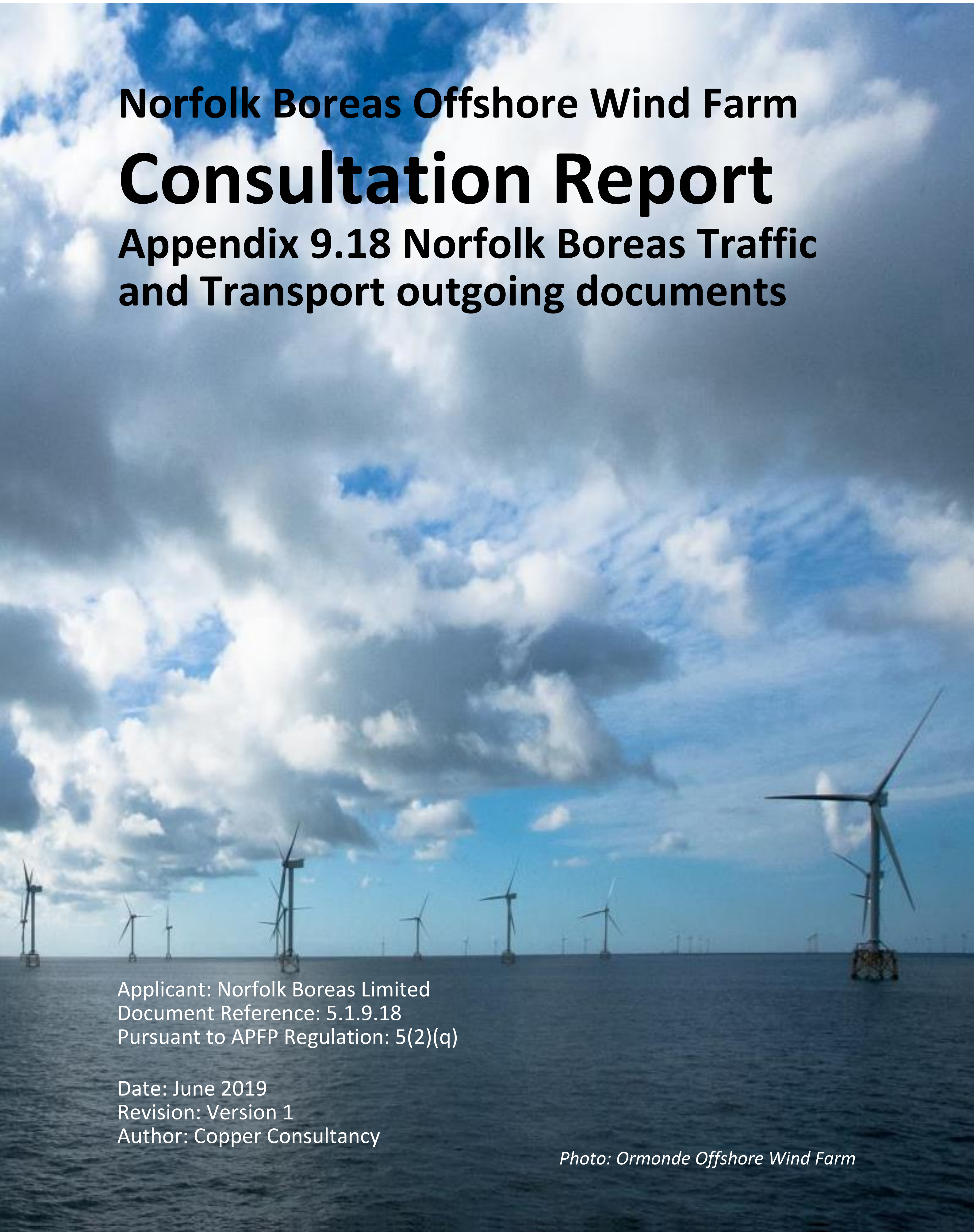

Norfolk Boreas Offshore Wind Farm

Consultation Report

Appendix 9.18 Norfolk Boreas Traffic and Transport outgoing documents

Applicant: Norfolk Boreas Limited
Document Reference: 5.1.9.18
Pursuant to APFP Regulation: 5(2)(q)

Date: June 2019
Revision: Version 1
Author: Copper Consultancy

Photo: Ormonde Offshore Wind Farm

This page is intentionally blank.

Norfolk Boreas Offshore Wind Farm

Environmental Impact Assessment

Traffic and Transport Method Statement

Document Reference: PB5640.004.003

Author: Royal HaskoningDHV
Applicant: Norfolk Boreas Ltd
Date: May 2018

Date	Issue No.	Remarks / Reason for Issue	Author	Checked	Approved
1/12/17	01D	1st Draft for Internal Review	RE/ JI	AR/DT	AD
20/12/17	02D	Revised following internal review	RE/ JI	DT	AD
04/01/2018	03D	Draft submitted for Vattenfall review	RE/JI	DT	JL
25/01/2018	01F	Issue to consultees	RE/JI	CD	JL
02/05/2018	01D	Updated reflecting HVDC design decision	AR/RE/JI	CD	AD
02/05/2018	02D	Updated draft submitted for Vattenfall review	RE/JI	JL	DT

This method statement has been prepared by Royal HaskoningDHV on behalf of Norfolk Boreas Limited in order to build upon the information provided within the Norfolk Boreas Environmental Impact Assessment (EIA) Scoping Report. It has been produced following a full review of the Scoping Opinion provided by the Planning Inspectorate. All content and material within this document is draft for stakeholder consultation purposes, within the Evidence Plan Process.

Many participants of the Norfolk **Boreas** Evidence Plan Process will also have participated in the Norfolk **Vanguard** Evidence Plan Process. This document is presented as a complete and standalone document however in order to maximise resource and save duplication of effort, the main areas of deviation from what has already been presented through the Norfolk Vanguard Evidence Plan Process and PEIR or in the Norfolk Boreas Scoping Report are presented in orange text throughout this document.

Table of Contents

Figures

Tables

Glossary of Acronyms

AADF	Annual Average Daily Flows
AADT	Annual Average Daily Traffic
AILs	Abnormal Indivisible Loads
AMP	Access Management Plan
ATC	Automated Traffic Counts
CIA	Cumulative Impact Assessment
TMP	Traffic Management Plan
DCO	Development Consent Order
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EIA	Environment Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
GEART	Guidelines for the Environmental Assessment of Road Traffic
HGV	Heavy Goods Vehicle
MA	Mobilisation Area
NCC	Norfolk County Council
NNDR	Norwich Northern Distributor Road
PDS	Project Design Statement
PEIR	Preliminary Environmental Information Report
PIC	Personal Injury Collision
WCS	Worst Case Scenario
TC	Trenchless Crossing
TEMPro	Trip End Model Presentation Programme
TMP	Traffic Management Plan

Glossary of Terminology

Delivery	A delivery consists of a single trip (i.e. either an arrival to, or departure from site)
Interface cables	Buried high-voltage cables linking the onshore project substation to the Necton National Grid substation.
Jointing pit	Underground structures constructed at regular intervals along the cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	Where the offshore cables come ashore.
Link boxes	Underground chambers or above ground cabinets next to the cable trench housing low voltage electrical earthing links.
Mobilisation area	Required to store equipment and provide welfare facilities. Located adjacent to the onshore cable route, accessible from local highways network suitable for the delivery of cable drums and other heavy and oversized equipment.
National Grid substation	Area shown in Method Statements Appendix 1 within which the National Grid

extension	substation extension will be located.
Necton National Grid substation	The grid connection location for Norfolk Boreas
Onshore cable route	The 45m wide working width which would contain the buried export cables as well as the temporary running track, topsoil storage and excavated material during construction.
Onshore infrastructure	The combined name for all onshore infrastructure associated with the project from landfall to grid connection.
Onshore project area	All onshore electrical infrastructure.
Onshore project substation	A compound containing electrical equipment to enable connection to the National Grid. An HVDC system, the substation will convert the exported power from HVDC to HVAC, with a step up to 400kV (grid voltage). There is a proposed location for the onshore project substation (Appendix 1 of the Method Statement) however the search zone has been retained as the location may move slightly within the search area.
Overhead line modification zone	Area within which the work would be undertaken to complete the necessary modification to the existing 400kV overhead lines.
The Applicant	Norfolk Boreas Ltd.
The project	Norfolk Boreas site including the onshore and offshore infrastructure
Transition pit	Underground structures that house the joints between the offshore export cables and the onshore cables.
Trenchless crossing zone	Areas within the onshore cable route which will house trenchless crossing entry or exit points.
Vehicle Movement	A vehicle movement consists of two vehicle movements (arrival + departure)

1 INTRODUCTION

1. The purpose of this method statement is to build upon the information provided within the Norfolk Boreas Environmental Impact Assessment (EIA) Scoping Report, in outlining the proposed approach to be taken and considerations to be made in the assessment of the Traffic and Transport effects of the proposed development.

2. This method statement and the consultation around it form part of the Norfolk Boreas Evidence Plan Process (EPP). The aim is to gain agreement on this method statement from all members of the Traffic and Transport Expert Topic Group (ETG), all agreements will be recorded in the agreement log.

3. This method statement has been produced following a full review of the Scoping Opinion provided by the Planning Inspectorate and the consultation which has been undertaken through the Norfolk Vanguard EPP including the consultee responses to the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b) received during December 2017.

4. As a result of the ongoing and active consultation and community engagement for both Norfolk Boreas and its sister project Norfolk Vanguard, a decision was announced in 22 February 2018 that both projects would utilise High Voltage Direct Current (HVDC) technology for the electrical connection from the windfarms to the National Grid.

5. HVDC technology removes the need for a cable relay station, reduces the onshore cable corridor width from 100 to 45m and reduces the number of offshore export cable trenches from six to two.

6. This is a significant decision that changes the worst-case impacts of the traffic and transport impacts arising from the Norfolk Boreas project. In light of this change it was decided to update and re consult on the Traffic and Transport method statement.

7. All the data presented in the previous Boreas Traffic and Transport Method Statement (PB5460.004.003 01F, January 2018) has been superseded. Information provided in this Method Statement is a draft for stakeholder consultation only and is provided in confidence.

1.1 Background

8. A Scoping Report for the Norfolk Boreas EIA was submitted to the Planning Inspectorate on the 9th May 2017. Further background information on the project can be found in the Scoping Report which is available at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-000015-Scoping%20Report.pdf

9. The Planning Inspectorate's Scoping Opinion was received on the 16th June 2017 and can be found at:

https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-000013-Scoping%20Opinion.pdf

1.2 Norfolk Boreas Programme

10. This section provides an overview of the planned key milestone dates for Norfolk Boreas.

1.2.1 Development Consent Order (DCO) Programme

- EIA Scoping Request submission - 09/05/17 (complete)
- Preliminary Environmental Information (PEI) submission - Q4 2018
- Environmental Statement (ES) and DCO submission - Q2 2019

1.2.2 Evidence Plan Process Programme

11. The Evidence Plan Terms of Reference (Royal HaskoningDHV, 2017a) provides an overview of the Evidence Plan Process and expected outcomes, below is a summary of anticipated meetings:

- Agreement of Terms of Reference -Q3 2017
- Post-scoping Expert Topic Group consultation -Q1 2018
  - Discuss method statements and Project Design Statement
- Expert Topic Group and Steering Group meetings as required - 2018
  - To be determined by the relevant groups based on issues raised
- PEI Report (PEIR) Expert Topic Group and Steering Group meetings - Q4 2018/ - Q1 2019
  - To discuss the findings of the PEI (before or after submission)
- Pre-submission Expert Topic Group and Steering Group meetings - Q1/Q2 2019

- To discuss updates to the PEIR prior to submission of the ES

1.2.3 Consultation to Date

12. Norfolk Boreas is the sister project to Norfolk Vanguard (See section 2.1 for further details). A programme of consultation has already been undertaken for Norfolk Vanguard which is of relevance to Norfolk Boreas and this is listed below:

• EIA Scoping Request submission	03/10/16
• Receipt of Scoping Opinion	11/11/16
• Steering Group meeting	21/03/16
• Steering Group meeting	20/09/16
• Post-scoping Expert Topic Group meetings ○ Discuss method statements and Project Design Statement	- 25/01/17
• Post-scoping Expert Topic Group meetings ○ Discuss method statements and Project Design Statement	- 27/02/17
• Post-scoping Expert Topic Group meetings	- 17/07/17
○ Review of T&T - Traffic Demand, Distribution and Assignment Technical Note	Q1 – 2018
• Norfolk Vanguard Preliminary Environmental Information Report - public consultation	-11/12/2017

13. Responses to the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b) were received in December 2017. This method statement has been updated to incorporate any key comments made that affect the proposed methodology for the Norfolk Boreas EIA.

2 ONSHORE PROJECT DESCRIPTION

2.1 Context and Scenarios

14. Norfolk Boreas is the sister project to Norfolk Vanguard. Vattenfall Wind Power Ltd (VWPL) is developing the two projects in tandem, and is planning to co-locate the export infrastructure for both projects in order to minimise overall impacts. This co-location strategy applies to the offshore and onshore parts of the export cable route, the cable landfalls and onshore substations.

15. The Norfolk Boreas project is approximately 12 months behind Norfolk Vanguard in the Development Consent Order (DCO) process. As such, the Norfolk Vanguard team is leading on site selection for both projects. Although Norfolk Boreas is the subject of a separate DCO application, the project will adopt these strategic site selection decisions.

16. In order to minimise impacts associated with onshore construction works for the two projects, VWPL is aiming to carry out enabling works for both projects under a single Norfolk Vanguard DCO application. This covers the installation of buried ducts along the onshore cable route, from the landfall to the onshore substation, overhead line modifications at the Necton National Grid substation, visual screening works and access road construction.

17. However, Norfolk Boreas needs to consider the possibility that the Norfolk Vanguard project may not be constructed. In order for Norfolk Boreas to be commercially feasible as an independent project, this scenario must be provided for within the Norfolk Boreas DCO. Thus, there are two alternative scenarios to be considered in the context of the EIA and this method statement:

- **Scenario 1:** Norfolk Vanguard consents and constructs significant elements of the transmission infrastructure which would be used by Norfolk Boreas. This includes, cable ducts, access road to the onshore project substation, overhead line modification at the Necton National Grid substation, strategic landscaping and planting schemes. Under Scenario 1 Norfolk Boreas will seek to consent the Horizontal Direction Drill (HDD) at landfall, the creation of the jointing and transition pits, the installation of cables in the pre-installed ducts, onshore project substation, 400kV interface cables (between the onshore project substation and the Necton National Grid substation), extension to the Necton National Grid substation and further landscape and planting schemes.

- **Scenario 2:** Norfolk Vanguard is not constructed and therefore Norfolk Boreas will seek to consent and construct all required project infrastructure including: HDD at landfall, installation of cable ducts, creation of the transition and jointing pits, cable installation, onshore project substation, 400kV interface works (between the onshore project substation and the Necton National Grid substation), extension to the Necton National Grid substation, overhead line modification and any landscape and planting schemes. For the sake of clarity, the Norfolk Boreas project would, under Scenario 2, involve the construction and installation of all onshore infrastructure necessary for a viable project.

18. **Appendix 1** contains a set of figures showing the onshore infrastructure and **Appendix 2** contains a detailed comparison of what is included in the two different scenarios across all elements of the project.

19. Norfolk Boreas are proposing to employ a construction strategy whereby there are multiple moving work fronts which complete the majority of all construction works in each area before moving on. This reduces overall construction time as most works are completed in one pass.

20. The construction strategy allows flexibility for areas to be avoided at sensitive times and to minimise impact through scheduling of works. However, multiple 'live' working fronts leads to a higher daily demand for traffic and the potential for significant impacts.

2.2 Site Selection Update

21. A detailed programme of site selection work has been undertaken by VWPL to refine the locations of the onshore infrastructure for both the Norfolk Vanguard and Norfolk Boreas projects. The Norfolk Vanguard EIA Scoping Report presented search areas for the onshore infrastructure which were identified following constraints mapping to avoid or minimise potential impacts (e.g. noise, visual, landscape, traffic, human health and socio-economic impacts).

22. Further data review has been undertaken to understand the engineering and environmental constraints within the search areas identified. This process has been informed by public drop in exhibitions (October 2016, March and April 2017), along with the Scoping Opinion for Norfolk Vanguard and the feedback from the Expert Topic Groups.

23. Details of the site selection process are provided in Chapter 4 of the Norfolk Vanguard Preliminary Environmental Information Report (Royal HaskoningDHV,

2017b). The resultant project infrastructure parameters and derived worse case traffic demand are set in section 2.3.

2.3 Indicative Worst Case Scenarios

24. The assessment for traffic and transport will identify the period when the maximum traffic will be generated for the construction and operation phases. For the construction phase, it is necessary to narrow down the project options and associated infrastructure parameters to a worst case scenario (i.e. maximum forecast traffic generation) to ensure that the assessment is proportional and easily understood.

25. The parameters discussed in this section are based on the best available information for Norfolk Boreas at the time of writing and are subject to change as the project progresses.

2.3.1 Infrastructure Parameters

26. **Table 2.1** summarises the onshore project parameters which will inform the worst case impact assessment for Traffic and Transport.

Table 2.1: Worst Case Onshore Project Parameters

Project Parameter	Scenario 1	Scenario 2	Notes
Landfall	✓	✓	Horizontal Direction Drilling (HDD) and associated compounds
Cable corridor – Duct Installation	✗	✓	With associated trenchless crossing technique areas, construction compounds and mobilisation areas
Cable corridor – Cable Installation	✓	✓	With associated cable pulling activities and jointing pit construction
Onshore project substation	✓	✓	HVDC format project substation
Interface cables	✓	✓	Connecting the onshore project substation and the Necton National Grid Substation
Necton National Grid Substation extension	✓	✓	Required to be extended to accommodate the Norfolk Boreas connection points
Necton National Grid Substation Overhead line modification	✗	✓	Required to accommodate Norfolk Boreas

27.

28.

29. **Table** 2.2 summarises the scenario characteristics that have informed the traffic and transport access strategies for each scenario.

Table 2.2: Traffic and transport scenario characteristics

Scenario	Characteristics / Access Strategy
Scenario 1	No continuous running track. Cable installation requires multiple side accesses to cable route and jointing pit locations. Side accesses connect via the wider major highway network , a total of 108 highway links. Lower overall traffic demand (to that of Scenario 2) due to the absence of trenching activities and associated construction of continuous running track. Norfolk Vanguard consented - Norfolk Boreas landfall, and onshore project substation will be constructed at the same time as the later stages of Norfolk Vanguard cable installation phases.
Scenario 2	Continuous running track for the length of the onshore cable route providing access to all work fronts. Delivery of plant and materials direct to each of the 14 mobilisation areas. The mobilisation areas are required to store equipment and provide welfare facilities. Mobilisation areas provide the only point of access to the running track. The mobilisation areas would be located close to main A-roads, thereby minimising the impacts upon local communities and utilising the most suitable roads resulting in 66 links. Higher overall traffic demand associated with more construction activities. Daily traffic demand over prolonged construction duration.

30. **Table 2.3** details the scenario character outputs that inform the impact assessment. Full detail of the derivation is contained in section 5 and accompanying appendices.

Table 2.3: Traffic and Transport scenario comparisons

Theme	Scenario 1		Scenario 2	
	Primary Works Stage	Cable Pull and Jointing Stage*	Primary works/Duct Installation Stage*	Cable Pull and Jointing Stage
Study Area	86 Links	108 Links	86 Links	108 links
Overall Construction Traffic Demand	15,927	40,314	139,406	42,055
Daily Construction Traffic Movements	93	533	837	533
Construction Duration	2 years (2024-2025)	2 years (2026-2027)	2 years (2023-2024)	2 years (2025-2026)

Theme	Scenario 1		Scenario 2	
	Primary Works Stage	Cable Pull and Jointing Stage*	Primary works/Duct Installation Stage*	Cable Pull and Jointing Stage
Norfolk Vanguard Interaction	Norfolk Vanguard cable pull phase (2024-2025)	Norfolk Vanguard operational activities	Norfolk Vanguard not consented	Norfolk Vanguard not consented
*	Worst case stage for each individual scenario assessment.			

31. Full details of the parameter components for Scenario 1 and Scenario 2 are provided in **Appendix 2**, further details are outlined as follows:

2.3.1.1 Landfall

32. The landfall compound zone (**Appendix 1**) denotes the location where up to two Norfolk Boreas offshore export cables would be brought ashore. These would be jointed to the onshore cables in transition pits located within landfall compound zone in **Appendix 1**. Under Scenario 1 Norfolk Boreas would share the landfall area with Norfolk Vanguard at Happisburgh South.

33. Works associated at landfall would be the same under both scenarios. Under Scenario 1, if Norfolk Boreas cable ducts are installed concurrently with the Norfolk Vanguard ducts, the Norfolk Boreas ducts would be installed only on the landward (western) side of the transition pits.

2.3.1.2 Onshore Cable Corridor

34. The onshore cable corridor would contain the final onshore cable route. Currently an indicative cable route has been identified and is displayed in **Appendix 1**.

2.3.1.2.1 Onshore Cable Route

35. The onshore cable route would contain the main HVDC export cables housed within High Density Polyethylene (HDPE) ducts. The main onshore cable route connects the landfall to the onshore project substation.

36. The key elements of the onshore cable route for Scenarios 1 and 2 are detailed in **Appendix 2**, and summarised below.

Scenario 1

37. Norfolk Vanguard would install cable ducts and undertake enabling works (e.g. trenching and duct installation) for Norfolk Boreas along the entire length of the

onshore cable corridor. Therefore, all excavations except jointing pits would have already been undertaken. In addition, all the ducts would be installed and ground reinstated by Norfolk Vanguard.

Scenario 2

38. Norfolk Boreas would be responsible for installing all onshore cable route infrastructure required for the project, including installing ducts along the entire cable route and reinstating land (cable pulling would then happen at a later date). The duct installation would also include:

- Trenches for the ducts;
- Mobilisation areas:
- A running track to deliver equipment to the installation site from mobilisation areas; and
- Storage areas for topsoil and subsoil.

2.3.1.2.2 Running Track

39. A running track provides safe access for construction vehicles within the onshore cable corridor. The running track could be up to 6m wide, with a separation of 2m would be maintained from the edge of the running track and the cable trench for safety and duct storage prior to pulling in the duct sections. Speed limits on the running track would typically be limited to 20mph.

Scenario 1

40. Under Scenario 1 in some locations, small sections of the running track would be required to be reinstated to allow access to more remote jointing bay locations (assuming that the entire running track required for the Norfolk Vanguard Project would have been removed). It is considered as a worst case scenario this would require approximately 20% of the running track to be reinstated to facilitate access to jointing pits.

Scenario 2

41. Under Scenario 2, a running track would be installed along the entire length of the cable route (approximately 60km) to allow safe access from mobilisation areas to the duct installation sites. For the cable pulling stage, approximately 20% of running track would be left in place from the duct installation works, or as a worst case, will be required to be reinstated to allow access to more remote jointing pits locations.

2.3.1.2.3 Cable Pulling Process

42. Under either Scenario the onshore cables would be pulled through the installed ducts later in the construction programme in a staged approach, as offshore generating capacity came online.

43. Cable pulling would not require the trenches to be reopened, with the cables pulled through the preinstalled ducts between the jointing pits located along the onshore cable route. Access to and from the jointing pits would be required to facilitate the works during this phase of the project.

2.3.1.2.4 Jointing Pits

44. Jointing pits would be required along the onshore cable route to allow cable pulling and jointing of two sections of cable. Under both Scenario 1 and 2, the jointing pits would be installed by Norfolk Boreas for pulling cables through.

45. The jointing pits would typically be located at 800m intervals, the maximum cable length which can be delivered, although site specific constraints may result in shorter intervals where necessary.

46. Access to and from jointing pits would be required for the cable pull through. These would be retained or reinstated from those used by Norfolk Vanguard in Scenario 1, but would require construction in Scenario 2. Under either scenario the land on which the access route has been established would be reinstated.

2.3.1.2.5 Crossing Installation Methods

Scenario 1

47. Under this scenario all necessary crossing installation would have been completed by Norfolk Vanguard. No additional works would be required by Norfolk Boreas.

Scenario 2

48. Under this scenario all crossings would be consented and installed by Norfolk Boreas. When crossing some features along the onshore cable route, alternative or amended installation approaches would be required to minimise the impact on the feature or obstacle being crossed as much as reasonably practicable.

49. Where the onshore cable route crosses roads, tracks and public rights of way, traffic management during the construction phase would be employed to allow these activities to continue safely. Where appropriate, single lane operation of roads would be implemented during installation with appropriate traffic management

measures. The detailed installation method for each crossing utilising traffic management would be agreed with the relevant highways authority or landowner prior to works beginning.

50. Trenchless crossing methods could be required at locations where standard traffic management techniques are not deemed to be suitable. Further work to identify these locations is ongoing and details will be provided within the PEIR and ES project description chapters.

51. Trenchless installation methods such as HDD, micro tunnelling or auger boring are likely to be used where open cut trenching is not suitable due to the crossing width or the feature being crossed. Trenchless methods will be employed at sensitive locations such as River Wensum and River Bure (Special Area of Conservation – SAC, Site of Special Scientific Interest – SSSI), major infrastructure such as railways and the A47 and A149. The locations of these are shown in **Appendix 1** (termed trenchless crossing zones).

2.3.1.2.6 Temporary Construction Compounds

Scenario 1

52. Under Scenario 1 no mobilisation areas would be required as materials will be delivered directly to jointing pits locations.

Scenario 2

53. Mobilisation areas would be required to store equipment and provide welfare facilities. Proposed locations for these are provided in **Appendix 1**. They would be located adjacent to the onshore cable route corridor, accessible from the local highways network suitable for the delivery of cable drums and other heavy and oversized equipment.

54. The mobilisation areas would remain in place for the duration of the onshore duct installation activities, anticipated to be up to two years. Following installation of the ducts, the mobilisation areas would be removed and the land reinstated.

2.3.1.2.7 Cable Route Side Access

55. Small temporary access routes would be required to facilitate the safe ingress and egress from the public highways to the construction locations (termed side accesses). These would be used to for the following:

- To gain access to joint locations during cable pulling and jointing phase;
- To gain to access link boxes, and

- To gain access to cables to make repairs during operational phase.

56. Detailed traffic and transport assessments are ongoing to identify where these side accesses are likely to be required the current proposed locations are displayed in **Appendix 1**.

Scenario 1

57. Under Scenario 1 some of the side accesses to the cable route would be retained or reinstated from the Norfolk Vanguard project. For the purposes of this Method Statement the worst case scenario would be the reinstatement of these accesses.

Scenario 2

58. Under Scenario 2 side accesses to the cable route would need to be constructed and retained for two years to provide for the cable pulling phases before being removed and the land reinstated.

2.3.1.3 Onshore Project Substation (Scenario 1 and Scenario 2)

59. The onshore project substation would consist of an HVDC substation[1], the proposed onshore project substation location is presented in **Appendix 1**.

60. The location of the onshore project substation was determined by an optioneering process which is explained in Chapter 4 (Site selection and Alternatives) of the Norfolk Vanguard PEIR (Royal HaskoningDHV, 2017b).

61. During construction of the onshore project substation, a temporary construction compound would be established to support the works. The compound would be formed of hard standing with appropriate access to the A47 to allow the delivery and storage of large and heavy materials and assets, such as power transformers.

62. The compound would be of dimensions 200m x 100m and would accommodate construction management offices, welfare facilities, car parking, workshops and storage areas. Water, sewerage and electricity services would be required at the site and supplied either via mains connection or mobile supplies such as bowsers, septic tanks and generators.

63. Construction activities would be conducted during working hours of 7am-7pm. Evening or weekend working might be required to maintain programme progress and for specific time critical activities such as transformer oil filling and processing; however, these would be kept to a minimum.

[1] Also referred to as a HVDC converter station.

64. The construction programme for the onshore substation is anticipated to be 24 to 30 months.

Scenario 1

65. Under Scenario 1, a number of enabling works would be undertaken by Norfolk Vanguard. These include:

- Permanent A47 access improvement;
- Access road to the onshore project substation; and
- Strategic landscaping to reduce visual impacts.

66. Under this scenario the access road would be shared with the onshore project substation for Norfolk Vanguard.

Scenario 2

67. Under this scenario all enabling works, including access would need to be constructed by Norfolk Boreas.

2.3.1.4 Necton National Grid Substation Extension

68. The existing Necton National Grid substation is required to be extended to accommodate the Norfolk Boreas and Norfolk Vanguard connection points. The proposed footprint of this extension is provided in **Appendix 1**.

69. The extension to the Necton National Grid substation would be undertaken by Norfolk Boreas under both scenarios.

70. Under Scenario 2 in addition to the substation extension works modifications to the overhead line would also be required as part of Norfolk Boreas. Under Scenario 1 these works would have been undertaken by Norfolk Vanguard.

2.3.2 Construction Programme

71. Details of the Construction programme and the influence on the traffic and transport worst case scenario are discussed within section 6.2.1 for Scenario 1 and section 6.3.1 for Scenario 2.

2.3.3 Operation and Maintenance (O&M) Strategy

72. The operations and maintenance strategies for each parameter of the proposed project would result in limited, periodic traffic demand (see section 5.3). The traffic

demand will be derived to enable the necessary screening for traffic, noise and air quality effects.

73. It is anticipated the level of daily traffic demand will be indiscernible from day to day traffic fluctuations on the local highway network and therefore unlikely to have a significant impact on traffic receptors.

2.3.4 Decommissioning

74. No decision has been made regarding the final decommissioning policy for the substation, as it is recognised that industry best practice, rules and legislation change over time. However, the substation equipment will likely be removed and reused or recycled. It is expected that the onshore cables will be removed from ducts and recycled, with the jointing pits and ducts left in situ. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator.

2.3.5 Project Worst Case Traffic Impact Scenarios

75. In consideration of the project parameters, the following scenarios have been adopted to inform the Traffic and Transport worst case impact assessment.

Table 2.4: Worst case traffic impact scenarios

Phase	Scenario	PEIR Assessment
Construction	Scenario 1, Cable Pull and Jointing Stage	✓
	Scenario 2, Primary works/Duct Installation Stage	✓
Operation	Indiscernible impact forecast	✗
Decommission	Determined by relevant legislation and guidance at time of decommissioning.	✗

2.3.6 Cumulative Impact Scenarios

2.3.6.1 Norfolk Vanguard

76. VWPL are seeking to minimise cumulative impacts between Norfolk Boreas and Norfolk Vanguard through the alignment of onshore cable route and the preference for Norfolk Vanguard to pre-install ducts and undertake other enabling works for Norfolk Boreas. Cumulative impacts between the two sister projects will be assessed within the Norfolk Boreas EIA as part of the Cumulative Impact Assessment (CIA).

2.3.6.2 Other Projects

77. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Boreas in the context of other developments that are existing, consented or at application stage.

78. A number of major projects may be required to be assessed cumulatively in context with the worst case scenario for both Scenario 1 and Scenario 2 due to their associated traffic generation, location of project and development time period.

79. CIA screening will be undertaken in consultation with stakeholders.

80. Table 2.5 details the significant cumulative projects selected for further inclusion into the EIA assessment and identifies which potential Norfolk Boreas Assessment Scenario would be potentially impacted.

81. VWPL are committed to working with Ørsted on identifying the potential interactions between the Norfolk Boreas and Norfolk Vanguard onshore cable corridor with the Hornsea Project 3 Offshore Wind Farm onshore cable route, and assessing and mitigating and cumulative effects.

82. CIA screening will be undertaken in consultation with stakeholders.

Table 2.5: Cumulative projects for worst case scenario assessment

Project name	Developer	Site location	Development time period	Norfolk Boreas Scenario Potential Impact		Notes
				Scenario 1	Scenario 2	
Hornsea Project Three Offshore Wind Farm	Ørsted (formally DONG energy)	Trimmingham, North of Cromer Landfall site	2021 - 2026	✓	✓	Overlapping proposed project boundaries may result in impacts of a direct and / or indirect nature during construction.
A47 Improvement Corridor Programme	Highways England	A47 North Tuddenham to Easton, A47 Blofield to North Burlingham.	Starts 2019/2020 with projected finish year of 2022.	✗	✗	The A47 Improvement corridor is expected to be complete by 2022. The Norfolk Boreas assessment years with the highest traffic demand occurs in 2024 (Scenario 2) and 2026 (Scenario 1). There will be limited traffic demand associated with preconstruction during 2022 for both project scenarios.
		A47/A11 Junction; Thickthorn Junction Development.		✗	✗	
		A47/A12 Junction enhancements to the following junctions and roundabouts: Vauxhall, Gapton, Harfreys, Bridge Road and James Paget Hospital.		✗	✗	
Norfolk Vanguard Offshore Windfarm	Vattenfall Wind Power Ltd	Similar locations to Norfolk Vanguard onshore electrical infrastructure.	2020 - 2025	✓	✗	Traffic associated with the Primary Works phase of scenario 1 will overlap the cable installation stages of Norfolk Vanguard.

3 BASELINE ENVIRONMENT

3.1 Desk Based Review

83. A review of the baseline conditions will be undertaken; including the consideration of the following desk based information sources:

- Department for Transport – http://www.dft.gov.uk/traffic-counts; (Department for Transport, 2017)
- Norfolk County Council – http://www.norfolk.gov.uk, (Norfolk County Council, 2017)
- Sustrans – http://www.sustrans.org.uk, (Sustrans, 2017)
- Crashmap - http://www.crashmap.co.uk/search, (Crashmap, 2017)

3.1.1 Study Areas

84. The traffic and transport project study area has been established through stakeholder engagement by determining the most probable routes for traffic for both the Norfolk Vanguard and Norfolk Boreas projects, for the movement of materials and employees.

85. Specifically, the project study area has been established by assigning trip origins on the 'A' class road network and 'trip ends' at the onshore project area. The trip ends vary for Scenario 1 and 2 as follows:

- Scenario 1 trip ends: landfall, onshore project substation (including National Grid Extension works) and jointing pit access points.
- Scenario 2 trips ends: landfall, onshore cable route running track, mobilisation areas, trenchless crossing sites and the onshore project substation (including National Grids Extension works).

86. Whilst the project study area is identical for both scenarios, the differing trips ends (a consequence of the differing project parameters (see section 2.3) necessitates two discrete access strategies as outlined below. Note that under both scenarios, routes that extend outside of the project study area have been deemed to be not subject to significant adverse impacts.

3.1.1.1 Scenario 1

87. The access strategy for Scenario 1 is illustrated in **Figures 1** and **1.1** and is divided into a total of 108 discrete highway sections known as links. Links are defined as sections of road with similar characteristics and traffic flows. For the purpose of the

assessment the 108 links are split into two distinct categories base on their function within the project:

- Links 1a-79 serve to assign the project's traffic demand during the primary works/duct installation stage.

- Links A to V serve to assign the project's traffic demand during the cable pull and jointing stage and are connected via links 1a – 79.

3.1.1.2 Scenario 2

88. The access strategy for Scenario 2 is illustrated in **Figure 2** and consists of only of highway links 1a-79.

3.1.2 Available Data

3.1.2.1 Traffic Flow Data

89. Existing traffic flow data has been captured for links 1a-65. The datasets that are to be used in the assessment are summarised in **Table 3.1** and presented graphically in **Figure 3**.

Table 3.1: Data Sources

Data	Year	Link coverage	Confidence	Notes
Classified Annual Average Daily Traffic (AADT) counts	2015	1a, 1b, 2-4, 6-9, 11, 12, 13a, 13b, 14, 18, 19, 24, 26, 27, 29, 30, 40a, 40b, 44a, 44b, 45, 50, 53, 56, 57, 64 and 65.	High	Data sourced from the DfT which provides classified AADT traffic count data.
Classified Automatic Traffic Counts (ATC)	2017	15-17, 20-23, 25, 32-37, 41-43, 46-49, 52 and 61.	High	Traffic counts commissioned by Norfolk Vanguard Ltd which provide classified hourly and daily traffic count data.
AADT Traffic Flows	2012, 2017 and 2032	5, 28, 31, 38, 39, 51, 58-60, 62 and 63.	High	Data sourced and interpolated from the Norfolk County Council (Norwich Northern Distributor Road (A1067 to A47(T))) DCO Application*
Classified Automatic Traffic Counts (ATC)	2016	10, 54 and 55	High	Traffic counts sourced from Norfolk County Council.

Data	Year	Link coverage	Confidence	Notes
Estimated Traffic Flow	2017	66-79	Medium	For links with limited project traffic demand flows have been estimated based on data sources for similar links within the study area.

* Document 5.6 NNDR Traffic Forecasting Report: Volume 3 – Appendices H to K

90. The baseline traffic flow data are summarised in **Table 3.2** which includes the date and type of survey from which the data has been derived and detailed within **Table 3.1.**

Table 3.2: Existing daily traffic flows and associated data sources

Link ID	Link description	Total vehicles (24Hr AADT*)	Total HGVs (24Hr AADT*)	Data source, type and date
1a	A47	15,380	1,546	2015 DfT AADF
1b	A47	15,380	1,546	2015 DfT AADF
2	A47	20,675	2,038	2015 DfT AADF
3	A47	36,940	2,751	2015 DfT AADF
4	A47	42,551	2,916	2015 DfT AADF
5	A47	40,800	2,050	NNDR Data
6	A47	18,349	1,108	2015 DfT AADF
7	A47	13,339	1,222	2015 DfT AADF
8	A146	11,947	645	2015 DfT AADF
9	A47	33,788	1,029	2015 DfT AADF
10	A47	26,533	599	November 2017 ATC
11	A1065	6,754	536	2015 DfT AADF
12	A1065	4,866	463	2015 DfT AADF
13a	A148	12,886	733	2015 DfT AADF
13b	A148	9,297	549	2015 DfT AADF
14	A148	10,873	502	2015 DfT AADF
15	B1145 - Litcham	1,725	35	April 2017 ATC
16	B1110/B1146 - Holt Road	7,344	83	April 2017 ATC
17	B1145 - Billingford Road	2,803	46	April 2017 ATC
18	A1067	7,698	551	2015 DfT AADF
19	A148	11,404	978	2015 DfT AADF

Link ID	Link description	Total vehicles (24Hr AADT*)	Total HGVs (24Hr AADT*)	Data source, type and date
20	Mill Common Road	271	6	April 2017 ATC
21	B1147 - Etling Green	1,391	15	April 2017 ATC
22	B1147 - Dereham Road	2,137	20	April 2017 ATC
23	Northgate - from junction with B1146	1,725	35	August 2017 ATC
24	A1067	9,140	461	2015 DfT AADF
25	Elsing Lane	495	5	April 2017 ATC
26	A1074	21,564	1,026	2015 DfT AADF
27	A140	29,064	1,949	2015 DfT AADF
28	A140	23,060	1,370	NNDR Data
29	A1067	11,562	782	2015 DfT AADF
30	A1067	10,130	640	2015 DfT AADF
31	A1067	19,080	609	NNDR Data
32	B1149 – Norwich road	4,043	75	April 2017 ATC
33	B1149 - Holt Road	5,274	162	April 2017 ATC
34	B1145 - west of Cawston	2,648	26	April 2017 ATC
35a	B1159 - Coast Road	3,236	29	April 2017 ATC
35b	B1159 - Coast Road	3,236	29	April 2017 ATC
36	B1149 - Holt Road	7,553	145	April 2017 ATC
37	B1145 - Cawston road	3,816	49	April 2017 ATC
38	A140 - Cromer Road	21,280	832	NNDR Data
39	A140 - Hevingham	12,420	413	NNDR Data
40a	A140 - Roughton	8,754	183	2015 DfT AADF
40b	A140 - Roughton	11,725	526	2015 DfT AADF
41	B1436 - Felbrigg	6,372	144	April 2017 ATC
42	B1145 - Reepham Road	2,265	18	April 2017 ATC
43	Cromer Road - Ingworth	983	3	April 2017 ATC
44a	A149	8,190	424	2015 DfT AADF
44b	A149	8,190	424	2015 DfT AADF
45	A149	6,276	326	2015 DfT AADF
46	B1145 - Lyngate Road	5,530	90	April 2017 ATC

Link ID	Link description	Total vehicles (24Hr AADT*)	Total HGVs (24Hr AADT*)	Data source, type and date
47a	Bacton Road – North Walsham	1,949	16	April 2017 ATC
47b	North Walsham Road - Edingthorpe Green	1,949	16	April 2017 ATC
47c	North Walsham Road – Broomholm	1,949	16	April 2017 ATC
48	B1159 - Bacton Road	2,394	45	April 2017 ATC
49	B1159	3,469	64	April 2017 ATC
50	A1151	9,148	339	2015 DfT AADF
51	A1151	12,100	515	NNDR Data
52	A149 - Wayford Road	12,850	175	April 2017 ATC
53	A149	34,323	1,326	2015 DfT AADF
54	A149	25,239	551	November 2017 ATC
55	A149	11,904	162	November 2017 ATC
56	A149	8,125	329	2015 DfT AADF
57	A149	8,256	456	2015 DfT AADF
58	NNDR - Link a	n/a	n/a	NNDR Data
59	NNDR - Link b	n/a	n/a	NNDR Data
60	NNDR - Link c	n/a	n/a	NNDR Data
61	B1436 - Roughton Road	4,451	103	April 2017 ATC
62	A1042	27,073	1,099	NNDR Data
63	A1151	15,140	633	NNDR Data
64	A12	9,413	548	2015 DfT AADF
65	A47	14,909	504	AADF
66	Wendling – Dereham Road	1,300	50	Estimated
67	North Walsham Road / Happisburgh Road	1,000	40	Estimated
68	The Street / Heydon Road	1,000	40	Estimated
69	Little London Road	500	20	Estimated
70	Plantation Road	1,000	40	Estimated
71	Vicarage Road / Whimpwell Street	2,000	70	Estimated

Link ID	Link description	Total vehicles (24Hr AADT*)	Total HGVs (24Hr AADT*)	Data source, type and date
72	Dereham Road / Longham Road - Dillington	1,000	40	Estimated
73	Hoe Road South	800	30	Estimated
74	Mill Street, Elsing Road – Swanton Morley	800	30	Estimated
75	B1354 - Blickling	2,000	70	Estimated
76	High Noon Road / Church Road	500	20	Estimated
77	Hall Lane – North Walsham	500	20	Estimated
78	Bylaugh	500	20	Estimated
79	B1145 / Suffield Road	2,000	70	Estimated
A-V	No data have been captured for these minor links recognising the very low baseline flows.			

91. A proportional approach has been adopted for baseline data for links 66 – 79 and links A - V. It is forecast that the links will have low project traffic demand, therefore, it is reasoned that the impacts relating to the volume of traffic (i.e. Severance, Pedestrian Amenity, Noise and Air Quality) would not be significant, and therefore baseline traffic flow data would be superfluous.

3.1.2.2 Personal Injury Collisions

92. A review of the collisions rates provided by Department for Transport (2015) shows that the rate of people killed or seriously injured per billion vehicle miles in Norfolk is 73. This rate is higher than the average for the East of England (67) but lower than for England (80)

93. The NCC Local Transport Plan also raises concerns with regard to road safety, noting that:

"Despite some real achievements, road safety continues to be a major public concern and is reflected in our conversations with residents."

94. Norfolk County Council considers a collision cluster as five personal injury collisions (PIC) occurring within a three year period in a 50m radius for built up areas and 100m in non-built up areas.

Highway links 1a - 79

95. To identify collision clusters high level open source PIC data for the most recent five year period (01/01/2012 to 31/12/2016)[2] was obtained for the traffic and transport project study area on the major highway links from the website Crashmap[3]

96. Full PIC data has been obtained from Norfolk County Council and Suffolk County Council for collision clusters identified by the high level Crashmap search.

97. **Table 3.3** provides a summary of all identified collision clusters within the major highway network; these are also shown graphically in **Figure 4**.

Table 3.3: Crashmap collisions cluster information

Link	Collision ref no.	Description	No. of collisions			
			Total	Fatal	Serious	Slight
2	1	A47 at the junction of Woodlane and Berrys Lane	**5**	0	0	5
3	14	A146 (Loddon Road) junction with slip road off of A47	**6**	0	0	6
5	12	A47 Junction with the B1140 (Acle Road)	**5**	0	2	3
8	13	A146 (Loddon Road) junction with slip road onto A47	**5**	0	0	5
8	15	A146 (Beccles Road) at the junction of B1136 (Yarmouth Road)	**6**	0	0	6
8	16	A146 (Beccles Road)	**5**	0	1	4
12	17	A1065 junction with Gogg's Mill Road	**5**	0	1	4
26	2	Dereham Road (A1074) within the vicinity of the Norwich Road junction	**10**	0	0	10
26	4	Dereham Road (A1074) at the junction of Larkman Lane and Marl Pit Lane	**7**	0	0	7
26/27	3	A140, A1074 and Dereham Road (A1074) roundabout	**12**	0	0	12
27	5	A140 at the junction of Hellesdon Hall Road	**5**	0	1	4
28	6	A140 (Sweet Briar Road) at the junction of Drayton high Road, Drayton Road and Boundary Road	**9**	0	1	8
28/38/62	7	A1402 (Boundary Road and Mile Cross Lane) at the junction of A140, Cromer Road and Aylsham Road	**7**	0	2	5
38/38/39	18	A140 (Holt Road) roundabout with B1149	**5**	0	1	4

[2] Full year details of 2017 collision data to be updated once available on the Crashmap site. Due to be updated mid 2018.

[3] www.crashmap.co.uk – provides high level open source data including the location, date and severity of collisions.

Link	Collision ref no.	Description	No. of collisions			
			Total	**Fatal**	**Serious**	**Slight**
55	11	A149 (Norwich Road) roundabout with the Caister-on-Sea bypass	**6**	0	0	6
55/56	10	A149 (Norwich Road roundabout with the A1064 (Main Road) and Castle Lane	**5**	0	0	5
62	8	A1042 (Mile Cross Lane) at the junction of Vulcan Road and Weston Road	**8**	0	2	6
62/63	9	A1052 (Chartwell Road) Roundabout with the A1151 (Wroxham Road and Sprowston Road) and Mousehold Lane	**10**	0	1	9
65	19	A47 roundabout, Horn Hill with Belvere Road	**5**	0	0	5

98. **Table 3.3** details that 90% of all collisions within the identified collision clusters resulted in slight injuries with no fatalities recorded.

Highway links A - Z

99. To identify collision clusters high level open source PIC data for the most recent five year period (01/01/2013 to 31/12/2017) was obtained for the traffic and transport project study area on the minor highway links from the website Crashmap (Crashmap, 2017).

100. No identified collision clusters were found on the minor highway links.

3.2 Planned Data Collection

3.2.1 Existing Traffic Data

101. The traffic data sourced for the assessment represents the most up to information available. Noting the DCO consent programme set out in section 1.2.1, it is considered that these data will remain valid for the whole of the determination period.

102. Further traffic data may be required should the access strategy be subject to material change following stakeholder engagement. In the event of new traffic data requirements suitable traffic flow data will be obtained from the following sources and in order of preference;

a. Norfolk County Council (NCC)

b. New traffic counts commissioned by Vattenfall Wind Power Ltd (VWPL)

103. Any new traffic counts commissioned will be undertaken during periods of normal traffic flow conditions on the transport network (e.g. non-school holiday periods, typical weather conditions) unless otherwise agreed with NCC/HE.

4 IMPACT ASSESSMENT METHODOLOGY

4.1 Defining Impact Significance

104. The principal guidelines for the assessment of the environmental impacts of road traffic associated with new developments are the 'Guidelines for the Environmental Assessment of Road traffic' (GEART) published by the Institute of Environmental Assessment in January 1993. The guidance provides a framework for the assessment of traffic-borne environmental impacts such as pedestrian severance and amenity, driver delay, accidents and safety; and noise, vibration and air quality.

105. GEART suggests the following rules to define the extent and scale of the assessment required:

a) Rule 1: Include highway links where traffic flows are predicted to increase by more than 30% (or where the number of HGVs is predicted to increase by more than 30%); and

b) Rule 2: Include any other specifically sensitive areas where traffic flows (or HGV component) are predicted to increase by 10% or more.

106. The above criteria applied to the project traffic assignment in the project study area will dictate the scale of the detailed impact assessment.

107. Traffic demand will be derived by way of a 'first principles' approach whereby traffic generation is calculated from the understanding of likely material demand and resourcing requirements. These numbers will be informed by industry experts, drawing on their experience of delivering and operating offshore wind farm projects.

108. The project's traffic demand will be assigned to the highway links within the project study area and the increase in traffic flow to baseline conditions determined. This will facilitate an assessment of the magnitude of effect as set out in **Table 4.1.**

4.2 Magnitude

109. **Table 4.1** details the assessment framework for magnitude thresholds adapted from GEART. These thresholds are guidance only and provide a starting point by which transport data will inform a local analysis of the impact magnitude.

Table 4.1: Example Definitions of the Magnitude Levels for a Generic Receptor

Magnitude	Definition			
Effects	Very Low	Low	Medium	High
Severance	Changes in total traffic flows of less than 30%	Changes in total traffic flows of 30 to 60%	Changes in total traffic flows of 60 to 90%	Changes in total traffic flows of over 90%
Pedestrian amenity	Change in traffic flows (or HGV component) less than 100%	Greater than 100% increase in traffic (or HGV component) and a review based upon the quantum of vehicles, vehicle speed and pedestrian footfall.		
Highway Safety	Informed by a review of collision patterns and trends based upon the existing personal injury collision records and the forecast increase in traffic			
Driver Delay	Informed by projected traffic increases through sensitive junctions within the project study area.			

4.2.1 Highway Traffic Sensitive Receptors

110. The sensitivity of a road (link) can be defined by the type of user groups who may use it. A sensitive area may for example be a village environment or where pedestrian or cyclist activity may be high, for example in the vicinity of a school. **Table 4.2** provides broad definitions of the different sensitivity levels which have been applied to the assessment.

Table 4.2: Example Definitions of the Different Sensitivity Levels for a Highway Link

Sensitivity	Definition
Low	Few sensitive receptors and / or highway environment can accommodate changes in volumes of traffic.
Medium	A low concentration of sensitive receptors (potentially. residential dwellings, some amenities, pedestrian desire lines, etc.) and limited separation from traffic provided by the highway environment. Junctions approaching or at capacity.
High*	High concentrations of sensitive receptors (potentially hospitals, schools, areas with high tourist footfall etc.) and limited separation provided by the highway environment. Defined Collision Clusters. Congested junctions with negative spare capacity.
Negligible	Routes of no importance to the assessment not included in the project study area.

*High sensitivity links are considered to be ‘specifically sensitive areas’ for the purposes of GEART Rule 2

111. A desktop exercise augmented by site visits would be undertaken to identify the sensitive receptors in the study area utilising the definitions outlined in **Table 4.2**.

4.2.2 Significance

112. **Table 4.3** sets out the adopted assessment matrix.

Table 4.3: Impact Significance Matrix*

		Negative magnitude				Beneficial magnitude			
		High	Medium	Low	Very low	Very low	Low	Medium	High
Sensitivity	High	*Major*	*Major*	*Moderate*	*Minor*	*Minor*	*Moderate*	*Major*	*Major*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Major*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*	*Negligible*	*Minor*	*Minor*	*Moderate*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Minor*

*Beneficial magnitude matrix has been included for completeness, although it is not anticipated for traffic and transport impacts.

113. Note that for the purposes of the EIA, **major** and **moderate** impacts are deemed to be significant. In addition, whilst **minor** impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

4.2.3 Future Year Assessment

114. To take account of sub-regional growth in housing and employment, light vehicle flows will be factored to the future year baseline traffic demand using the Department for Transport Trip End Model Presentation Programme (TEMPro) Version 7.2 with data set 7.0 for Norfolk geographical areas and HGV's would be factored up with National Trip End Model (NTEM) factors.

115. In additional to TEMPro growth, it will be necessary to quantify and assign traffic demand from identified significant committed developments within the project study area (refer to section 2.3.6)

4.2.4 Other Assessments

116. Traffic-borne noise and vibration effects and air quality effects will be informed by the traffic data outlined within the Traffic and Transport Assessment and impacts assessed within the respective chapters (Air Quality Method Statement (document

reference PB5640.004.007) and Noise and Vibration Method Statement (document reference PB5640.004.002) (Royal HaskoningDHV *unpublished* a and b) provide further details).

4.2.4.1 Air Quality

117. Air quality will be assessed in accordance with the Institute of Air Quality Management guidance 'Land-Use Planning & Development Control: Planning for Air Quality' May 2015 (V1.1) and will be assessed based on the following criteria;

- More than 100 vehicles within or adjacent to an Air Quality Management Area (AQMA), or more than 500 elsewhere; or,
- More than 25 HDVs (>3.5 tonnes) within or adjacent to an AQMA or more than 100 elsewhere.

4.2.4.2 Noise & Vibration

118. Noise and vibration will follow the methodology contained in the Design Manual for Roads and Bridges DMRB, Volume 11, Section 3, Chapter 3 and will be assessed based on the following criteria

- Road links with a predicted increase in traffic volume of 25%
- Road links with a predicted decrease in traffic volume of 20%

4.2.4.3 Abnormal Indivisible Loads (AILs)

119. The importing of large Abnormal Indivisible Loads (AILs) may lead to delays on the highway network. The quantum of AIL deliveries has not been established at this stage. When components have been established an AIL routing study will be undertaken to inform the management measures required prior to DCO submission.

4.2.5 Mitigation

120. The EIA will determine the requirement for the implementation of mitigation measures to reduce the significance of the impact to transport receptors.

121. The 'embedded or designed in' mitigation detailed in **Table 4.4** (Scenario 1) and **Table 4.5** (Scenario 2) detail informs the traffic assignments included in the environmental assessment:

Table 4.4: Scenario 1 embedded mitigation proposals

Scenario 1
Commitment to the development of a construction Traffic Management Plan (TMP) to manage HGV movements to the parameters assessed (e.g. routes, timings, number of movements).
Commitment to the development of a construction Travel Plan to manage employee traffic movements.
Suitable access points and identification of optimum routes for construction traffic to use (minimising the impact on sensitive receptors);
Commitment to a standard compliant A47 onshore project substation access to mitigate the risk of right turn incidents.

Table 4.5: Scenario 2 embedded mitigation proposals

Scenario 2
Commitment to the development of a construction Traffic Management Plan (TMP) to manage HGV movements to the parameters assessed (e.g. routes, timings, number of movements).
Commitment to the development of a construction Travel Plan to manage employee traffic movements.
Suitable access points and identification of optimum routes for construction traffic to use (minimising the impact on sensitive receptors);
Mobilisation areas would be located close to main A-roads, thereby minimising the impacts upon local communities and utilising the most suitable roads.
Mobilisation areas would be located away from population centres where practical, thereby minimising impacts on sensitive receptors.
Main duct installation to adapt suitable side accesses and road crossing locations to minimise local route impacts.
Reducing points of access through the adoption of a running track.
Consolidating HGVs at mobilisation areas to reduce vehicle movements along more sensitive local routes
Consolidating onshore cable route section construction employee movements at mobilisation areas for further onward travel along the running track to place of work.
Limiting the maximum trenchless crossing gangs to be active at any point within the construction programme to three so as to reduce vehicle movements along more sensitive local routes.
Commitment to a standard compliant A47 onshore project substation access to mitigate the risk of right turn incidents.

5 POTENTIAL IMPACTS

5.1 Potential Impacts during Construction

122. The construction phase will result in a requirement for the import / export of materials and plant to the onshore cable route and onshore project substation. The requirement for abnormal loads will also be considered.

123. As set out in section 2.3, there are two different project construction scenarios, both of which will have unique transport effects and therefore two discrete impact assessments will be undertaken and set out within PEIR and ES.

124. **Table 5.1** shows the effects which have been identified as being susceptible to changes in traffic flow and are appropriate to gauge the traffic within the project study area. **Table 5.1** also sets out which potential impacts will be assessed under each Scenario. Section 6 of this document sets out the Traffic demand, distribution and assignment which will be used in the assessment.

Table 5.1: Environmental effects

Environmental Effect	Scenario 1	Scenario 2
Driver Delay	✓	✓
Severance	✓	✓
Pedestrian / cycle amenity	✓	✓
Road safety	✓	✓
Minor road access and amenity	✓	✗
Air Quality	Considered in topic specific ES chapter	
Noise and Vibration	Considered in topic specific ES chapter	

125. Further detail on these potential impacts is set out as follows.

5.1.1 Impact: Driver Delay

126. GEART recommends the use of proprietary software packages to model junction delay and hence increased vehicle delays. However, it is noted that vehicle delays are only likely to be significant when the surrounding highway network is at, or close to, capacity.

127. During consultation with the highway authorities as part of the Norfolk Vanguard EPP process, sensitive junctions have been identified within **Table 5.2** that require an assessment of potential delays for drivers during peak hours.

Table 5.2: Junctions Identified as sensitive to changes in traffic

Junction notation	Location	Junction description	Junction type
Junction 1	Great Yarmouth	Junction of the A47 and Gapton Hall 'Gapton Roundabout'	Four arm roundabout with partial signal control
Junction 2	Great Yarmouth	Junction of the A47 and the A149 'Vauxhall Roundabout'	Four arm roundabout
Junction 3	Great Yarmouth	Junction of the B1141 and the A149 'Fuller's Hill Roundabout'	Four arm roundabout
Junction 4	Acle	Junction of the A47 and A1064	Four arm roundabout

128. The assessment therefore seeks to disaggregate the peak hour traffic movements on to these junctions to facilitate a judgement of the potential significance of the driver delays effect for both Scenario 1 and Scenario 2.

5.1.2 Impact: Severance

129. The term severance is used to describe a complex series of factors that separate people from places and other people. Severance may result from the difficulty of crossing a heavily trafficked road. It can also relate to quite minor traffic flows if they impede pedestrian access to essential facilities. Severance effects could equally be applied to residents, motorists, cyclists or pedestrians.

130. GEART suggests that changes in total traffic flow of 30%, 60% and 90% are considered to be slight, moderate and substantial respectively.

131. Severance will be assessed for both Scenario 1 and Scenario 2 separately.

5.1.3 Impact: Pedestrian / Cycle Amenity

132. Pedestrian and cycle amenity is broadly defined as the relative pleasantness of a journey, and is considered to be affected by traffic flow, traffic composition and pavement width and separation from traffic. This definition also includes pedestrian fear and intimidation, and can be considered to be a much broader category including consideration of the exposure to noise and air pollution, and the overall relationship between pedestrians and traffic.

133. GEART suggests that a threshold of a doubling of total traffic flow or the HGV component may lead to a negative impact upon pedestrian amenity.

134. Pedestrian / cycle amenity will be assessed for both Scenario 1 and Scenario 2 separately.

5.1.4 Impact: Road Safety

135. The salient GEART guidance on road safety is as follows:

"Where a development is expected to produce a change in the character of traffic (e.g. HGV movements on rural roads), then data on existing accident levels may not be sufficient. Professional judgement will be needed to assess the implications of local circumstances, or factors which may elevate or lessen the risk of accidents, e.g. junction conflicts."

136. An examination of the existing collisions occurring on the roads contained within the initial project study area will be undertaken to identify any areas of the highway with concentrations of collisions. These areas are considered to be sensitive to changes in traffic flows (sensitive receptors) and therefore a more detailed analysis of significance will be undertaken by a qualified Road Safety Auditor.

137. Road safety will be assessed for both Scenario 1 and Scenario 2 separately.

5.1.5 Impact: Minor Road Access and Amenity

138. As noted in section 3.1.1, Scenario 2 utilises primarily the A and B (Major) road network to access the cable route and therefore, the effect of Minor Road Access and amenity is considered not to be significant.

139. For Scenario 1, the introduction of additional points of access to facilitate a reduction in running track necessitates the use of local routes that are too narrow for a HGV to pass another vehicle and/or that have limited forward visibility for HGV manoeuvres (e.g. when turning out of a point of access). Without mitigation, the use of these routes has the potential for significant amenity, driver delay and road safety impacts.

140. Assessment of these routes would entail vehicle swept path analysis and on site observations to determine suitable routes and appropriate traffic management measures. These activities will be undertaken during the development of the Norfolk Vanguard DCO submission.

141. As a general principal, a traffic management hierarchy of measures would be developed with the least intrusive measures preferred and 'hard engineering' solutions only pursued where traffic conditions dictate absolute requirement.

142. Measures would be applied on a route by route assessment basis and presented in a schedule to inform the Traffic and Transport impact assessment. Preliminary Traffic Management drawings will be submitted for the DCO application with the accompanying supplementary documents.

5.2 Primary Base Port Assessment

143. In addition to the onshore impacts there is also the potential for impacts associated with employee and HGVs movements for the offshore construction phase via the primary base port.

144. At this stage, no final decision has been made upon which port will be used, however it is noted that this may be a facility on the Norfolk coast. The traffic impacts of the primary base port will be assessed when the actual site has been announced in context with any port operating permissions.

5.3 Potential Impacts during Operation and Maintenance

145. During the operational phase, traffic movements would be limited to those generated by the daily operation and periodic maintenance at the onshore substation and at link boxes along the onshore cable route.

146. Along the onshore cable route, periodic access to installed link boxes may be required for inspection, estimated to be annually. These test pits will be accessible from ground level and will be located close to existing access routes where possible. Access to the cable easement will be required to conduct emergency repairs if necessary.

147. The onshore substation will not be manned; however access will be required periodically for routine maintenance activities, estimated at an average of one visit per week for the substation.

148. Considering the discussed activities above, no significant traffic impacts are anticipated during the operational phase and no further assessment will be undertaken.

5.4 Potential Impacts during Decommissioning

149. It is anticipated that the decommissioning impacts will be similar or less in nature to those of construction.

5.5 Potential Cumulative Impacts

150. The projects identified under section 2.3.6 (Cumulative impact scenarios) have the potential to increase the project's impacts.

151. In order to quantify the potential impact from these projects their respective Transport Assessments (TA) or Environmental Statements (ES) will be reviewed to understand their proposed traffic demand and associated implementation dates. This traffic demand will then be assigned to the highway network as appropriate to facilitate an assessment of cumulative impacts.

5.6 Supplementary Documentation

152. Supplementary documentation which is to be provided as part of the DCO application are detailed in **Table 5.3.**

Table 5.3: Supplementary Documentation

Document	Purpose
Outline Traffic Management Plan	The Outline TMP would control the movement of materials on the highway network to the assessed 'envelope'. The document would include a number of control measures such as HGV routing, timings and traffic generation. Details of monitoring, enforcement and corrective measures would also be included within the document.
Outline Access Management Plan	The Outline AMP would provide outline proposals for access to the onshore infrastructure and will include details of access design and traffic management requirements.
Outline Travel Plan	The Outline TP would set out how construction employee traffic would be managed and controlled.

6 TRAFFIC DEMAND, DISTRIBUTION AND ASSIGNMENT

6.1 Introduction

153. This section of the Method Statement presents the traffic demand, distribution and assignment that will inform the impact assessment for Scenarios 1 and 2.

154. In light of VWPLs significant decision to commit to utilising High Voltage Direct Current (HVDC) technology for the electrical connection from the windfarms to the National Grid. This section has been revisited to provide an update to the revised traffic demand, distribution and assignments in respect to the reduced worst-case impacts of the traffic and transport impacts arising from the Norfolk Boreas project.

155. A comprehensive level of detail has been included to facilitate a review of the traffic generation by stakeholders in advance of producing the Norfolk Boreas PEI report.

156. The assessment for traffic and transport identifies the period when the maximum traffic will be generated for each Scenario, notated as Scenario 1 - Worst Case Scenario (S1-WCS) and the Scenario 2 – Worst Case Scenario (S2-WCS).

157. The S1 and S2 WCS traffic demand have been developed by examining:

- The likely minimum construction programme;
- The earliest commencement date;
- Demand for materials and personnel;
- Likely shift patterns;
- Likely delivery windows; and
- The distribution of traffic.

158. Section 6.2 sets out the parameters and assumptions that together inform the S1-WCS. Section 6.3 will inform the S2-WCS.

6.2 Scenario 1 – Worst Case Scenario

6.2.1 Scenario 1 - Construction Programme

159. Table 6.1 details the Scenario 1 project construction programme for a two phase cable installation approach.

160. The cable Installation work period represents the maximum construction intensity period in terms of traffic and therefore informs the S1-WCS.

Table 6.1: Two phase development under Scenario 1 - indicative construction programme

Activity	Year						
	2022	2023	2024	2025	2026	2027	20
Landfall							
Duct Installation							
Cable pull, joint and commission							
Phase 1							
Phase 2							
Onshore Cable Route							
Cable pull, joint and commission							
Cable installation Phase 1							
Cable installation Phase 2							
Onshore Project Substation							
Preconstruction works							
Primary works							
Electrical plant installation and commission							
Phase 1							
Phase 2							

161. The landfall and onshore cable corridor cable installation phases works are programmed for a two year period (2026-2027). The construction traffic derivation for the cable installation phase includes a four month break in traffic movements during the winter period. The break in traffic movements informs the S1-WCS by condensing traffic movements into a shorter construction time period and thereby increasing daily movements. In real terms, a four month break is unlikely, however, the traffic derivation serves to simulate the accelerated working required to ensure construction keeps to the two year programme in the event of prolonged inclement weather.

162. It is considered that the earliest date that the cable installation period could commence would be 2026; as such a reference year for background traffic of 2026 has been derived (refer to section 4.2.3) for the purpose of the Scenario 1 assessment. Background traffic flows for 2026 are presented in **Appendix 3.**

163. The nature of construction works typically requires that employees work longer hours in the summer and shorter hours in the winter to take advantage of the available daylight. There is a possibility that a proportion of employee arrival /

departures may overlap with the network peaks. Network peaks will be identified for all the critical junction locations to inform the S1-WCS.

164. The delivery of materials and plant to the cable installation locations could occur between a typical 7am to 7pm delivery window. To account for breaks in deliveries such as lunch breaks and rest breaks, the HGV construction traffic would be profiled over a 10 hour period resulting in a worst case higher hourly HGV flows.

165. To further inform the S1-WCS, it is proposed that delivery intensity is informed by a five day week noting that the potential to extend to a seven day working week during specific periods of the installation. Seven day working would occur for example, following periods of poor weather, but will be reserved for programme acceleration if required.

6.2.2 Scenario 1 - Worst Case Traffic Demand

6.2.2.1 Scenario 1 - HGV Traffic Demand

166. Details of materials, plant, and timescales for the project have been informed by work undertaken by the project design engineers. **Appendix 4** details the forecasts associated with the expected quantity of materials, plant and total HGV deliveries for each of the components of the onshore project area associated with the S1-WCS.

167. When reviewing traffic forecasts, it should be noted one delivery equals a one way trip (i.e. an arrival or departure). A movement equals two vehicle movements (i.e. an arrival and a departure).

168. **Appendix 5** details the indicative maximum traffic generation forecasts broken down by each onshore component of the project.

6.2.2.2 Scenario 1 - Peak HGV Construction Demand

169. **Appendix 6** shows the disaggregation of components of the Scenario 1 onshore project area traffic demand (contained within **Appendix 4** and **5**) by activity over time (per component of the onshore project area). These data facilitate the derivation of total deliveries and HGV movements per day.

170. To meet the two year cable installation period, the onshore cable corridor would be segregated into 16 cable route sections each with their own work gang. Each cable route section would incorporate six cable jointing pit locations. Each jointing pit location will be constructed within a six week construction programme with the worst case traffic demand occurring in week one. In effect a total of 16 joint

locations would be under construction and at peak activity at any one time for the duration of the project.

171. To ensure the assessment considers the maximum impacts on the Scenario 1 highway network access strategy it is necessary to assign the traffic demand for all 16 cable route sections to the network. This method has the advantage of assessing the peak impact on all minor links and is therefore appropriate for screening traffic and transport effects.

6.2.2.3 Scenario 1 - Contingencies

172. To ensure that minor omissions and uncertainties in design can be accommodated within future assessed traffic flows, a 20% contingency has been applied to all onshore infrastructure HGV flows.

6.2.2.4 Scenario 1 - Employee Traffic Demand

173. The project design engineers have provided details of the expected resourcing requirements during the Scenario 1 worst case construction scenarios at each of the onshore infrastructure sites. Based on this input, it is estimated that a workforce of 180 employees will be required during construction peaks serving cable route sections and the onshore substation. This information is set out in **Appendix 6**.

174. It is envisaged that construction employees will work during the hours of 7am to 7pm.

175. In recognition of the large geographical area and rural nature of the project study area it has been assumed, as a worst case that all construction employees travel by car. To be conservative, no allowance has been made for the opportunities for employees to car share, walk and cycle or use public transport. Measures to encourage mode shift / vehicle share would be included in the construction Travel Plan.

6.2.2.5 Scenario 1 - Summary of Traffic Demand Assumptions

176. The key assumptions that have informed the construction traffic demand WCS are summarised in **Table 6.2.**

Table 6.2: Scenario 1 Traffic Demand Assumptions

Traffic demand
An appropriate level of contingency (20%) reflecting the uncertainties in the design has been applied to all material quantities.
HGV movements to occur over five days (Monday – Friday).
Employee to car ratio of 1:1
No allowance has been made for the potential for employees to car share.
The nature of construction works typically requires that employees work longer hours in the summer and shorter hours in the winter to take advantage of the available daylight. Therefore as a worst case, during the construction duration, workers departing for home are assumed to overlap the network peak hours.
Construction timing
Minimum 24 months construction duration for the cable installation phase
Earliest start of construction 2026
7am to 7pm working day with a 10 hour delivery window – Five day working week (Monday – Friday)
Construction intensity
Full overlap of the peak period of construction activity for all components of the onshore project area.

6.2.3 Scenario 1 - Traffic Distribution

177. At present, the supply chain for materials cannot be detailed as this will depend on the contractor employed and will therefore not be available until the pre-construction phase, after the DCO has been determined. The following sections describe the assumptions that have been adopted to inform the distribution of HGV and construction employee traffic.

6.2.3.1 Scenario 1 - HGV Distribution

178. Trips associated with bulk materials such as concrete and stone aggregate would make up the majority of the total HGV movements for Scenario 1.

179. A review of the potential supply chain within the project study area indicates that while there are a number of local suppliers that may meet some of Norfolk Boreas's demand, they are unlikely to meet the substantive material demands required of the project.

180. A viable alternative for sourcing bulk materials would be to import materials from the ports local to the project. Kings Lynn Port to the west and Lowestoft / Great Yarmouth Ports to the south east are considered to be the most likely source for all

materials with appropriate facilities to import and offload construction materials and, as such, it is assumed that all HGV movements would have an origin and destination in these regions (noting that in practice, some of the demand could be met by local supply chain). The relevant port locations are presented graphically in relation to all onshore infrastructure locations in **Figure 5**.

181. A single port could have the capacity to provide all required materials for the project, however, it is unlikely that HGVs would travel long distances to service the furthest onshore infrastructure site from a single port as the economics would be a 'distance deterrent'. Rather, it is considered reasonable to assume that two ports (one from the south east, and one from the west) would be utilised for importing materials. Each port would generate the maximum traffic demand on the highway links which serve the closest onshore infrastructure locations.

6.2.3.2 Scenario 1 - Delivery Locations

182. **Figure 5** details the onshore project area. The site delivery strategy is as follows:

- Landfall: deliveries would be made directly to the landfall south of Happisburgh with construction traffic using the B1159 to access the local routes leading to the temporary construction compound at the landfall site.
- Onshore cable corridor: Delivery of plant and materials would be direct to each jointing pit location, which are placed approximately every 800m along the 60km onshore cable corridor.
- Onshore project substation: Deliveries would occur directly to the temporary construction compound at the substation site.
- National Grid substation extension: Deliveries would occur directly to the National Grid substation.

6.2.3.3 Scenario 1 - Employee Distribution

183. The availability of local labour and rented accommodation has been reviewed as part of the socio economics study to inform the potential construction employee distribution.

184. The types of specialist skills required for the project means that construction personnel often have to be drawn from across the country since they are unable to rely solely on local labour sources. Socio economic data estimates that 30% of the workforce would be drawn from the local area (resident) and 70% would be beyond a daily commute (from outside Norfolk).

185. Those personnel who are not local (from outside Norfolk), i.e. who reside beyond a reasonable daily commute (defined as up to a 45 minute drive to the onshore infrastructure sites) are likely to base themselves within local rented accommodation. To inform the distribution of labour from outside Norfolk, the availability of local rented accommodation within commuting distances of the project has been captured via the Socio-economics studies which will form part of the Norfolk Vanguard and Norfolk Boreas DCO applications.

186. In informing the distribution of the employees who potentially could be drawn from the local area (resident workers), the socio economics study has examined the distribution of residents within the local area (defined as a 90 minute drive to the onshore infrastructure sites) with the relevant skill sets. A 90 minute drive time has been selected for residents as they are more likely to travel further for available work.

187. In acknowledgement of the large geographical project study area, three destination locations have been proposed for specific components of the onshore project area and are listed below:

- Origin Data Set A – based on a 45 minute and 90 minute drive time to the Substation location in the vicinity of Necton.
- Origin Data Set B – based on 45 minute and 90 minute drive time to a central point along the onshore cable route in the vicinity of Cawston.
- Origin Data Set C – based on a 45 minute and 90 minute drive time to the landfall location in the vicinity of Happisburgh.

188. The distribution of local rented accommodation per post code cluster is outlined within **Appendix 7**. The distribution of bed spaces per postcode cluster has been factored using a gravity model approach, whereby the number of bed spaces is divided by the journey time (taken from a route planner) from the centre of the postcode cluster to either Origin Data Set A, B or C.

189. **Appendix 7** also assigns each postcode cluster a point of entry on to the highway network to inform the distribution of available workforce from outside Norfolk.

190. The distribution of local available workforce per postcode cluster is outlined within **Appendix 8**. This has been factored using a gravity model approach, whereby the number of available workforce is divided by the journey time (taken from a route planner) from the centre of the postcode cluster to either Origin Data Set A, B or C.

191. **Appendix 8** also assigns each postcode cluster a point of entry on to the highway network to inform the distribution of local available workforce.

192. **Appendix 9** provides a summary of the access strategy point of entry links and their corresponding percentage distribution for resident and employees from outside Norfolk.

193. **Figures 6, 7** and **8** graphically depict the percentage distribution for resident and non-local employees point of entry onto the highway network for Destinations A, B and C respectively.

6.2.4 Scenario 1 - Construction Traffic Assignment

6.2.4.1 Scenario 1 - HGV Traffic Assignment

194. Utilising two port locations (Kings Lynn to the west and either Lowestoft or Great Yarmouth to the south-east) the links are categorised using distance deterrent to forecast the maximum traffic assignment on each link.

- Category 1 Links – A discrete port location would serve the demand for the all onshore infrastructure locations with distance deterrent applied. Rather than apply a notional 50/50 east /west origin split, it has been assumed up to a maximum of 70% of traffic could be generated from either port location.

- Category 2 Links – Regardless of origin, traffic converges on links local to the respective onshore infrastructure locations to complete the 'last leg' of the journey. These links are not subject to distance deterrent and have 100% of the required traffic demand assigned.

195. The maximum traffic demand per week for each onshore infrastructure site location is contained within **Appendix 6**. Table 6.3 summarise the traffic assignment methodology.

Table 6.3 HGV assignment methodology

Steps	Description	Reference	Appendix Tables
Step 1	Assigns the peak construction HGV traffic deliveries travelling to each individual onshore infrastructure site location according to their assumed origin	Appendix 10 (Kings Lynn) Appendix 11 (Lowestoft) Appendix 12 (Great Yarmouth)	Tables 1 & 2
Step 2	The sum HGV deliveries per link for each port location.	Appendix 10 (Kings Lynn) Appendix 11 (Lowestoft) Appendix 12 (Great Yarmouth)	Table 3

Steps	Description	Reference	Appendix Tables
Step 3	Presenting 100% assignment and then applying a 70% distance deterrent. Summarises and colour codes each port assignment link flows.	Appendix 13 (HGV Assignment)	Kings Lynn (green) Table 1a (100% assignment) Table 1b (70% assignment). Lowestoft (blue) Table 2a (100% assignment) Table 2b (70% assignment). Great Yarmouth (purple) Table 3a (100% assignment) Table 3b (70% assignment).
Step 4	Table 5 represent the final consolidated HGV traffic deliveries and movements associated with each link within the study area made up of the following composition. • Green – Kings Lynn origin – Category 1 link • Blue – Lowestoft origin – Category 1 link • Purple – Great Yarmouth origin – Category 1 link • Orange – All three port origins – Category 2 link	Appendix 13 (HGV Assignment)	Table 5 (Final assignment)

196. Table 6.4 summarises the links that have had 70% or 100% traffic flows assigned according to Link Category. The information is shown graphically in **Figures 9** and **9.1**.

Table 6.4 Scenario 1 link summary

Link category	Links affected
Category 1 Links with 70% flow assignments applied	2, 3, 4-10, 13a, 13b, 14, 18, 19, 29, 30, 32, 36, 39, 40b, 41, 44a, 44b, 45, 52-60, 64 and 65.
Category 2 Links with 100% flow assignments applied.	1a, 1b, 16, 17, 21-25, 33, 34, 35a, 35b, 42, 46, 47b, 47c, 49, 66-79 and A-V.

6.2.4.2 Scenario 1 - Employee Traffic Assignment

197. It is assumed all employees working on each of the onshore infrastructure sites would travel direct to each respective site.

198. Utilising the maximum employee numbers per week for each of the onshore infrastructure sites as contained within **Appendix 6**, the following four steps assign traffic to the highway network:

- Step 1: assigns the peak employee traffic to the onshore project substation utilising 'Origin Data Set A' and according to their assumed origin link as shown in **Appendix 14**.
- Step 2: assigns the peak employee traffic to the cable route sections utilising 'Origin Data Set B' and according to their assumed origin link as shown in **Appendix 15**.
- Step 3: provides a cumulative summation of the movement to all employee traffic movements as shown in **Appendix 16**.

6.2.5 Scenario 1 – Summary

199. The resultant construction traffic demand for a 2026 assessment year is detailed in **Appendix 17**.

6.3 Scenario 2 – Worst Case Scenario

6.3.1 Scenario 2 - Construction Programme

200. Table 6.5 details the two-phase Scenario 2 project construction programme. Consistent with Scenario 1, a two phase approach to cable pull, joint and commission stage has been selected for worst case assessment. It can be noted that a sequential approach has been adopted for construction stages. The duct (installation / primary works) period representing the maximum construction intensity period in terms of traffic and therefore informing the S2-WCS.

Table 6.5: Two Phase Development Under Scenario 2 - Indicative Construction Programme

Activity	Year					
	2021	2022	2023	2024	2025	2026
Landfall						
Duct Installation			■	■		
Cable Pull, Joint and Commission					■	■
Phase 1					■	

Activity	Year					
	2021	2022	2023	2024	2025	2026
Phase 2						
Onshore cable corridor						
Preconstruction works						
Duct installation works						
Cable pull, joint and commission						
Phase 1						
Phase 2						
Onshore project substation						
Preconstruction works						
Primary works						
Electrical plant installation and commission						
Phase 1						
Phase 2						

201. The duct installation works are programmed for a two year period (2023-2024). The construction traffic derivation for the duct installation includes a three month break in traffic movements during the winter period. The break in activities informs the S2-WCS by condensing traffic movements into a shorter construction time period and thereby increasing daily movements. In real terms, a three month break is unlikely, however, the traffic derivation serves to simulate the worst case with accelerated working required to ensure construction keeps to the two year programme in the event of prolonged inclement weather.

202. It is considered that the earliest date that the duct installation / primary works period could commence would be 2023 as such a reference year for background traffic of 2023 has been derived (refer to 4.2.3) for the purpose of the Scenario 2 assessment. Background traffic flows for 2023 are presented in **Appendix 18**.

203. The remainder of the S2-WCS construction programme follows the assumptions set out within sections 163 to 165 of the S1-WCS.

6.3.2 Scenario 2 – Worst Case Traffic Demand

6.3.2.1 Scenario 2 - HGV Traffic Demand

204. Details of materials, plant, and timescales for the project have been informed by work undertaken by the project design engineers. **Appendix 19** details the forecasts associated with the expected quantity of materials, plant and total HGV deliveries for each of the components of the onshore project area associated with the S2-WCS.

205. **Appendix 20** details the indicative maximum traffic generation forecasts broken down by each onshore component of the project.

6.3.2.2 Scenario 2 - Peak HGV Construction Demand

206. **Appendix 21** shows the disaggregation of components of the onshore project area traffic demand (contained within **Appendix 19** and **20**) by activity over time. These data facilitates derivation of total deliveries and HGV movements per day.

207. To meet the two year duct installation/ primary works period, 15 onshore cable route sections of a total of 20 would be close to or at peak activity at any one time for the duration of the project.

208. To ensure the assessment considers the maximum impacts on the study area highway network, it is necessary to assign the traffic demand for a total of 20 onshore cable route sections to the network. This method has the advantage of ensuring the peak impact on all minor links is assessed and is therefore appropriate for screening traffic and transport effects.

209. There is a drawback in application of peak impact on all links, in that potential in-combination traffic flows on the Strategic/ Principal road network are over estimated by assigning traffic flows for all 20 onshore cable route sections (noting 15 onshore cable route sections would be active at any one time).

210. To address this overestimate, it has been agreed by the Norfolk Vanguard ETG that a 'primary route reduction factor' (a multiple of 15/20) can be applied to the project traffic flows assigned to the Strategic/ Principal road network.

211. A reduction factor is not applied to the local road network as traffic would be assigned to discrete onshore cable route sections and is less influenced by multiple onshore cable route section activity.

212. If the assessment predicts significant impacts, the level of overestimation on the

minor roads can be re-evaluated on a link and junction basis.

213. The trenchless crossing (TC) zones[4] traffic demand departs from the above methodology. The 17 TC zones will be split into three groups based on their geographic location and then assigned a TC work gang as detailed:

- Gang 1 will construct TC1, TC2, TC3a, TC3b, TC4 and TC5;
- Gang 2 will construct TC6, TC7, TC8, TC9, TC10 and TC11; and
- Gang 3 will construct TC12, TC13, TC14, TC15 & TC16.

214. Each work gang will construct TCs consecutively within their TC geographic location. This constrains traffic demand to a level that would be generated of three trenchless crossing zones active at any point within the construction programme (a traffic demand 'cap').

6.3.2.3 Scenario 2 - Contingencies

215. To ensure that minor omissions and uncertainties in design can be accommodated within future assessed traffic flows, an appropriate level of contingency, namely has been applied to all onshore infrastructure HGV flows.

- 10% for trenchless crossing zones; and
- 20% for duct installation, cable pull and jointing, onshore project substation and National Grid substation extension.

6.3.2.4 Scenario 2 - Employee Traffic Demand

216. Table 6.6 summarises the total onshore infrastructure component's employee demand to be assessed.

Table 6.6 Employee demand

Infrastructure component	Realistic programme	ES assessed employees	Notes
Duct installation	280	400	
Landfall	10	20	
Trenchless crossings	30	30	3 gangs of 10 employees each.
Onshore project substation	50	50	
NG Substation Extension	50	50	

[4] Trenchless crossing zones are areas within the onshore cable route which will house trenchless crossing entry or exit points. The 17 TC zones do not include the landfall zone.

Infrastructure component	Realistic programme	ES assessed employees	Notes
Totals	420	550	

217. The remainder of the S2-WCS employee traffic assessment would follow the assumptions set out within sections 174 and 175 of the S1-WCS.

6.3.2.5 Scenario 2 - Summary of Traffic Demand Assumptions

218. The key assumptions that have informed the construction traffic demand for S2-WCS are outlined in Table 6.7.

Table 6.7: Scenario 2 Traffic Demand Assumptions

Traffic demand
An appropriate level of contingency reflecting the uncertainties in the design has been applied to all material quantities. • 10% for trenchless crossing zones; and • 20% for duct installation, cable pull and jointing, onshore project substation and National Grid substation extension.
HGV movements to occur over five days (Monday – Friday).
No allowance for reduction of HGV traffic due to intermodal freight transfer (rail, maritime).
Employee to vehicle worst case ratio of 1:1
The nature of construction works typically requires that employees work longer hours in the summer and shorter hours in the winter to take advantage of the available daylight. Therefore as a worst case, during the construction duration, workers departing for home are assumed to overlap the network peak hours.
Construction timing
Minimum 24 months construction duration for main duct Installation and Primary works
Earliest start of construction 2024
7am to 7pm working day with a 10 hour delivery window – Five day working week (Monday – Friday)
Construction intensity
Full overlap of the peak period of construction activity for all components of the onshore project area.

6.3.3 Scenario 2 - Traffic Distribution

219. As Paragraph 177 (S1-WCS).

6.3.3.1 Scenario 2 - HGV Distribution

220. As Paragraphs 178 - 181 (S1-WCS)

221. The distances along the relevant routes to the port locations in relation to all onshore infrastructure locations are shown in **Figure 10**.

6.3.3.2 Scenario 2 - Delivery Locations

222. **Figure 10** details the onshore project study area. The site delivery strategy is as follows:

- Landfall: As S1-WCS (section 6.2.3.2 refers).
- Onshore cable route: Delivery of plant and materials would be direct to each of the 14 mobilisation areas. The mobilisation areas are required to store equipment and provide welfare facilities and are placed evenly along the 60km onshore cable corridor.
- Trenchless Crossings: Materials and plant are assumed to be delivered directly to the 17 Trenchless Crossing locations.
- Onshore project substation: Delivery to the substation mobilisation area.
- National Grid substation extension and overhead line modification: As S1-WCS (Section 6.2.3.2 refers).

6.3.3.3 Scenario 2 - Employee Distribution

223. The S2-WCS employee distribution methodology adheres to the methodology set out within the S1-WCS employee distribution (section 6.2.3.3, Appendices 9-11 and **Figures 6**, **7** and **8)** refers.

6.3.4 Scenario 2 - Construction Traffic Assignment

6.3.4.1 Scenario 2 - HGV Traffic Assignment

224. For Scenario 2, a proportional two stage process has been developed to consolidate traffic assignments.

- Stage 1 (Classify): Classifying all links within the study area according to their project function.
- Stage 2 (categorise): Identify and categorise links based on distance between the port origin and final onshore infrastructure destination, applying a 'distance deterrent' factor to traffic flows.

6.3.4.1.1 Stage 1 (Classify)

225. As discussed in section 210, a Primary Route reduction factor is applied to the Strategic/ Principal highway network to address the over estimation of cumulative project traffic flows from maximum cable route intensity.

6.3.4.1.2 Stage 2 (Categories)

226. As discussed in section 210, a Primary Route reduction factor is applied to the Strategic/ Principal highway network to address the over estimation of cumulative project traffic flows from maximum cable route intensity.

227. Stage 2 follows the same categorisation process as set out for Scenario 1 (sections 178 to 181 refers).

228. The maximum traffic demand per week for each onshore infrastructure site location is contained within **Appendix 21**. Table 6.8 summarises the traffic assignment methodology.

Table 6.8 HGV assignment methodology

Steps	Description	Reference	Appendix Tables
Step 1	Assigns the peak construction HGV traffic deliveries travelling to each individual onshore infrastructure site location according to their assumed origin	Appendix 22 (Kings Lynn) Appendix 23 (Lowestoft) Appendix 24 (Great Yarmouth)	Tables 1, 4, 5 & 6
Step 2	Primary route reduction factor (0.75) applied to Total Daily HGV Deliveries (gross) for all identified Primary Collector Roads as classified in Table 24.16.	Appendix 22 (Kings Lynn) Appendix 23 (Lowestoft) Appendix 24 (Great Yarmouth)	Table 2
Step 3	TC deliveries for both drive and reception sides assigned to links.	Appendix 22 (Kings Lynn) Appendix 23 (Lowestoft) Appendix 24 (Great Yarmouth)	Table 3
Step 4	The sum HGV deliveries per link for each port location.	Appendix 22 (Kings Lynn) Appendix 23 (Lowestoft) Appendix 24 (Great Yarmouth)	Table 7
Step 5	Presenting 100% assignment and then applying a 70% distance deterrent. Summarises and colour codes each port assignment link flows.	Appendix 25 (HGV Assignment)	Kings Lynn (green) Table 1a (100% assignment) Table 1b (70% assignment).

Steps	Description	Reference	Appendix Tables
			Lowestoft (blue) Table 2a (100% assignment) Table 2b (70% assignment). Great Yarmouth (purple) Table 3a (100% assignment) Table 3b (70% assignment).
Step 7	Table 5 represent the final consolidated HGV traffic deliveries and movements associated with each link within the study area made up of the following composition. Green – Kings Lynn origin – Category 1 link Blue – Lowestoft origin – Category 1 link Purple – Great Yarmouth origin – Category 1 link Orange – All three port origins – Category 2 link	Appendix 25 (HGV Assignment)	Table 5 (Final assignment)

229. Table 6.9 below summarises the links that have had 70% or 100% traffic flows assigned according to Link Category. The information is shown graphically in **Figure 11**.

Table 6.9: Scenario 2 Link Summary

Link category	Links affected
Category 1 Links with 70% flow assignments applied	2-10, 13a, 13b, 14, 18, 19, 29, 30, 32, 33, 36, 39, 40a, 41, 44a, 44b, 45, 52-60, 64 and 65.
Category 2 Links with 100% flow assignments applied.	1a, 1b, 16, 17, 21, 22, 24, 25, 34, 35a, 35b, 37, 40b, 42, 46, 47b, 47c, 49 and 66-79.

6.3.4.2 Scenario 2 - Employee Traffic Assignment

230. It is assumed all employees working on each of the onshore infrastructure sites would travel direct to each respective site.

231. Utilising the maximum employee numbers per week for each of the onshore infrastructure sites as contained within **Appendix 21**, the following five steps assign traffic to the highway network:

- Step 1: assigns the peak employee traffic to the onshore project substation and National Grid substation extension utilising 'Origin Data Set A' and according to their assumed origin link as shown in **Appendix 26**.
- Step 2: assigns the peak employee traffic to the mobilisation areas utilising 'Origin Data Set B' and according to their assumed origin link as shown in **Appendix 27**.
- Step 3: assigns the peak employee traffic to the trenchless crossing sites utilising 'Origin Data Set B' as shown in **Appendix 27**.
- Step 4: assigns the peak employee traffic to the landfall site utilising 'Origin Data Set C' and according to their assumed origin link as shown in **Appendix 28.**
- Step 5: provides a cumulative summation of the movement to all employee traffic movements as shown in **Appendix 29**.

6.3.5 Scenario 2 – Summary

232. The resultant construction traffic demand for a 2023 assessment year is detail in **Appendix 30**.

7 DOCUMENT SUMMARY

233. The purpose of this method statement is to build upon the information provided within the Norfolk Boreas Environmental Impact Assessment (EIA) Scoping Report and that amassed for the Norfolk Vanguard PEIR. This method statement updates the previous version circulated in January 2018 in light of the decision by Norfolk Boreas Ltd to commit to the using HVDC technology to export the electricity generated by the project to the National Grid connection.

234. The updated method statement contains updated HGV and employee traffic figures for both Scenario 1 and Scenario 2 which reflect the refined scope of the works required under the HVDC format.

235. The aim is to confirm agreement on this method statement with members of the Traffic and Transport ETG.

236. Norfolk Boreas is the sister project to Norfolk Vanguard. Vattenfall Wind Power Ltd (VWPL) is developing the two projects in tandem, and is planning to co-locate the export infrastructure for both projects in order to minimise overall impacts.

237. Section 2 established the project parameters worst case traffic impact scenarios to inform the Traffic and Transport EIA as follows:

Table 7.1: Scenario Assessments

Phase	Scenario	PEIR Assessment
Construction	Scenario 1, Cable Pull and Jointing Stage	✓
	Scenario 2, Primary works/Duct Installation Stage	✓
Operation	Indiscernible impact forecast	✗
Decommission	Determined by relevant legislation and guidance at time of decommissioning.	✗

238. Section 3 defines the study area and the road links that will inform the EIA. Section 3 also sets out the traffic and personal injury collision data to be utilised for the assessment. The traffic data sourced for the assessment represents the most up to date information available. Noting the DCO consent programme, it is considered that these data will remain valid for the whole of the determination period.

239. Section 4 sets out the impact assessment methodology which will utilise the ‘Guidelines for the Environmental Assessment of Road traffic’ which is the principal guidelines for the assessment of the environmental impacts of road traffic associated with new developments.

240. Section 5 identifies the potential Traffic and Transport effects that have the potential to be significantly impacted. These are: Driver Delay; Severance; Pedestrian Amenity; Road Safety and Minor Road Access and Amenity.

241. Section 6 sets out the traffic demand, distribution and assignment that will inform the impact assessment for Scenarios 1 and 2. A comprehensive level of detail has been included to facilitate a review of the traffic generation by stakeholders in advance of producing the Norfolk Boreas PEI report.

242. Section 6 draws on information supplied by the project design engineers and identifies the period when the maximum traffic will be generated for Scenarios 1 and 2 (worst case scenarios). The worst case scenarios' traffic demand has been developed by examining:

- The likely minimum construction programme;
- The earliest commencement date;
- Demand for materials and personnel;
- Likely shift patterns;
- Likely delivery windows; and
- The distribution of traffic.

8 REFERENCES

Crashmap, 2017. Crashmap. [Online] Available at: http://www.crashmap.co.uk/ [Accessed 13 April 2017].

Department for Transport, 2017. *Traffic Counts.* [Online] Available at: http://www.dft.gov.uk/traffic-counts/ [Accessed 08 December 2017].

Norfolk County Council, 2017. *Norfolk County Council.* [Online] Available at: https://www.norfolk.gov.uk/ [Accessed 08 December 2017].

Royal HaskoningDHVa (Unpublished) Norfolk Boreas Offshore Wind Farm Air Quality Method Statement. Document Reference PB5640.004.007

Royal HaskoningDHVb (Unpublished) Norfolk Boreas Offshore Wind Farm Noise and Vibration Method Statement. Document Reference PB5640.004.002

Royal HaskoningDHV (2017a) Norfolk Boreas Offshore Wind Farm: Evidence Plan Terms of Reference. [*Unpublished – Live Document*]

Royal HaskoningDHV (2017b) Norfolk Vanguard Offshore Wind Farm Preliminary Environmental Information Report. Available at https://corporate.vattenfall.co.uk/projects/wind-energy-projects/vattenfall-in-norfolk/norfolkvanguard/documents/preliminary-environmental-information-report/

Sustrans, 2017. *Sustrans Join The Movement.* [Online] Available at: www.sustrans.org.uk [Accessed 08 December 2017].