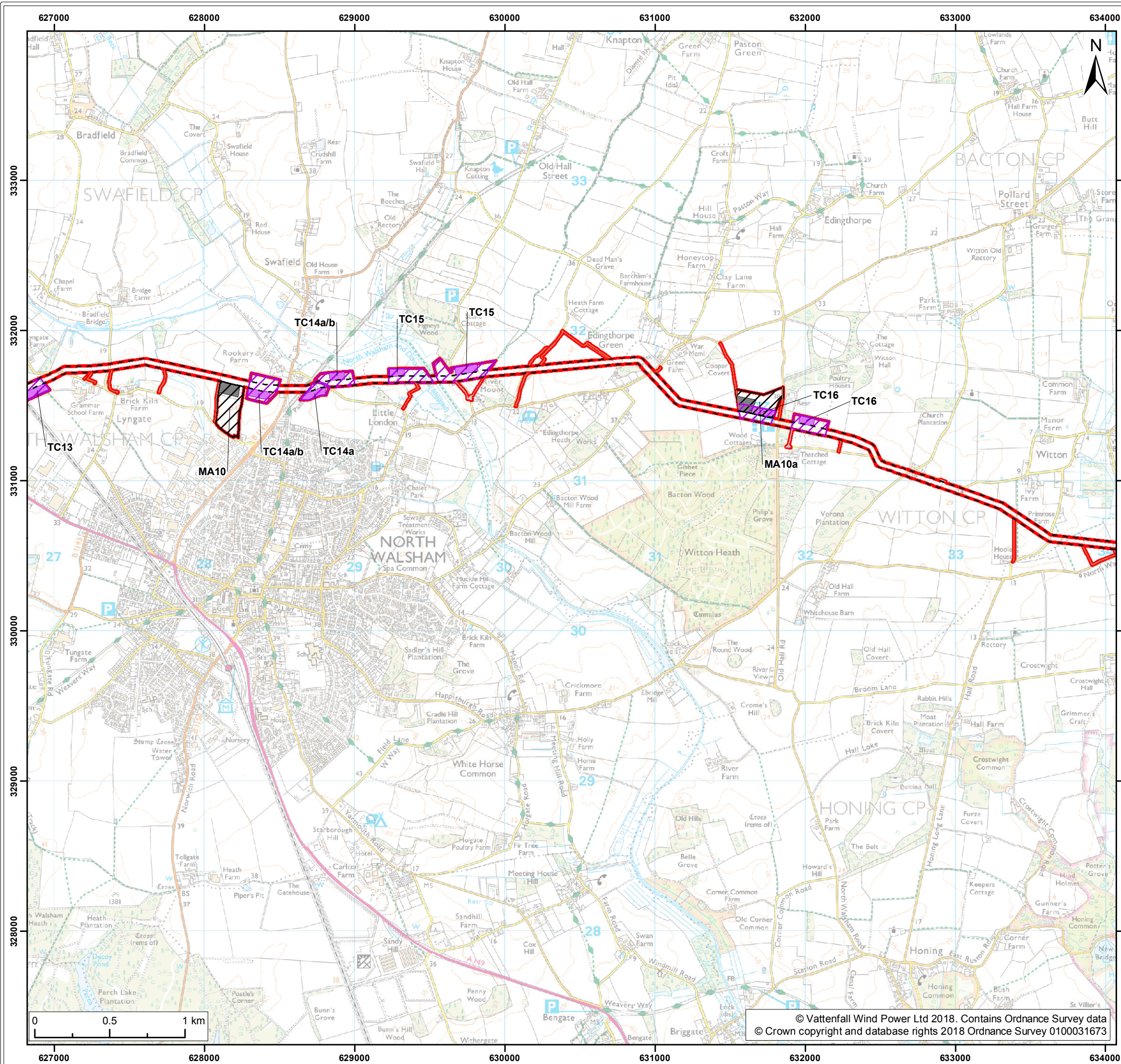
Title:
Onshore project area (map 1 of 9)

Figure: 2		Drawing No: PB4476-005-000-002			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/06/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid EPSG: 27700

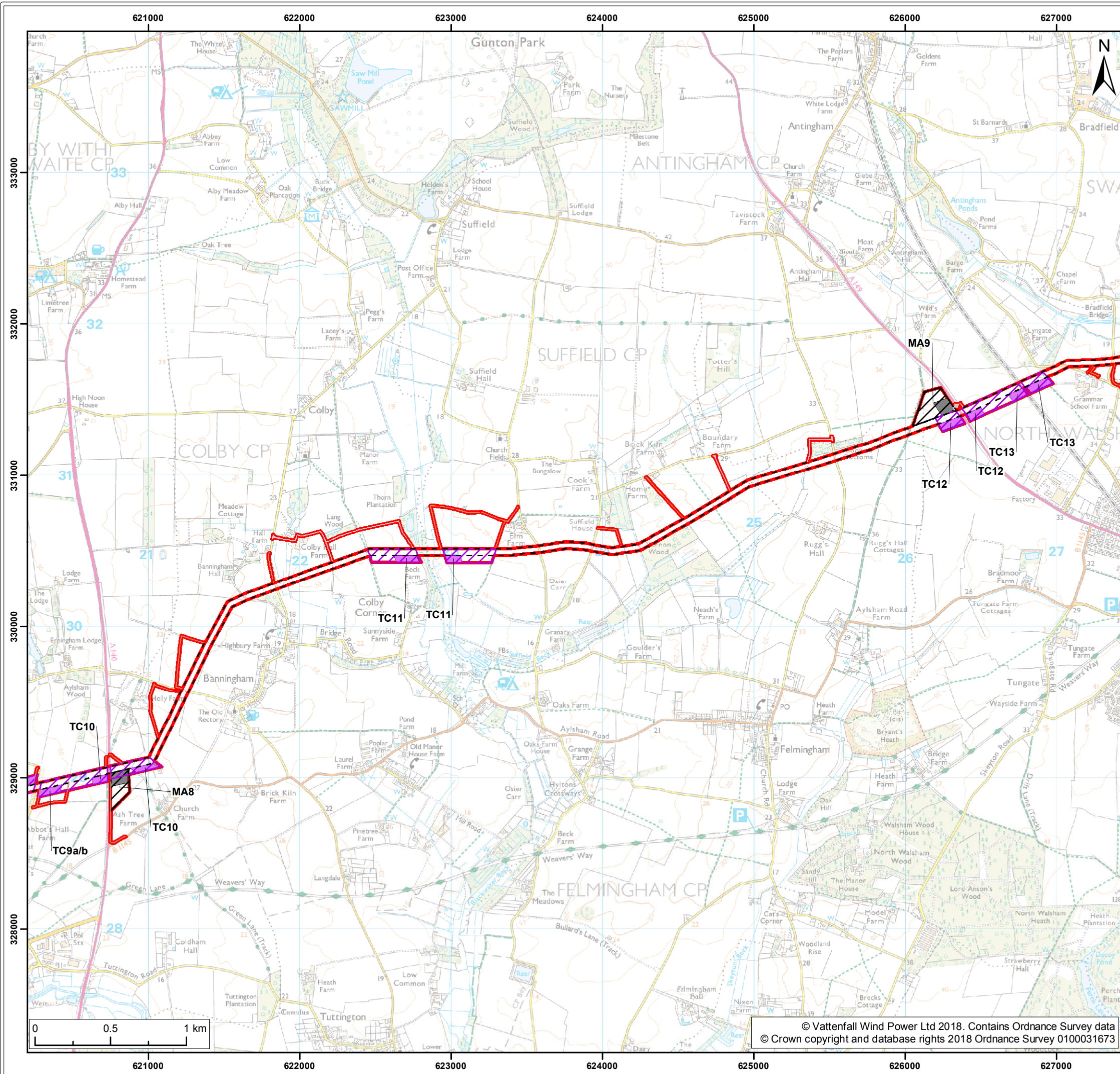


© Vattenfall Wind Power Ltd 2018. Contains Ordnance Survey data
© Crown copyright and database rights 2018 Ordnance Survey 0100031673



- Legend:
- Norfolk Vanguard onshore red line boundary
 - 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

NOTE: MA = Mobilisation area; TC = Trenchless crossing					
Project: Norfolk Vanguard			Report: Environmental Statement: Non-Technical Summary		
Title: Onshore project area (map 2 of 9)					
Figure: 2		Drawing No: PB4476-005-000-002			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/06/2018	LB	GK	A3	1:25,000
Co-ordinate system: British National Grid					
				EPSG: 27700	



- Legend:
- Norfolk Vanguard onshore red line boundary
 - 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

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

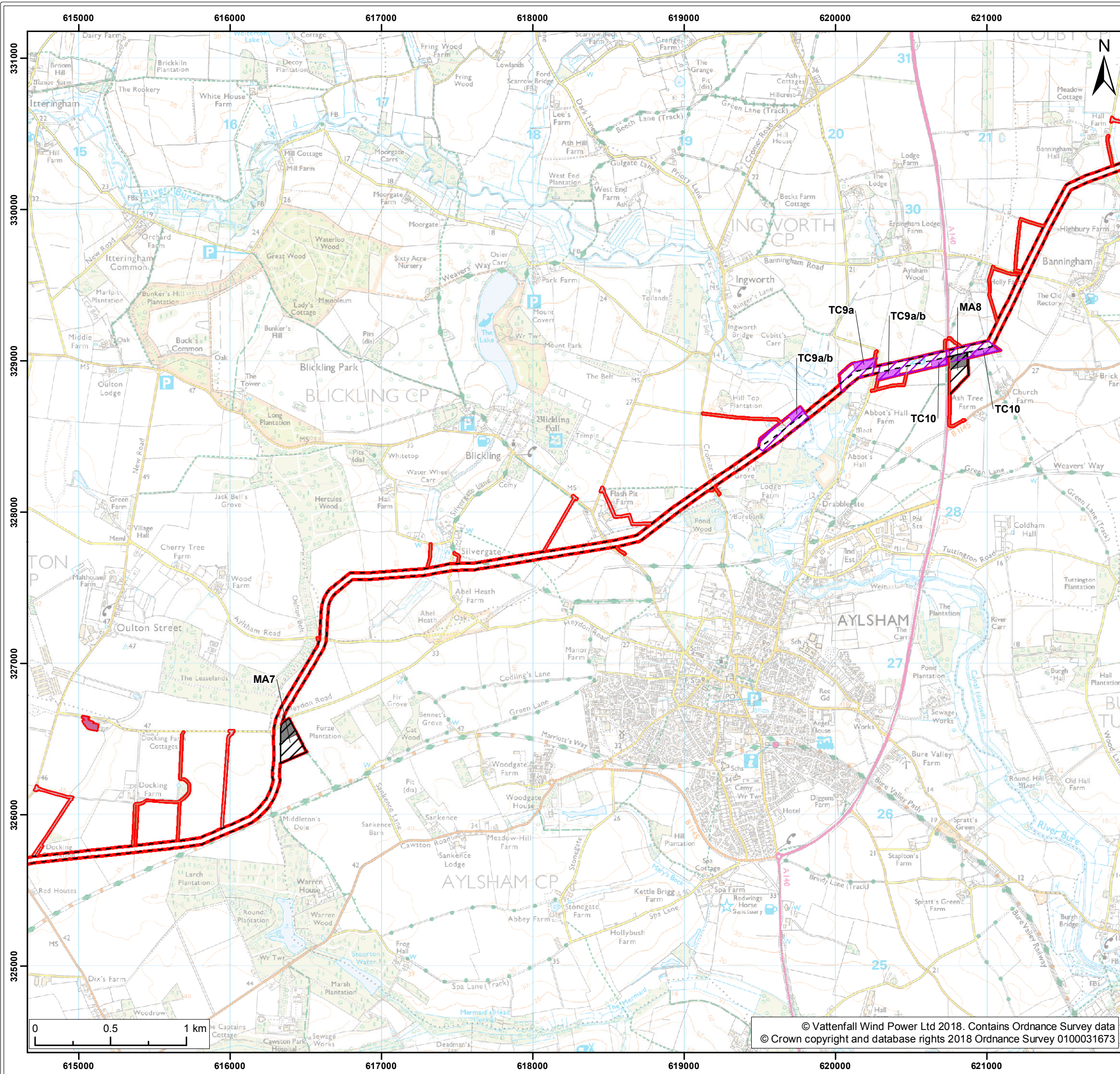
Title:
Onshore project area (map 3 of 9)

Figure: 2		Drawing No: PB4476-005-000-002			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/06/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid EPSG: 27700



© Vattenfall Wind Power Ltd 2018. Contains Ordnance Survey data
© Crown copyright and database rights 2018 Ordnance Survey 0100031673



- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Cable logistics area
 - Access**
 - Construction access
 - Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

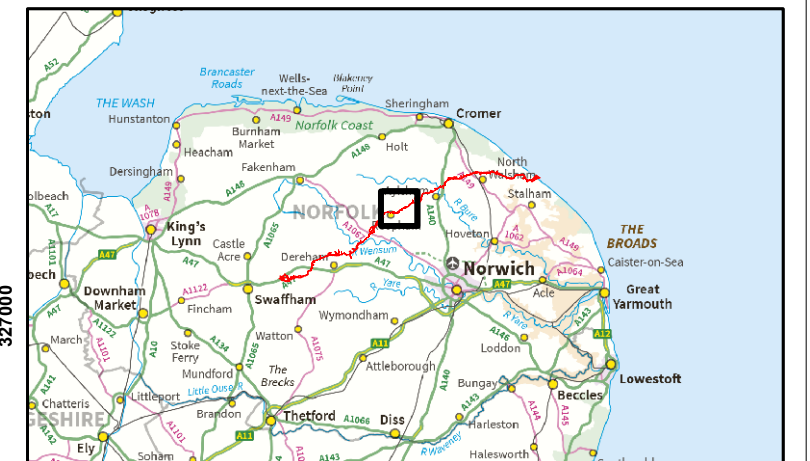
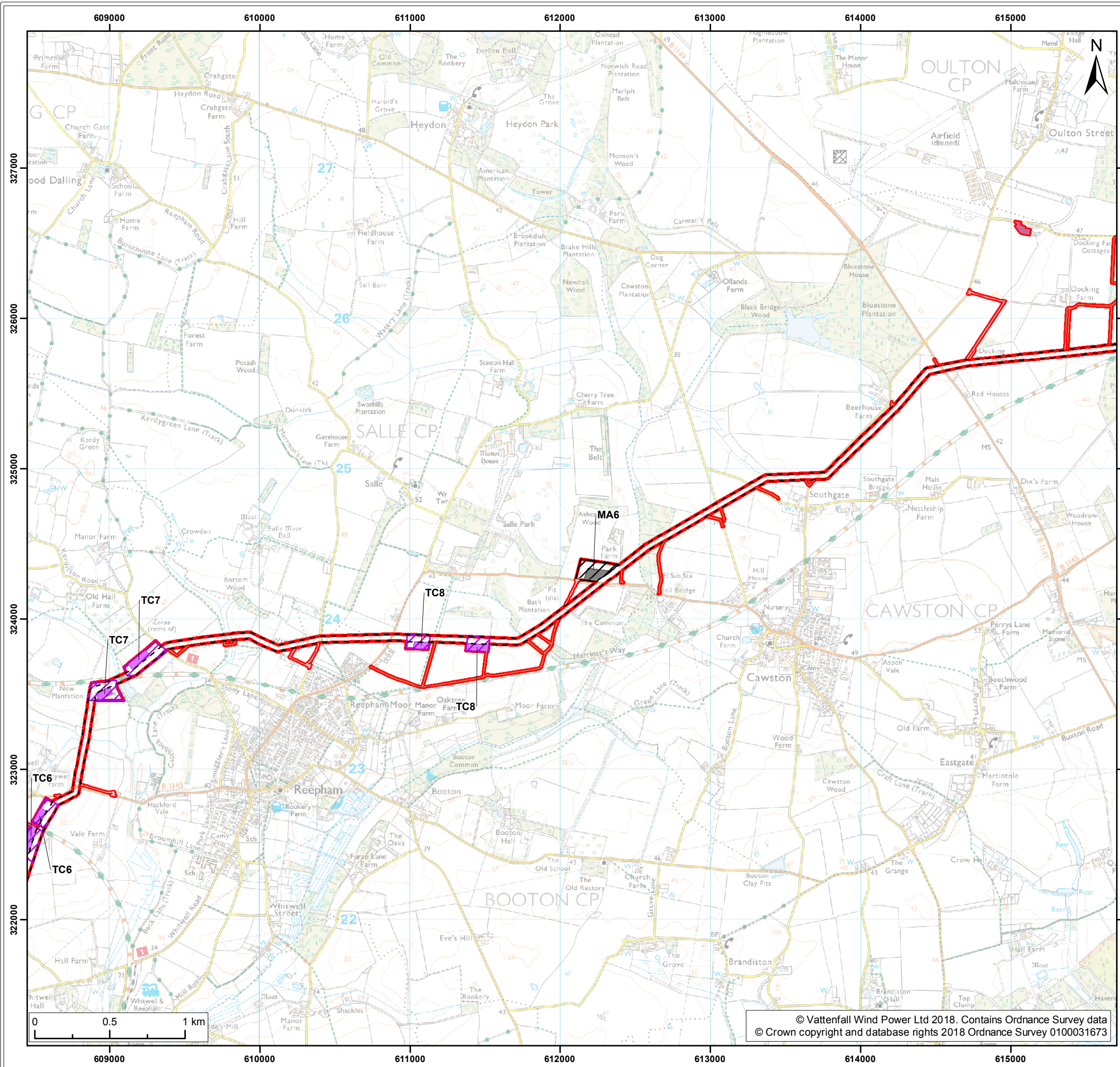
Title:
Onshore project area (map 4 of 9)

Figure: 2		Drawing No: PB4476-005-000-002			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/06/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid EPSG: 27700



© Vattenfall Wind Power Ltd 2018. Contains Ordnance Survey data
© Crown copyright and database rights 2018 Ordnance Survey 0100031673



Legend:

- Norfolk Vanguard onshore red line boundary
- Onshore cable route**
 - Onshore cable route
 - Trenchless crossing zone (e.g. HDD)
 - Indicative trenchless crossing compound
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Cable logistics area
- Access**
 - Construction access
 - Operation access

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

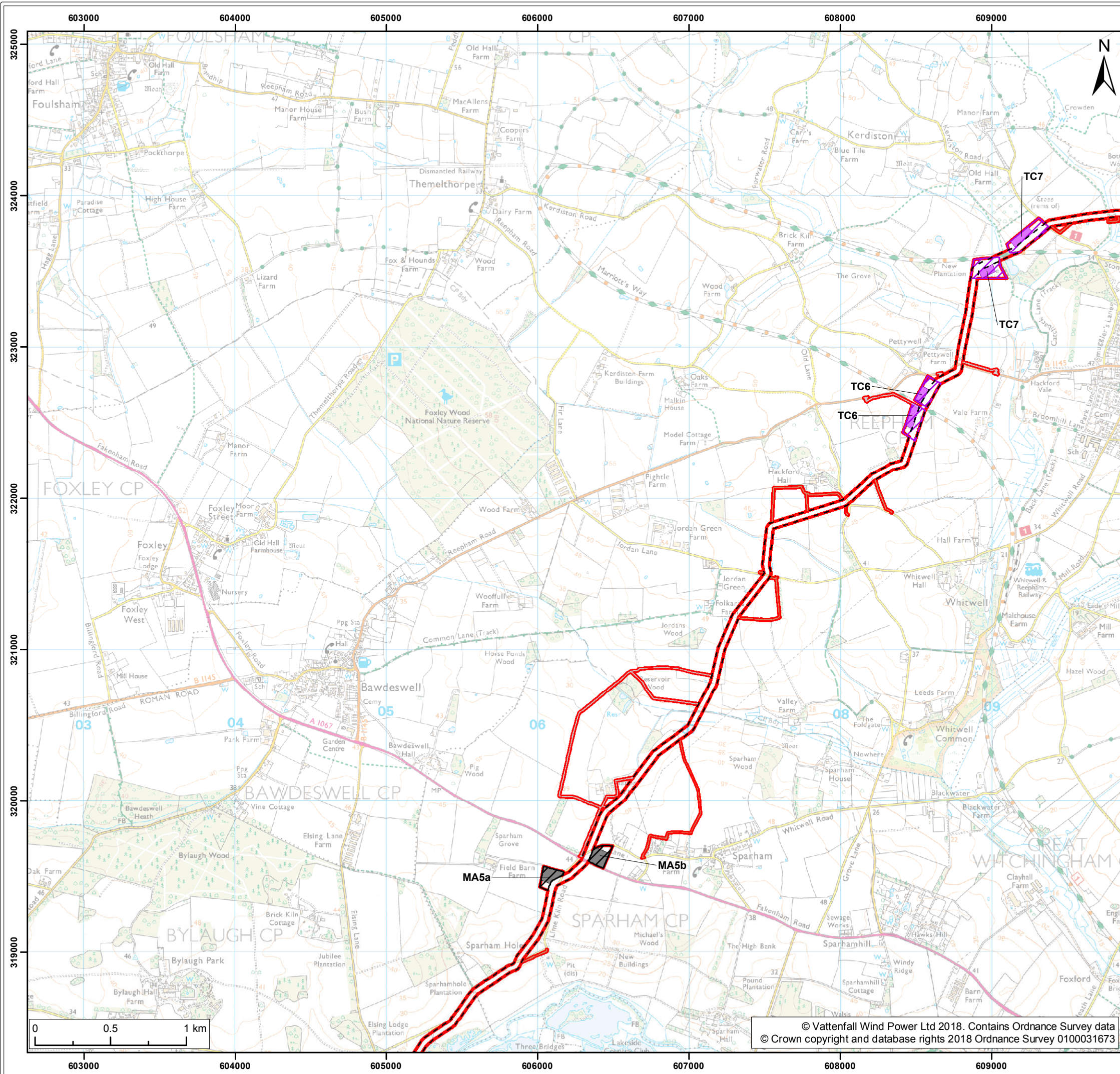
Title:
Onshore project area (map 5 of 9)

022000

Figure:	2	Drawing No: PB4476-005-000-002									
Revision:		Date:		Drawn:		Checked:		Size:		Scale:	
01		04/06/2018		LB		GK		A3		1:25,000	

Co-ordinate system: British National Grid EPSG: 27700

© Vattenfall Wind Power Ltd 2018. Contains Ordnance Survey data
© Crown copyright and database rights 2018 Ordnance Survey 0100031673



- Legend:
- Norfolk Vanguard onshore red line boundary
 - 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

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

Title:

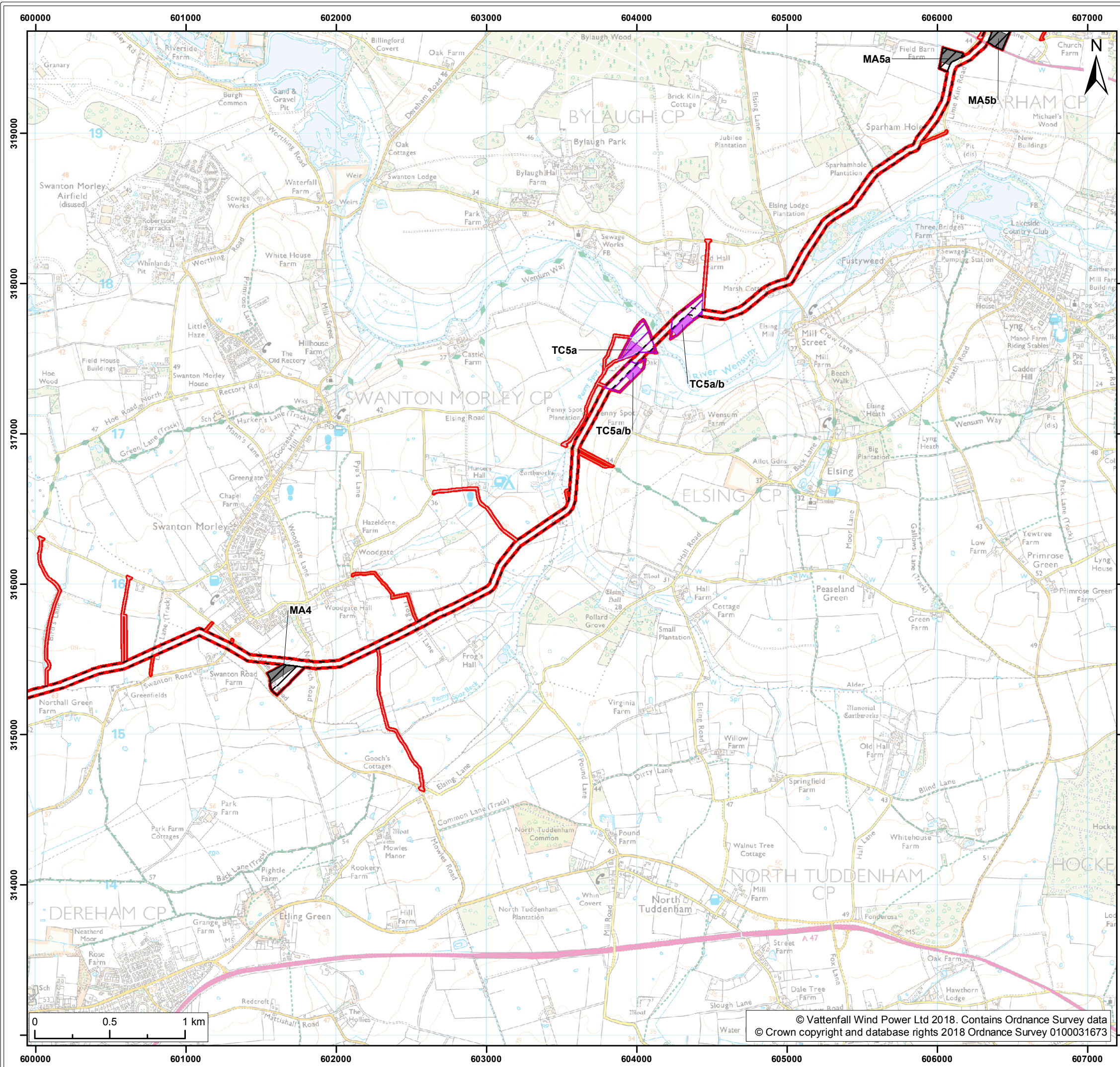
Onshore project area
(map 6 of 9)

Figure: 2		Drawing No: PB4476-005-000-002			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/06/2018	LB	GK	A3	1:25,000

Co-ordinate system: British National Grid EPSG: 27700



© Vattenfall Wind Power Ltd 2018. Contains Ordnance Survey data
© Crown copyright and database rights 2018 Ordnance Survey 0100031673

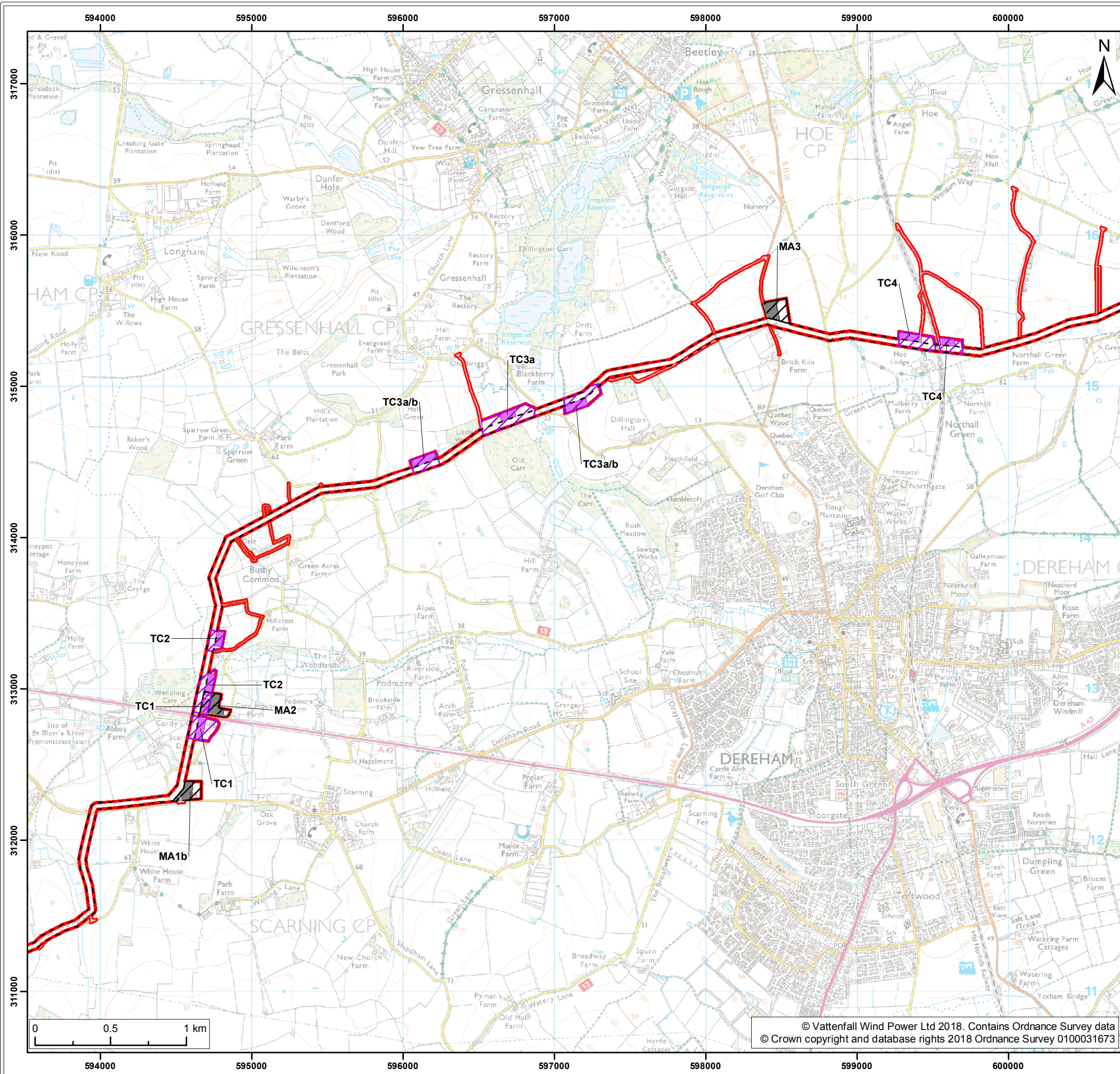


Legend:

- Norfolk Vanguard onshore red line boundary
- 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

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:				
Norfolk Vanguard	Environmental Statement: Non-Technical Summary				
Title:					
Onshore project area (map 7 of 9)					
Figure: 2	Drawing No: PB4476-005-000-002				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/06/2018	LB	GK	A3	1:25,000
Co-ordinate system: British National Grid					
EPSG: 27700					



Legend:

- Norfolk Vanguard onshore red line boundary
- 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

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

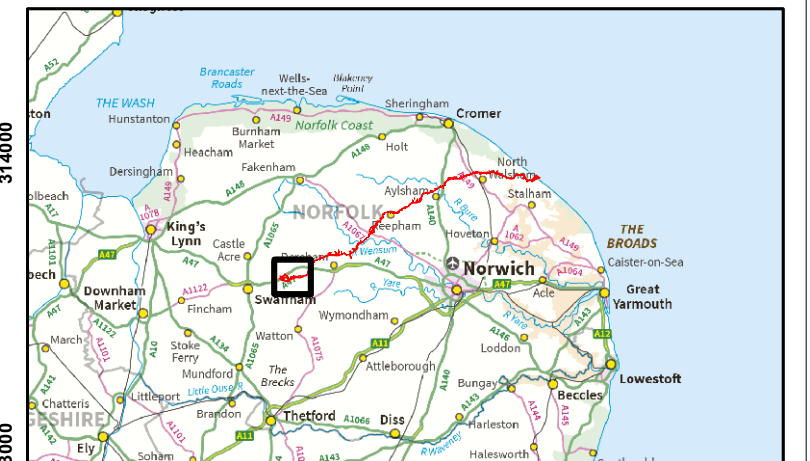
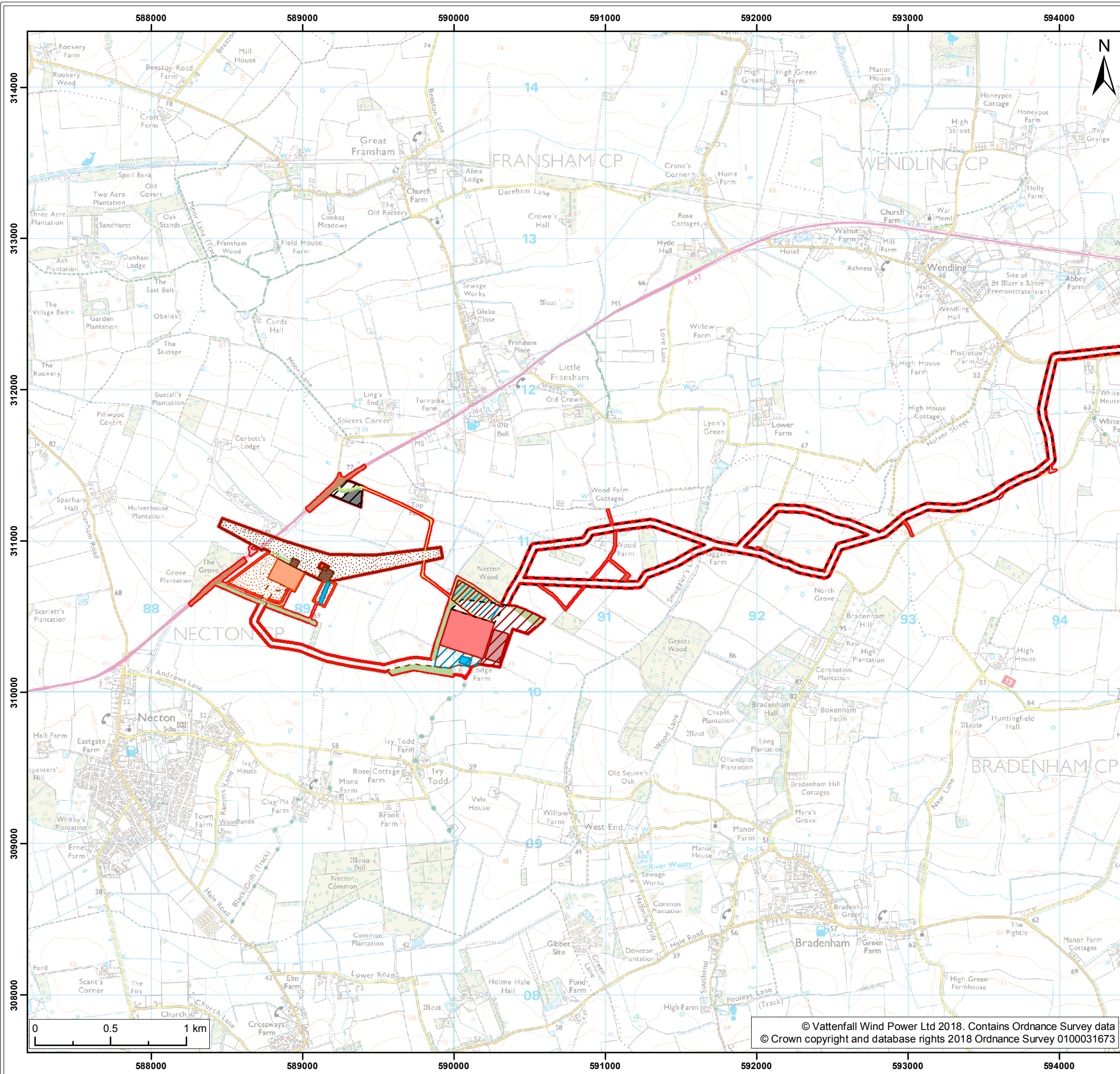
Title:

Onshore project area
(map 8 of 9)

312

Figure:	2	Drawing No: PB4476-005-000-002				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:	
01	04/06/2018	LB	GK	A3	1:25,000	

Co-ordinate system: British National Grid EPSG: 27700



Legend:

Norfolk Vanguard onshore red line boundary

Onshore cable route

Onshore 400kv cable route

Mobilisation zone

Indicative mobilisation area compound

Permanent access

Construction access

Operation access

Onshore project substation

Onshore project substation temporary construction compound zone

Indicative onshore project substation temporary construction compound

National Grid

National Grid substation extension

National Grid new / replacement overhead line tower

National Grid temporary works

Overhead line temporary works

Mitigation areas

Attenuation pond zone

Indicative attenuation pond

Indicative mitigation planting

NOTE: MA = Mobilisation area; TC = Trenchless crossing

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

Title:

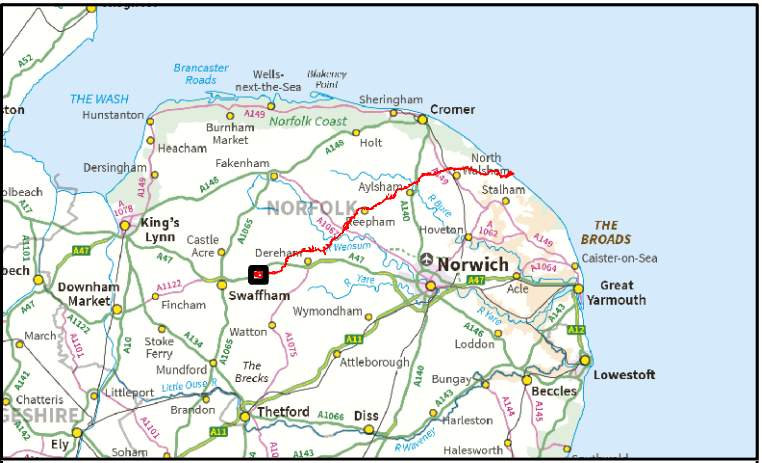
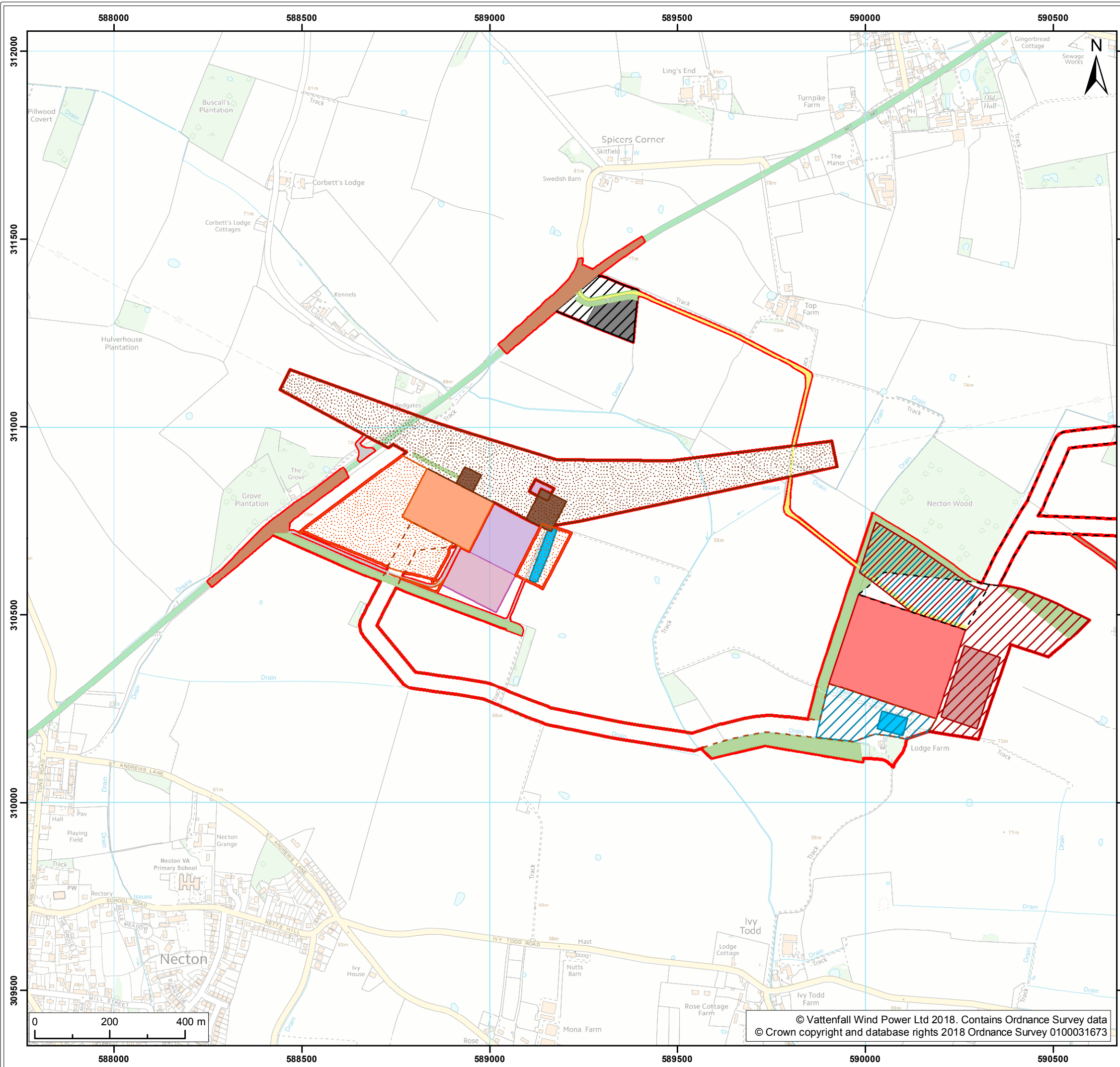
Onshore project area
(map 9 of 9)

Figure:	2	Drawing No:	PB4476-005-000-002			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:	
01	04/06/2018	LB	GK	A3	1:25,000	

Co-ordinate system: British National Grid EPSG: 27700

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together



- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route
 - Onshore 400kv cable route
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Access
 - Permanent access
 - Construction access
 - Operation access
 - Onshore project substation
 - Onshore project substation
 - Onshore project substation temporary construction compound zone
 - Indicative onshore project substation temporary construction compound
 - National Grid
 - National Grid substation extension
 - National Grid new / replacement overhead line tower
 - National Grid temporary works
 - Overhead line temporary works
 - Mitigation areas
 - Attenuation pond zone
 - Indicative attenuation pond
 - Indicative mitigation planting
 - Existing substation locations
 - Dudgeon substation
 - Necton National Grid substation

Project:	Report:
Norfolk Vanguard	Environmental Statement: Non-Technical Summary

Title:
Onshore project substation and extension
to National Grid substation

Figure: 3		Drawing No: PB4476-005-000-003			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/06/2018	LB	GK	A3	1:10,000

Co-ordinate system: British National Grid EPSG: 27700



1.2 The Developer

6. The project is being developed by Norfolk Vanguard Limited (an affiliate company of Vattenfall Wind Power Limited (VWPL, henceforth Vattenfall)). Vattenfall is the second largest developer in the global offshore wind sector and is strongly committed to significant growth in wind energy, both onshore and offshore.
7. Vattenfall has invested over £3bn in the UK, mainly in onshore and offshore wind since 2008 and now has nearly 1GW in operation. Vattenfall plans to invest €5bn in renewables, mainly offshore wind, in Northern Europe by 2020 with an overall ambition to have 4GW of operational capacity by 2020 and 7GW by 2025. The company has the ambition that the UK will continue to be a growth market for Vattenfall, with Norfolk Vanguard providing a significant next step towards this ambition.
8. Norfolk Vanguard lies within an offshore zone that was originally identified by The Crown Estate as a suitable area offering ‘potential for offshore wind’ as part of the Round 3 Offshore Wind Zone tendering process in 2008. At that time, Vattenfall was part of a consortium with ScottishPower Renewables (SPR), through which East Anglia ONE was consented. In December 2014, a decision was made to split the former Zone, and Vattenfall took control of all development activities for projects in the northern half and SPR in the southern half.
9. Vattenfall is also developing a “sister project” to Norfolk Vanguard; Norfolk Boreas would share a grid connection location and also much of the offshore and onshore cable corridors with Norfolk Vanguard, with the DCO application following approximately one year behind the Norfolk Vanguard DCO application. In order to minimise impacts, Norfolk Vanguard Limited is including within its DCO application some enabling works for the Norfolk Boreas project.

1.3 The Need for the Project

10. Climate change is a global issue which is caused by the increase of carbon emissions into the atmosphere. The project would make a significant contribution both to the achievement of UK decarbonisation targets and to global commitments to mitigating climate change. By generating low carbon, renewable electricity in the UK, the project will also help to reduce the UK’s reliance on imported energy. Further detail is provided on this in ES Chapter 2 Need for the Project and Chapter 3 Policy and Legislative Context.
11. Moreover, the project would have a direct positive impact by providing the equivalent of 2% of the UK’s energy demand, or 25% of the East of England’s electricity demand (domestic, commercial and industrial). The project will also

contribute to the economy by providing jobs during all phases of the proposed project.

12. In addition, Vattenfall is leading the way in bringing down the cost of offshore wind throughout Europe, meaning that the project has the potential to be one of the lowest cost sources of new power generation when operational.

1.4 Site Selection and Consideration of Alternatives

13. The site selection and consideration of alternatives is a progressive process to identify and assess potential sites and options for the proposed development. In common with most offshore wind farm projects in the UK, the site selection process starts with the identification of wide search areas within which the key project elements may be located.
14. For the offshore wind farm itself, a zone suitable for the development of large scale offshore wind farms was identified off the East Anglian coast by the UK Government and The Crown Estate following a Strategic Environmental Assessment.
15. In 2015, the location of the wind farm site within this zone was identified by Norfolk Vanguard Limited following a review of available environmental and technical information. Important environmental considerations included:
 - Shipping and navigation;
 - Existing infrastructure, including cables and pipelines and oil and gas platforms;
 - Aggregate dredging grounds;
 - Nature conservation designations;
 - Commercial fisheries activity; and
 - Civil and military radar coverage and helicopter main routes.
16. Other technical considerations included likely wind resource and the suitability of seabed conditions to accommodate wind turbines.
17. Possible landfall locations and offshore cable corridors were subsequently reviewed within an area from The Wash to Harwich and extending out to the wind farm site. The majority of the coastline between the Wash and Harwich is protected by European level nature conservation designations; however, three potential landfall areas were identified that avoided these designated areas. A comprehensive assessment was then undertaken to better understand the risks associated with each landfall / offshore cable corridor option based on an understanding of the environmental constraints. This process led to the identification of the preferred option landfall and offshore cable corridor.

18. Onshore, an early project decision was taken to avoid the need for the installation of new overhead lines as this was felt to present a risk of significant and permanent landscape and visual impact as well as creating significant project risk. As such, a decision was made that the project connection would be made using buried cables in underground ducts.
19. In October 2016, an offer was made by National Grid to connect to the existing Necton National Grid substation. This followed a detailed review by National Grid and Vattenfall to assess a range of connection options and identify the preferred point to connect.
20. After the connection point was confirmed, a detailed site selection exercise was undertaken by Vattenfall to identify where the onshore project substation would be located. In order to minimise the distance to the existing Necton National Grid substation from the onshore project substation (and hence to reduce transmission losses), the onshore project substation search area was defined as a 3km radius from the existing Necton National Grid substation. Potential sites within this 3km radius were then identified and assessed.
21. In parallel with the onshore substation site selection exercise, potential onshore cable route options were also developed.
22. The main considerations when identifying the onshore cable route and onshore project substation were:
 - The National Grid offer to connect at the Necton National Grid substation;
 - Avoid proximity to residential dwellings;
 - Avoid proximity to historic buildings;
 - Avoid designated sites;
 - Minimise impacts to local residents in relation to access to services and road usage, including footpath closures;
 - Avoid noise sensitive receptors such as houses;
 - Wherever possible, seek to use open agricultural land;
 - Use of existing woodland, and landform to help screen the substation, minimising visual impact wherever possible;
 - Minimise requirement for road, river and rail crossings;
 - Ease of road access for large loads (substation only);
 - Avoid areas of important habitat, trees, ponds and agricultural ditches;
 - Install cables in flat terrain maintaining a straight route where possible for ease of pulling cables through ducts;
 - Avoid other services (e.g. gas pipelines);

- Minimise the number of hedgerow crossings, using existing gaps in field boundaries where possible; and
 - Minimise impacts on agricultural practices and access, and avoid rendering parcels of agricultural land inaccessible during construction where possible.
23. In response to feedback on the Preliminary Environmental Information Report that was issued to consultees in October 2017, another important project decision was to use High Voltage Direct Current (HVDC) technology. This decision removed the requirement for a cable relay station and decreased the working width of the onshore cable corridor from 100m to 45m, thereby reducing potential impacts along the cable corridor.
24. The location of the National Grid substation extension is largely dictated by the location and configuration of the existing National Grid substation and has been determined in consultation with the National Grid and in accordance with the Horlock Rules¹.

1.5 The EIA Process

25. The topics included in the EIA were agreed with the Planning Inspectorate and other relevant stakeholders through the scoping process; the Planning Inspectorate providing a Scoping Opinion in November 2016 which is available at:

<https://www.vattenfall.co.uk/norfolkvanguard>

26. Open and wide consultation with communities, stakeholders, landowners and statutory bodies has been undertaken throughout the EIA process to inform the approach to each assessment.
27. For each topic, a detailed description of the current baseline has been identified through a combination of desk based studies, consultation and a variety of surveys commissioned to inform the EIA process.
28. All potential impacts of the construction, operation or decommissioning of the project have been identified, and an assessment made on the severity of each potential impact.
29. Where significant environmental impacts are identified, mitigation measures are proposed to avoid or reduce impacts to acceptable levels.

¹ National Grid's guidelines for the consideration of siting of electricity network infrastructure.

30. The process also considers:

- Inter-relationships, where impacts to one receptor can have a knock on impact on another (for example an impact on a fish population may lead to reduced prey for birds and marine mammals);
- Cumulative impacts, where the project will be considered alongside the predicted impacts of other sizable construction projects in the nearby area (for example another offshore wind farm or a road development); and
- Transboundary impacts, where activities in other countries may be impacted (for example shipping routes and fishing activities).

1.6 Role of National Policy Statements in the Decision Making Process

31. There are three National Policy Statements (NPS) which are relevant to the project:

- EN-1 Overarching Energy, which highlights that there should be a presumption in favour of granting consent for projects which fall within relevant NPSs, and recognises that offshore wind is a key factor in meeting UK policy objectives;
- EN-3 Renewable Energy Infrastructure, which identifies the construction of offshore generating stations in excess of 100MW as NSIPs; and
- EN-5 Electricity Networks, which covers the electrical infrastructure in conjunction with EN-1.

32. Each technical topic within the ES outlines how the development of the project will comply with the requirements of these NPSs.

2 PROJECT DESCRIPTION

33. The wind farm itself comprises two distinct areas, Norfolk Vanguard East and Norfolk Vanguard West, within which wind turbines will be located (Figure 1). The offshore wind farm will comprise of the following:
- Wind turbines;
 - Offshore platforms (including electrical and accommodation platforms); and
 - Subsea cables (including array cables connecting the wind turbines and platforms and export cables taking energy to shore).
34. The project will also require onshore infrastructure in order to transmit and connect the offshore wind farm to the National Grid (Figure 2), which in summary would comprise:
- Landfall at Happisburgh South, where the offshore cables are brought ashore and jointed to the onshore cables;
 - Underground cables;
 - An onshore project substation near the existing Necton National Grid substation; and
 - Works at the Necton National Grid Substation (including extension of the existing substation and modification of the overhead powerlines).
35. A diagram illustrating the main project elements that would be installed for the project is shown on Plate 1.
36. Construction of the project is anticipated to commence between 2020 and 2021 for the onshore works, and around 2024 for the offshore works. A high level timeline is shown on Plate 2.

2.1 Offshore Works

37. Between 90 and 200 wind turbines would be installed within the wind farm site (Figure 1). A range of different turbines sizes and foundations are currently being considered. Turbines could be as tall as 350m (above sea level) and produce up to 20MW of power each, whilst the smallest turbines under consideration would produce 9MW of power per turbine.

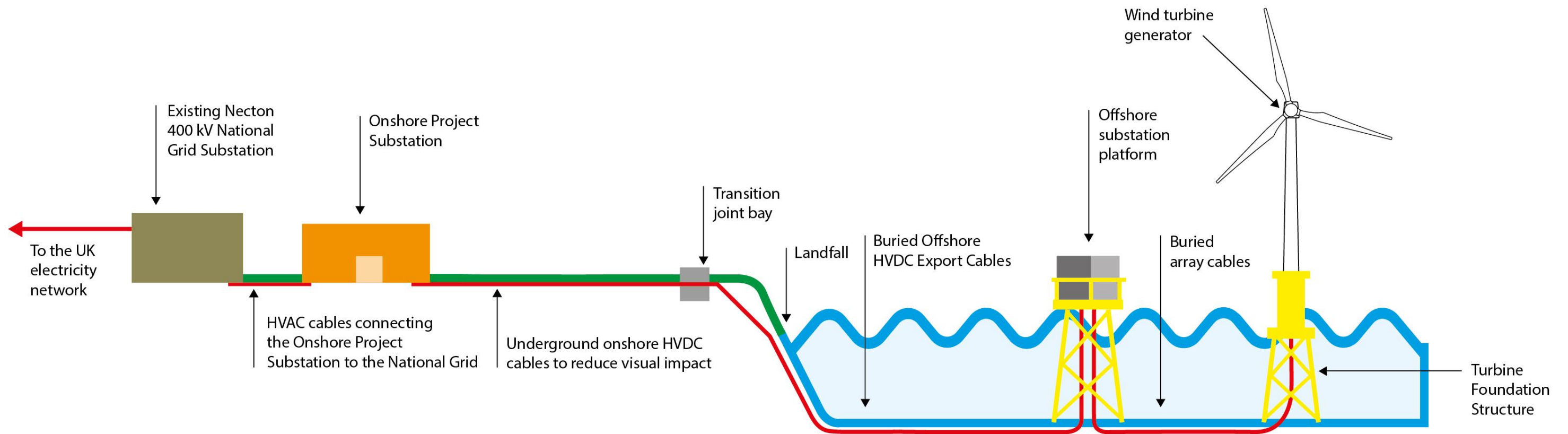


Plate 1 Diagram illustrating the key components of the Norfolk Vanguard project

Norfolk Vanguard timeline

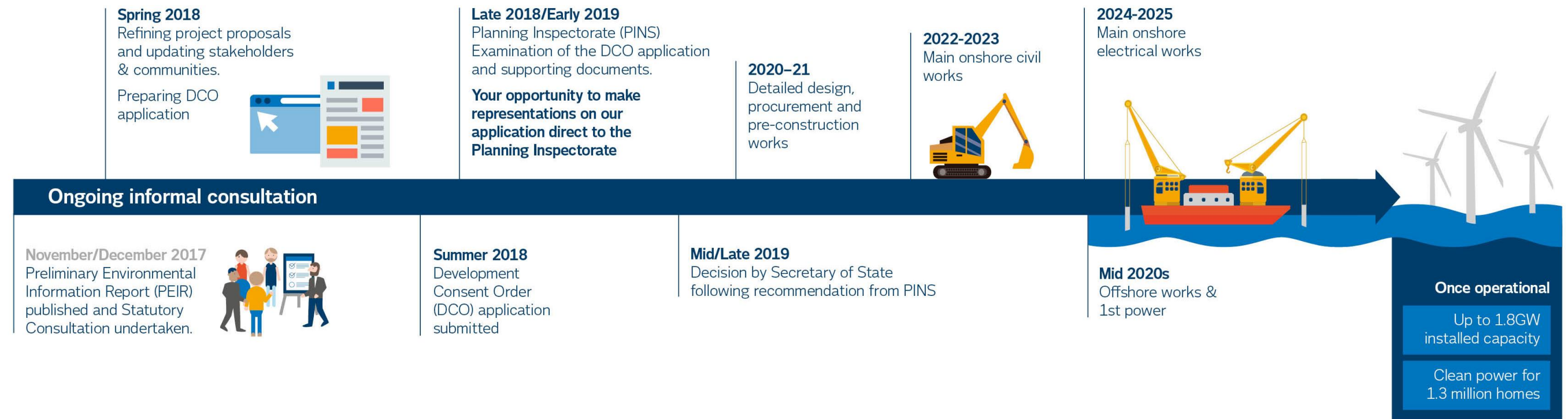


Plate 2 Indicative timeline for Norfolk Vanguard

38. The turbines will be connected to offshore electrical platforms. The electrical platforms will collect the energy and transmit it along the export cables that will be used to transmit the electricity to shore.
39. All offshore cables would be buried where possible, or cable protection would be installed to ensure the cables are not damaged.

2.2 Onshore Works

40. Offshore export cables would make landfall immediately south of Happisburgh. At the landfall, ducts will be drilled under the cliffs and beach, which will avoid the need for any construction works on the beach, see Plate 3. Once the ducts are in place, the offshore export cables would be pulled through the ducts and connected to the onshore cables.

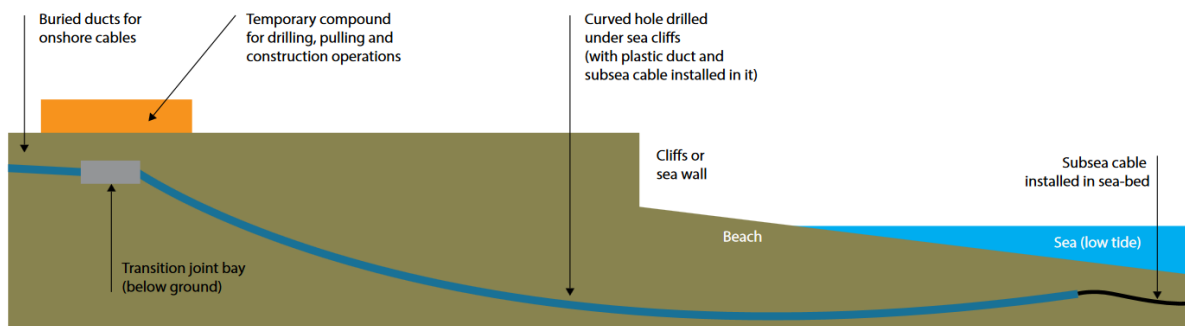


Plate 3 Diagram illustrating ducts installed at the landfall

41. Along the onshore cable route, ducts will be buried, with no above ground infrastructure left after construction²; the ducts for Norfolk Boreas will be installed at the same time as those for Norfolk Vanguard in order to minimise disturbance. For most of the onshore cable route, trenches will be dug to place the ducts in. At certain locations where specific features need to be crossed / avoided, such as railways and rivers of conservation importance, trenchless techniques will be used to drill the ducts beneath features to minimise environmental impacts and disruption.
42. A number of temporary construction compounds will be required along the onshore cable route and a running track will be created along the onshore cable route to allow safe access of construction vehicles and to minimise construction vehicles on the public highway.

² Link boxes will be required at approximately 5km intervals along the onshore cable route. Link boxes would either be buried under ground, or alternatively, above ground link box cabinets may be installed with maximum dimension of 1.2m x 0.8m x 1.8m. Where possible, link boxes would be located close to field boundaries.

43. An onshore project substation will be required to convert the electricity produced by the wind farm into a format that can be accepted by the National Grid. The largest buildings within the onshore project substation will be the converter halls (up to two in total) with an approximate height of 19m. The total land requirement for the onshore project substation will be 250m x 300m.
44. In order to accommodate the electricity produced by the project, the existing Necton National Grid substation will need to be extended. The extension would be within the Necton National Grid Substation extension zone displayed in Figure 3.
45. Due to the extension of the Necton National Grid substation, the overhead powerline configuration around Necton would also require some modification. This would include the removal of one existing pylon and the installation of two new pylons.
46. Landscape and tree planting schemes will be carefully designed to reduce visual impacts of the onshore infrastructure at the onshore project substation and the extension to the existing Necton National Grid substation. Disturbed ground associated with the onshore construction will be reinstated following construction as far as possible.
47. Further details of the project elements are provided in ES Chapter 5 Project Description.

3 TOPICS CONSIDERED IN THE ENVIRONMENTAL IMPACT ASSESSMENT

48. The topics assessed within the Norfolk Vanguard EIA have been undertaken in accordance with the Planning Inspectorate's Scoping Opinion. Each of those topics have been summarised as part of this NTS in the following sections.

3.1 Offshore

3.1.1 Marine Geology, Oceanography and Physical Processes

49. The assessment considered the construction, operation, and decommissioning phases of the project and potential impacts on relevant receptors, including three marine sites designated as sandbanks or chalk reef which are important habitats for seabed species, and the East Anglian coast.
50. The assessment considers the impacts on waves, currents and movement of sediment, both in the water column and along the seabed when constructing, operating and decommissioning the project. Overall, the effects of the proposed project on these processes are predicted to be small scale, localised and temporary. Hence, they are categorised as low, negligible or no impact.
51. Importantly, a commitment has been made to bury, as far as possible, the cables that transport the electricity from the wind farm to the coast to minimise the need for additional cable protection which could affect movement of sediment along the seabed within the sandbanks and at the coast.
52. No cumulative impacts with adjacent projects, including East Anglia THREE OWF, Norfolk Boreas, and aggregate extraction activities were identified due to the small scale of the effects and their temporary nature.
53. The Marine Geology, Oceanography and Physical Processes chapter was used as a basis for the assessments of some of the following marine topics.

3.1.2 Marine Water and Sediment Quality

54. The assessment work undertaken showed that the water quality within the offshore study area is good, and seabed sediments do not contain levels of pollution that would be of concern. Additionally, natural levels of sediment in the water vary depending on season and during stormy weather. The assessment considers the impacts of the release of sediment, as well as the potential for the release of pollutants which may already be present within the seabed that may be disturbed when constructing the project. Overall, no significant impacts on marine water and sediment quality were identified in the assessment, and through the implementation of standard measures (such as developing an appropriate spill plan and using

biodegradable oils and lubricants in the wind turbines) to reduce the risk of potential pollution, all potential impacts to water and sediment quality are considered to be small scale, localised and temporary.

55. No cumulative impacts with adjacent projects, including East Anglia THREE, Norfolk Boreas, and aggregate extraction activities were identified due to the small scale of the effects and their temporary nature.

3.1.3 Benthic and Intertidal Ecology

56. A broad scale survey of the seabed ecology of the former East Anglia Zone (within which the wind farm site is located) was conducted in 2010 and 2011. In addition, a site specific survey was undertaken in the Norfolk Vanguard project area in 2016. These studies included a combination of samples taken from the seabed using a grabbing device, trawling gear and underwater video imagery.
57. Across the site, the main species were found to be marine worms, brittle stars, sea urchins and starfish, typical of the southern North Sea. Two protected habitats; sandbanks and reefs formed by marine worms are present in the area. Detailed pre-construction surveys will further inform micro-siting of the offshore infrastructure to mitigate potential impacts to these receptors. The offshore cable corridor runs through the Haisborough, Hammond and Winterton Special Area of Conservation (SAC), and to the south of the Cromer Shoal Chalk Beds Marine Conservation Zone (MCZ).
58. Potential impacts which were considered include temporary disturbance of habitats, loss of habitat, changes in water quality, increases in suspended sediments and potential impacts on designated sites of marine conservation interest.
59. Impacts were assessed to be negligible or minor due to the relatively small scale of the seabed footprint of Norfolk Vanguard, and in the context of the available habitat in the wider area.
60. Cumulative impacts may occur with Norfolk Boreas and East Anglia THREE offshore wind farms, and are assessed to be negligible or minor. These impacts would be small scale, highly localised and temporary.

3.1.4 Fish and Shellfish Ecology

61. Information from existing research of fish and shellfish in the Southern North Sea was reviewed and combined with relevant data obtained from surveys undertaken in areas relevant to the project in order to develop a comprehensive understanding of the fish and shellfish communities in the area.

62. Fish and shellfish species were taken forward for assessment based on their ecological value and value to commercial fishermen. Species of conservation importance such as salmon and lamprey were also included in the assessment. The impact assessment also took into consideration the information and results presented within the commercial fisheries, marine physical processes, seabed ecology and underwater noise assessments carried out for the project.
63. Overall, the assessment concluded that the project could result in a range of small scale effects on fish and shellfish ecology (such as temporary habitat loss and disturbance). The potential effects identified are anticipated to result in minor impacts to fish and shellfish populations.
64. Cumulative impacts may occur with adjacent offshore wind farm projects however, cumulative impacts are assessed as minor or negligible due to the temporary nature and geographically small-scale of impacts.

3.1.5 Marine Mammals

65. The numbers of marine mammals that use the wind farm sites were estimated based on high resolution aerial photographs using low flying aeroplanes and information from other surveys in the Southern North Sea area. The site surveys and other data indicated low numbers of marine mammals, with only three species, harbour porpoise, grey seal and harbour seal, using the wind farm sites in sufficient numbers to enable them to be analysed. The project is not predicted to have a significant impact on any other species which visit the area infrequently.
66. The impact assessment concluded that only minor impacts to marine mammals would occur as a result of construction, operation and decommissioning of the project, following implementation of the recommended mitigation measures.
67. There are potential cumulative impacts with other offshore wind projects as a result of underwater noise from pile driving, which have the potential to disturb harbour porpoise and grey seal over a wider area. The cumulative impact was assessed as minor following mitigation. Norfolk Vanguard Limited has committed to working with the regulators and other offshore wind developers to understand and manage cumulative impacts at a strategic level where possible.

3.1.6 Offshore Ornithology

68. The importance of the wind farm site for birds, and the potential effects of Norfolk Vanguard have been assessed using observations obtained from monthly digital aerial surveys. A standard survey area, covering Norfolk Vanguard East and West and 4km buffers placed around them, was surveyed over 24 months (NV West) and

32 months (NV East). The results of these surveys have been used to estimate the species and population sizes of birds using or passing across the area.

69. All species recorded were assessed with regard to their nature conservation value and sensitivity to effects from wind farms. Species of particular interest included red-throated diver, kittiwake, gannet, guillemot and razorbill. Effects assessed were disturbance and displacement, collision risk, barriers to movement and indirect effects (e.g. those on prey species etc.). Analysis followed industry best practice methods, including the use of collision risk modelling to fully assess the potential impacts of the proposed development.
70. The conclusion of the assessment was that the project is predicted to have minor impacts on birds when considered in isolation. There is the potential for effects of the project to act cumulatively with adjacent projects, including other offshore wind projects and aggregate extraction activities, although it is concluded that there is no pathway for interaction between impacts other than collision risk impact.
71. The collision risk for Norfolk Vanguard and adjacent offshore wind farm projects was assessed as no greater than a minor cumulative impact.

3.1.7 Commercial Fisheries

72. Fisheries activities of relevance to Norfolk Vanguard broadly fall into two categories:
 - Dutch vessels undertaking trawling (including UK flagged but Dutch owned beam trawlers) and seine netting; and
 - Local UK static gear fisheries.
73. The key species for the trawlers include plaice and Dover sole, whilst the local fishermen target lobster, edible crab and whelks.
74. All potential impacts were considered to be minor, following the implementation of mitigation measures.
75. There is potential for cumulative impacts to occur on commercial fisheries receptors if all the other proposed offshore wind farms, oil and gas decommissioning activities, aggregate dredging and conservation areas are implemented within the assessed area. Cumulative impacts were assessed as no greater than minor.

3.1.8 Shipping and Navigation

76. The shipping and navigation assessment considers the transport of goods or persons by vessel, for either commercial or recreational purposes, in addition to any navigational aspects of marine extraction activities, for example fish, marine aggregates, or oil/gas.

77. The key shipping and navigation features within the vicinity of Norfolk Vanguard are the International Maritime Organisation (IMO) Routeing Measures, namely the DR1 Lightbuoy Deep Water Route (DWR) passing between the wind farm sites, and the West Friesland DWR, to the east of Norfolk Vanguard East. These form part of the wider IMO Routeing Measure network within the North Sea, which has been established to promote safe navigation by all vessels. The majority of marine traffic in the vicinity of the wind farm sites is therefore from cargo vessels and tankers, largely utilising the routeing measures, however established commercial traffic routes also currently cross the wind farm sites.
78. Identified impacts include vessel displacement, an increase in vessel to vessel collision risk, the potential for a vessel to interact with the wind farm structures or subsea infrastructure (cables and mooring lines), and a potential diminishment of Search and Rescue resources. With suitable mitigation measures implemented where necessary (such as construction vessel routeing and entry/exit points into the wind farm sites), impacts were considered to be within acceptable or tolerable risk levels.
79. Furthermore, with suitable mitigation in place, all cumulative impacts were considered to be at acceptable levels.

3.1.9 Aviation and Radar

80. The potential effects of the offshore wind farm on radar were considered, since wind turbines can generate a 'clutter' effect on the screens of radar equipment which may hamper radar operators' ability to distinguish aircraft images from those created by the wind turbines, and therefore degrade the safety and efficiency of the air traffic services being provided.
81. It is predicted that the wind turbines will be detectable and have the potential to affect the National Air Traffic Services (NATS) Primary Surveillance Radar located at Cromer, and the Norfolk and the Ministry of Defence (MoD) Air Defence Radar located at Trimingham, Norfolk. A radar mitigation scheme has been agreed with NATS, which will successfully mitigate the impact to Cromer. The employment of appropriate mitigation measures for the Air Defence Radar at Trimingham is currently under discussion with the MoD and will be implemented prior to construction commencing, which will ensure impacts are mitigated. Agreed mitigation will remain in place during the decommissioning process and until the turbines are removed.
82. The potential for cumulative effects on radar has been analysed. The establishment of Norfolk Vanguard in the southern North Sea is assessed as providing adequate airspace around the development in which aircraft can be operated to enable the

prescribed radar separation standards to be achieved, without incurring adverse impacts from other developments, either onshore or offshore.

3.1.10 Offshore and Intertidal Archaeology and Cultural Heritage

83. The existing offshore and intertidal archaeological baseline has been established through a desk-based assessment and a review of offshore archaeological survey data. The known offshore archaeological baseline offshore comprises charted wrecks and obstructions and previously unidentified anomalies of possible maritime or aviation origin. The approach to mitigation is to avoid these features via Archaeological Exclusion Zones and micro-siting during detailed design to ensure that direct impacts will not occur.
84. In order to account for unexpected archaeological finds, a formal protocol for archaeological discoveries will be implemented during construction.
85. With the application of recommended measures, significant impacts to offshore and intertidal archaeology (including cumulative and transboundary impacts) will not occur.

3.1.11 Infrastructure and Other Users

86. This assessment looked at potential impacts upon other wind farm developments, cables and pipelines, oil and gas activities, marine aggregate activities and unexploded ordnance.
87. Impacts would largely be avoided, as there is a requirement for industries to co-operate and operate in a safe manner. Norfolk Vanguard Limited will be required to establish crossing agreements with operators of other relevant cables and pipelines to ensure that these crossings are made safely and without damage to other infrastructure.

3.2 Onshore

3.2.1 Ground Conditions and Contamination

88. The majority of the onshore project area is located in agricultural land, where significant contamination is not expected. The ground conditions assessment included a desk-based review of the current conditions found within the onshore project area, and identified mitigation measures where appropriate for those significant effects that may potentially arise as part of the project.
89. The impacts assessed include the potential for contamination leaks and spills from construction plant, potential for existing contaminant release during any works and impacts on groundwater quality and mineral resources availability. A Code of

Construction Practice will be produced for each stage of construction, which will provide details of the industry best practice measures that would be undertaken to reduce potential construction impacts onshore.

- 90. Provided mitigation measures are in place, the project is predicted to have no greater than minor impacts in relation to ground conditions and contamination during construction. No potential effects have been identified for the operational phase.
- 91. Cumulative impacts with other relevant projects are assessed as being no greater than minor.

3.2.2 Water Resources and Flood Risk

- 92. To inform the impact assessment, a desk based review of publicly available data and data obtained from the Environment Agency and Internal Drainage Boards was undertaken. In addition, a geomorphological walkover survey of the locations where the onshore cable route would cross watercourses was also undertaken.
- 93. The study area for this assessment was categorised by the three main surface water catchments; the River Bure catchment, the River Wensum catchment, and the River Wissey catchment. The River Bure and River Wensum, designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI), and several of their tributaries, including the King's Beck, North Walsham and Dilham Canal, Wendling Beck and Blackwater Drain will be crossed by the proposed onshore cable route. The proposed grid connection at the existing Necton National Grid substation will be located within the River Wissey headwaters. Due to the designated status of the River Bure and River Wensum, these watercourses and their tributaries are considered to be receptors of high value.
- 94. The impact assessment considered potential impacts upon receptors including direct disturbance of surface water bodies, increased flood risk, soils entering watercourses, and accidental spills of fuels, oils and lubricants during construction.
- 95. Mitigation measures have been identified including a commitment to trenchless crossing techniques for a number of sensitive watercourses, sediment management, construction drainage, and implementation of best practice measures to be set out in the Code of Construction Practice. With the implementation of these measures, there remain potentially significant impacts related to disturbance of some surface water bodies and soils potentially entering watercourses. The assessment is based on a worst case scenario which reflects the number of construction activities (e.g. cable trenching and watercourse crossings) occurring within the wider network of watercourses, rather than the potential impacts on any individual watercourse.

Overall these will be a short term impacts, limited to the duct installation period. Works will be undertaken in 150m sections at a time, and would take a maximum of two weeks for each 150m section. Typically impacts would be reversible once activities have been completed.

96. The presence of new permanent above ground infrastructure has the potential to increase flood risk where permeable ground is replaced with buildings and other hard surfaces. The onshore project substation and National Grid substation extension are located in Flood Zone 1, which is classified as land with a low risk of flooding (less than 0.1% chance of flooding in any year). The risk of flooding associated with the introduction of this new above ground infrastructure has been assessed, and a suite of mitigation measures have been incorporated into the design to mitigate any potential risk. This includes capturing surface water (from rainfall and water flowing overland) as it reaches the onshore project substation and discharging it in a controlled manner to mimic the run-off rate for greenfield land; creation of new water storage at the onshore project substation (e.g. a large pond); and the creation of increased water storage at the Necton National Grid substation. With these measures in place, the risk of flooding associated with the introduction of new above ground infrastructure has been assessed as negligible.
97. Cumulative impacts with other relevant projects are assessed as being no greater than for Norfolk Vanguard alone.

3.2.3 Land Use and Agriculture

98. To inform the land use and agriculture impact assessment, a desk based literature review of existing reports and survey data was undertaken to provide indicative baseline conditions for land use. Additionally, consultation has been undertaken with relevant Local Planning Authorities and feedback has been sought from landowners and occupiers within the study area to provide information on agricultural practices.
99. The assessment considered the potential impacts of the project on drainage, agricultural land, soil quality, Environmental Stewardship Schemes and utilities. Provided mitigation measures are in place, the project is predicted to have no greater than minor impacts in relation to land use and agriculture. Mitigation measures include the use of an Agricultural Liaison Officer, ensuring agricultural field drains are maintained, and employing best practice measures through a Soils Management Plan.
100. Cumulative impacts with other relevant projects are assessed as being no greater than minor.

3.2.4 Onshore Ecology

101. An extensive suite of ecological surveys was undertaken throughout 2017 to describe the ecological baseline. The scope of these surveys was agreed in advance with Natural England.
102. All statutory and non-statutory sites, designated for their nature conservation value, have been avoided, where possible, during the site selection process. Where avoidance was not possible, for example at the River Wensum SAC, alternative construction techniques have been selected to avoid impacts (e.g. trenchless techniques to pass beneath the feature). Ancient woodland and woodland parcels have been avoided where possible and, where hedgerows are crossed the working width will be reduced from 45m to 20m to minimise potential impacts.
103. Temporary habitat loss and fragmentation will occur during the project construction phase. Habitats will be reinstated as far as practicable following construction and the effects will be reversible in the long-term.
104. Potential impacts on badgers, bats, water voles, otters, great crested newts, common reptiles, Desmoulin's whorl snail and protected flora are also anticipated to occur during the construction phase. These impacts include disturbance and risk of injury, permanent and temporary habitat loss and habitat fragmentation. Species-specific mitigation has been identified for these impacts, which includes pre-construction surveys (to confirm if populations have changed), reinstatement of lost habitats and precautionary methods of working.
105. Significant residual impacts will remain after mitigation for bats (loss of connective hedgerow habitat) and hedgerows; however, these impacts will reduce to non-significant over time as replacement hedgerows mature.
106. Potential impacts during operation may arise from maintenance and operational lighting at the onshore project substation. Operational lighting will be designed to conform with best practice guidance to minimise disturbance to light-sensitive species.
107. Cumulative impacts with other relevant projects are assessed as being no greater than for Norfolk Vanguard alone.

3.2.5 Onshore Ornithology

108. Information was gathered through a combination of desk-based assessment and a programme of field surveys (wintering bird and breeding bird surveys) of the onshore study area conducted between 2016 and 2017.

109. The potential for temporary habitat and disturbance of birds during construction was assessed, along with potential noise and light disturbance during operation associated with the onshore project substation.
110. Provided mitigation measures are in place, the project is predicted to have no greater than minor impacts in relation to onshore ornithology. Mitigation measures include removing vegetation prior to bird breeding seasons, reinstatement of removed hedgerows following construction, and an operational lighting scheme at the onshore project substation that conforms to guidance set out in the Bat Conservation Trust's *Artificial Lighting And Wildlife Guidance*.
111. Cumulative impacts with other relevant projects are assessed as being no greater minor.

3.2.6 Traffic and Transport

112. The traffic and transport assessment for the project is based on forecasts of background levels of traffic for 2022 as this represents the main construction year. Transport requirements were determined through a series of desk based assessments utilising open source data obtained from the Department for Transport and the relevant Highway Authorities. Further traffic data was obtained via commissioned onsite Automatic Traffic Count surveys undertaken in 2017.
113. A total of 86 roads have been assessed for the effects of pedestrian severance, pedestrian amenity, road safety and driver delay during construction. With the application of appropriate mitigation measures (such as carefully agreeing delivery routes for lorries), the residual impact for all roads (with the exception of one) was assessed to be not significant.
114. Little London Road (south of Swafeld off the B1145) was identified as potentially experiencing significant residual impacts for pedestrian severance and pedestrian amenity during construction; this road is not wide enough to allow two-way construction traffic and as such is considered to be receptor of high sensitivity.
115. Advance notice of the works will be given to minimise disruption. A draft Traffic Management Plan has been developed which includes measures for managing the HGV movements on this sensitive highway link. The final Plan will be agreed with the relevant Highways Authorities and finalised prior to construction.
116. No significant impacts were identified for the operational phase.
117. Cumulative impacts with other relevant projects are assessed as being no greater than those for Norfolk Vanguard alone.

3.2.7 Noise and Vibration

118. To inform the noise and vibration impact assessment, a baseline noise survey was undertaken to quantify the existing noise environment in the vicinity of proposed onshore assets and construction corridors. Noise modelling was undertaken to inform several subsequent assessments in order to determine any potential impacts relating to the construction and operation of the project at agreed receptors.
119. Potential impacts from noise were identified as arising from construction works in a small number of locations along the onshore cable route. Provided mitigation measures are in place, the project is predicted to have no greater than minor impacts in relation to noise.
120. The only sources of noise during the operation of the project are those from the onshore project substation. Norfolk Vanguard Limited will provide a final design of the project which will not exceed the noise limits (at the nearest noise sensitive receptors) already imposed on the existing Necton substation. Noise reduction technologies and potential design approaches have been considered and there are many proven mitigation options that, through the detailed design process, can be combined to create a design that will adhere to the required noise limits.
121. During operation, there is the potential for impacts from the project to act cumulatively with Norfolk Boreas, as the two projects' onshore substations will operate simultaneously. This scenario has been modelled and the level of noise reduction required across both projects would be readily achievable. The resultant noise levels would not exceed the noise limits (at the nearest noise sensitive receptors) imposed on the existing Necton substation.
122. No impacts from vibration effects have been identified in the assessment.

3.2.8 Air Quality

123. A desk-based assessment was carried out using air quality monitoring data collected by Local Authorities within the study area, as well as pollution maps provided by the Department of Environment, Food and Rural Affairs (Defra), to establish existing pollution levels. The air quality assessment considered the potential impacts associated with onshore construction phase dust and road traffic emissions only.
124. In accordance with air quality guidance, a suite of best-practice mitigation measures has been identified (such as dampening down the running track during dry periods to minimise dust generation), which are commensurate with the level of dust risk of the construction activities. With the implementation of the mitigation measures, dust impacts can be considered to be not significant.

125. Cumulative impacts with other relevant projects are assessed as being not significant.

3.2.9 Human Health

126. An assessment of activities which may have an impact on physical or mental health during the construction, operation and decommissioning of the project was undertaken. Impacts associated with offshore elements of the project were not assessed as there are no sensitive receptors close enough to experience health impacts.
127. The human health effects that were considered included: construction and operational noise, air quality, exposure to contaminated land, employment during construction and operation, and exposure to electromagnetic fields (EMF) during operation.
128. The onshore infrastructure is largely routed through agricultural land and away from population centres and sensitive receptors, thus the potential number of receptors has been reduced through site selection and project design.
129. With the implementation of the mitigation measures identified within the separate topics (such as measures to minimise construction noise and to minimise the risk of dust generation), there are not predicted to be any significant effects.
130. The buried cable systems will produce EMFs. Public Health England has produced guidelines identifying EMF thresholds above which there is the potential for human health effects. The level of EMFs produced by the Norfolk Vanguard buried cable systems is approximately 1% of the value Public Health England has identified as safe. As such, the conclusion of the assessment is that there would be no effect to population health due to EMFs during operation.

3.2.10 Onshore Archaeology and Cultural Heritage

131. The existing onshore archaeology and cultural heritage baseline has been established by a desk based exercise and supplemented by a programme of aerial photographic assessment and non-intrusive surveys to identify potential archaeological features underground (such as using ground penetrating radar).
132. The onshore archaeological and cultural heritage baseline resource comprises both designated and non-designated heritage assets, and includes both below ground archaeological remains and above ground built heritage assets the baseline also considers the historic landscape character of project area.

133. Designated heritage assets (e.g. Scheduled Monuments) have been avoided as part of the site selection process and as such, no direct physical impacts are anticipated to occur. Indirect impacts do, however, have the potential to occur, such as impacts to the setting of a heritage asset.
134. Non-designated heritage assets may be subject to direct and / or indirect impacts as a result of the project. Direct impacts may arise as the result of ground excavation during construction.
135. A draft Written Scheme of Investigation has been submitted with the application, which outlines the stages of mitigation to be undertaken post-consent. This will inform further decisions regarding the subsequent archaeological mitigation strategy so that the historic environment resource can be safe-guarded in a manner that is both appropriate and proportionate to the significance of the archaeological remains identified and present. With this commitment in place any impacts are considered to be non-significant.
136. Cumulative impacts with other relevant projects are assessed as being non-significant.

3.3 Project Wide Impacts

3.3.1 Landscape and Visual Impact Assessment (LVIA)

137. The potential effects of the onshore components of the project were assessed for landscape and visual receptors during the construction, operation and decommissioning phases of the project. The visibility of the offshore works was scoped out of the assessment owing to its distance offshore and that it will not be visible from the coast.
138. The LVIA demonstrated that despite the scale of the project, any significant effects would occur in relatively contained areas only, with the majority of landscape and visual receptors either undergoing non-significant effects or no effect.
139. In respect of the landfall and onshore cable route, significant effects would occur only during the construction phase, with no significant effects during the operational phase as infrastructure will be buried below ground. These effects would be short term in relation to the construction works, and medium term in relation to the re-establishment of hedgerows.
140. There would be no cumulative effects in relation to either the landfall or the onshore cable route, with the exception of a localised and short term significant cumulative effect arising in respect of walkers on a short section of the Marriott's Way walking route to the south-west of Salle Park, where Hornsea Project Three onshore cable

route would have a cumulative influence if both projects were under construction at the same time.

141. During operation, potentially significant visual effects associated with the onshore project substation and National Grid substation extension would be largely contained within the local landscape, owing to the extent of existing woodland cover to the north and east and rising land to the south and, owing to the enclosure of hedgerows along roads and around settlements. As such, significant visual effects are limited to road-users on a short section of the A47, an opening on Ivy Todd Road and walkers on Lodge Lane.
142. Mitigation planting will be introduced and has been designed with the aim of reducing these identified impacts. The planting includes areas of fast growing woodland species as this will provide the height required, as well as the density, to ensure effective screening.
143. Woodland planting would mitigate these localised effects within 10 years in respect of the views from the A47, 20 years in respect of the views from Lodge Lane and 25 years in respect of the opening on Ivy Todd Road as the woodland becomes established. In respect of local landscape character, effects would be gradually mitigated as planting grows, and within 20 years of operation, significant effects would be mitigated.
144. The onshore project substation and National Grid substation extension for Norfolk Vanguard in conjunction with the onshore project substation and National Grid substation extension for Norfolk Boreas would have a significant cumulative effect. Significant effects would arise from Lodge Lane to the immediate south of the site and a very localised section of Ivy Todd Road to the south-west. Woodland planting would mitigate these cumulative effects within 20 years as the woodland becomes established.

3.3.2 Tourism and Recreation

145. A desk-based assessment combined with consultation enabled an identification of the important recreational and tourism features. Visitors are attracted to the local area to enjoy sandy beaches, historic towns and villages, and open landscapes.
146. There is the potential for tourism and recreation impacts to occur in the short term to local features near the landfall works (i.e. coastal areas and footpaths) during construction due to noise, traffic and general construction presence. Provided mitigation measures are in place the project is predicted to have no greater than minor impacts. In addition, at the landfall, ducts will be drilled under the cliffs and

beach, which will avoid the need for any construction works on the beach. No impacts were identified to tourism and recreation receptors during operation.

147. Cumulative impacts with other relevant projects are assessed as being no greater than minor.

3.3.3 Socio-economics

148. A review of policy, strategy, and business analysis was undertaken that showed that the offshore wind industry in East Anglia is growing quickly, with Vattenfall seen as a significant contributor in this growth. The project may create up to 1,063 jobs during construction and up to 294 jobs during operation. The East Anglia job market may be able to supply this demand and this would represent a potential minor benefit.
149. When considered cumulatively with other projects, there is the potential for major long term benefits to the region due to increased employment across the supply chain serving the offshore wind industry.

4 CONCLUSIONS

150. For all offshore topics, the assessments conclude that Norfolk Vanguard will not result in significant environmental impacts. In many cases, this is the result of the process of the development of the project design to avoid and minimise impacts, along with a number of important design decisions made by the project such as the adoption of HVDC technology. As a result, Norfolk Vanguard is predicted to result in few significant impacts and where any potentially significant impacts have been identified, mitigation has been proposed to reduce these impacts to non-significant.
151. There are potential cumulative impacts with other projects as a result of underwater noise from pile driving, which have the potential to disturb harbour porpoise and grey seal over a wider area. Norfolk Vanguard Limited has committed to working with the regulators and other offshore wind developers to manage these impacts at a strategic level and expect these to reduce impacts to minor.
152. For the majority of onshore topics, the assessments conclude that the project will not result in significant impacts. As above, the onshore site selection has resulted in many potential impacts being avoided.
153. Potentially significant landscape and visual impacts may arise as a result of the onshore project substation; however, these impacts are very localised and will reduce over time following the establishment of woodland planting. Significant residual impacts will remain after mitigation for bats (loss of connective hedgerow habitat), but these impacts will also reduce to non-significant over time as replacement hedgerows mature.
154. There are potential significant impacts associated with the number of highly sensitive watercourse crossings and the potential increases in sediment experienced during construction. With the implementation of appropriate measures, the impacts are reduced as low as possible but remain significant. However, these will be a short term impacts and reversible once construction is complete.
155. Potentially significant impacts were also identified on one road. This is related to pedestrian usage during construction. The impact is very localised and is for a relative short duration. A Traffic Management Plan will be developed and agreed with the relevant Highways Authorities with measures for managing the HGV movements on this sensitive highway link.
156. Throughout the ES, Norfolk Vanguard Limited has committed to implement mitigation that will ensure that impacts are below the level that would be considered unacceptable under the relevant technical guidance and standards.

5 CONTACT US

157. This document provides a summary of the issues which have been considered as part of the Environmental Impact Assessment for Norfolk Vanguard. For more detailed information, the Norfolk Vanguard ES is available online at the following links:

<https://www.vattenfall.co.uk/norfolkvanguard>

<https://infrastructure.planninginspectorate.gov.uk>

158. If you have any further questions on the Environmental Impact Assessment process and areas we are considering please feel free to get in touch:

Visit our project website:	www.vattenfall.co.uk/norfolkvanguard and register your interest in the project to receive updates.
Email us at:	Info@norfolkvanguard.co.uk
Write to us at:	Norfolk Vanguard, The Union Building, 51-59 Rose Lane, Norwich, Norfolk NR1 1BY
Phone us:	01603 567995

Contact Us:

You can contact us in the following ways:

Visit our project website: **www.vattenfall.co.uk/norfolkvanguard**

Call (general enquiries): **01603 567995**

Email (for all general enquiries): **info@norfolkvanguard.co.uk**

If you have a specific query, please contact the relevant person, listed below:

Call (Local Liaison Officer/Community queries) Sue Falch-Lovesey: **07817 544235**

Email: **susan.falch-lovesey@vattenfall.com**

Call (Land matters) Bob McCarthy: **(07787 783517 / 01223 859221)**

Email: **vattenfallinnorfolk@consentssolutions.com**

Call (Fisheries Liaison): Jonathan Keer, Brown and May Marine Ltd: **(01379 870181)**

Email: **jonathan@brownmay.com**

Post: **Norfolk Vanguard, The Union Building, 51-59 Rose Lane, Norwich, Norfolk NR1 1BY**