UK Onshore Scheme

Environmental Statement

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Chapter 02

Development of the UK Onshore Scheme (Alternatives)

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VikingLink nationalgrid

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Glossary & Abbreviations

Glossary of Terms	
Term	**Meaning**
AC electricity transmission	Electric power transmission in which the voltage varies in a sinusoidal fashion. This is the most common form of electricity transmission and distribution.
base scheme design	The design of the UK Onshore Scheme for the purposes of the planning application.
connection point	The existing Bicker Fen 400 kV Substation; the point on the National Electricity Transmission System (NETS) where Viking Link connects.
the Contractor	Party or parties responsible for the detailed design and construction UK Onshore Scheme.
converter station	Facility containing specialist equipment (some indoors and some potentially outdoors) for the purposes of converting electricity from AC to DC or DC to AC.
DC electricity transmission	Electric power transmission in which the voltage is continuous. This is most commonly used for long distance point to point transmission.
detailed scheme design	The design of the Scheme developed by the Contractor within the Limits of Deviation (AC and DC cables) and Rochdale Envelope (converter station).
landfall	The area between Mean Low Water Springs and Mean High Water Springs where the Onshore and Offshore Schemes meet.
Limits of Deviation	These define the maximum extents of the corridor for which planning permission is sought and within which proposed DC and AC cable routes may be installed.
Phase 1 Consultation	Consultation on shortlisted landfall and converter station sites undertaken following siting studies.
Phase 2 Consultation	Consultation on potential DC cable route corridors undertaken following routeing studies.
the Project	Viking Link, from the connection point at Revsing Substation in Denmark to the connection Bicker Fen Substation in Great Britain).
Rochdale Envelope	This defines the parameters of the proposed converter station for which planning permission is sought including its location, layout and dimensions.
route corridor	Approximately 1 kilometre wide corridor developed in routeing studies in which onshore DC cable route will be finalised.
refined route corridor	Approximately 200 metre wide corridor in which onshore DC cable route will be finalised.
the Scheme	UK Onshore Scheme from MLWS to the connection point comprising underground AC and DC cables, converter station and access road.

Glossary of Terms	
Term	**Meaning**
Transition Joint Pit	Buried concrete pit where onshore and submarine cables are physically jointed together.

List of Abbreviations	
Abbreviation	**Meaning**
AC	Alternating Current
AES	Agri-Environment Stewardship
ALC	Agricultural Land Classification
AONB	Area of Outstanding Natural Beauty
BBC	Boston Borough Council
CS	Converter Station
CSC	Current Source Conversion
DC	Direct Current
EA	Environment Agency
EIA	Environmental Impact Assessment
ELDC	East Lindsey District Council
ES	Environmental Statement
EU	European Union
GB	Great Britain
HV	High Voltage
km	kilometre
kV	kilovolt
LCC	Lincolnshire County Council
LCGM	Lincolnshire Coastal Grazing Marshes
LF	Landfall
LPA	Local Planning Authority
m	metres
MW	megawatt
NE	Natural England
NETS	National Electricity Transmission System
NGET	National Grid Electricity Transmission plc
NGVL	National Grid Viking Link Limited
NKDC	North Kesteven District Council

List of Abbreviations	
Abbreviation	**Meaning**
NPPF	National Planning Policy Framework
NSR	Noise Sensitive Receptor
PCI	Project of Common Interest
PRoW	Public Right of Way
RCA	Route Corridor A
RCB	Route Corridor B
RCC	Route Corridor C
RCD	Route Corridor D
RCE	Route Corridor E
SAC	Special Area of Conservation
SCI	Statement of Community Involvement
SCR	Shunt Compensation Reactors
SHDC	South Holland District Council
SPA	Special Protection Area
TJP	Transition Joint Pit
UXO	Unexploded Ordnance
VSC	Voltage Source Conversion

1 Introduction

1.1 Introduction

1.1.1 In developing proposals for the UK Onshore Scheme (hereafter also referred to as the 'Scheme') National Grid Viking Link Limited (NGVL) has given consideration to a range of alternatives at different levels. This has included, at a strategic level, consideration of alternative electricity transmission technologies and alternative connection points to the National Electricity Transmission System (NETS), and at a more detailed level, consideration of alternative landfall and converter station sites as well as alternative underground DC cable route corridors. This chapter describes the approach to the development of the Scheme and identifies the main alternatives which have been considered at both the strategic and detailed levels.

1.2 Legislative Requirements

1.2.1 The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 ('the 2011 EIA Regulations') require that the main alternatives studied by the applicant and the main reasons for the choices made are described within an Environmental Statement (ES). Schedule 4, Part 1 of the 2011 EIA Regulations sets out the information to be included within an ES which includes "*An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for the choice made, taking into account the environmental effects.*"

1.2.2 Subsequent sections in this chapter identify the alternatives which have been considered by NGVL and detail the reasons for the choices made taking into account environmental effects alongside other factors including engineering and other technical considerations as well as feedback from statutory and non-statutory consultees and from local communities.

1.3 Factors influencing consideration of Alternatives

1.3.1 The development of Viking Link (hereafter also referred to as 'the Project') has been informed through consideration of a range of factors. As appropriate to each stage in the development of the Project the level of detail which has been considered has increased from strategic alternatives to detailed alternatives as the Project has progressed.

1.3.2 In summary, the main factors which have been considered comprise:

- Technical feasibility (including engineering considerations),
- Economic viability (including commercial considerations),
- Environmental impact (including impact on the environment and people), and
- Consultation feedback (including feedback from consultees and local communities).

2 Strategic Alternatives

2.1 The Do Nothing Option

2.1.1 The ‘do nothing’ option considers a scenario in which Viking Link is not developed. There would be no interconnection between the Danish and British high voltage electricity networks and therefore no export and / or import of electricity between the two countries. In this scenario the UK’s ability to achieve the interconnection targets set out in the European Union’s (EU) 2030 climate and energy framework of 10% by 2020 and 15% by 2030 would be significantly reduced.

2.1.2 The potential benefits of increased interconnection in terms of energy security, sustainability and affordability would not be realised in the ‘do nothing’ option. These benefits are described in detail in the Planning Statement (Ref 2.1) and a summary is also provided in chapter 3 of the ES (ES-2-A.03).

2.2 The Do Something Option

2.2.1 In establishing the feasibility of the ‘do something’ option through technical and commercial studies considering the development of an interconnector between Denmark and Great Britain the following strategic alternatives were considered:

- The selection of the electricity transmission technology; and
- The selection of the connection point in Great Britain.

2.2.2 The following sub-sections outline the strategic alternatives which have been considered and the main reasons for the decisions made.

2.3 Selection of Electricity Transmission Technology

2.3.1 In order to connect the Danish and British high voltage electricity networks, a subsea cable approximately 750 km long is required. It is more efficient to use high voltage Direct Current (DC) technology to transmit electricity between the two countries, rather than high voltage Alternating Current (AC) due to the physical distance involved. At longer distances DC technology is more efficient as it can transmit larger volumes of electricity with fewer losses than an equivalent AC system. In addition to this the existing high voltage networks in both countries are not synchronised, which means that they operate at different frequencies which would prevent direct AC interconnection. DC systems also only require two cables whereas equivalent AC systems need multiples of three cables (i.e. one cable per phase) to accommodate the load capacity.

2.3.2 Further for high voltage AC submarine cables exceeding 70 km in length, the associated reactive power created would reduce the capability of the system to transmit power efficiently. In the onshore environment, intermediate shunt compensation reactors (SCRs) can be installed in high voltage AC systems (for example at substations) to compensate for the reactive power and to restore the power transfer efficiency. SCRs contain assemblies of electrical components of considerable physical size which would be impractical to install and operate in the marine environment.

2.3.3 As the existing high voltage electricity networks in Denmark and Great Britain predominantly use high voltage AC technology, converter stations are required at each 'end' of the high voltage DC cable to convert electricity from DC into AC (or vice versa), and connect the Project into the existing Danish and British electricity transmission networks. There are two high voltage AC to DC conversion technologies available that could meet the indicative power rating required for Viking Link. These are self-commutated voltage source conversion (VSC) and line-commutated current source conversion (CSC) technologies. VSC technology has been selected for Viking Link. The main benefits of this technology are its ability to control reactive and active power independently of each other, and as a result keep both the voltage and frequency stable. In addition, VSC technology would allow for a more compact converter station design and layout thereby reducing the operational land take required compared to a converter station using the alternative DC technology.

2.4 Selection of the Connection Point to the National Electricity Transmission System

Overview

2.4.1 At a strategic level a key consideration in the development of Viking Link has been the identification of a connection point, this the point on the NETS in Great Britain where the Project connects to. This section provides a high level summary of the alternative connection points which were considered and the key reasons for the selection of the existing Bicker Fen 400 kilovolt (kV) Substation as the connection point.

The Connection Application Process

2.4.2 As described in chapter 1 of this ES (ES-2-A.01) whilst NGVL is a part of the National Grid group of companies it is separate from National Grid Electricity Transmission plc (NGET). As separate companies, interactions between NGVL and NGET are undertaken on an 'arm's length' basis and are bound by business separation obligations overseen and enforced by the Office of Gas and Electricity Markets (Ofgem).

2.4.3 To secure a connection point for the Project, NGVL formally applied to NGET for a connection to the NETS following the same connection application process as any other potential connectee. As obligated NGET in conjunction with NGVL considered possible connection points. As part of this NGET undertook a high level desktop based, comparative assessment of known technical, economic and environmental factors to help differentiate between alternative connection point options.

Alternative Connection Points

2.4.4 The following section provides a summary of the alternative connection points which were considered by NGET and NGVL. Further information about this process is contained within the Strategic Options Report (Ref 2.2) prepared by NGVL, and the Connection Point Selection Report (Ref 2.3) prepared by NGET. It should be noted that the original work to identify a connection point was based on the Project having a 1,000 megawatt (MW) capacity. This was subsequently increased to 1,400 MW. NGET has confirmed that this subsequent increase in capacity did not have any impact on the selection of the connection point.

2.4.5 Originally 19 potential connection points were identified; this comprised 17 existing substations and 2 proposed substations. These are identified in Table 2.1 and illustrated in Figure 2.1.

Table 2.1 Alternative Connection Points

No.	Substation	Status	Location
1	Creyke Beck 400 kV Substation	Existing	East Riding of Yorkshire
2	Saltend North 275 kV Substation	Existing	East Riding of Yorkshire
3	Saltend South 275 kV Substation	Existing	East Riding of Yorkshire
4	Hedon 275 kV Substation	Existing	East Riding of Yorkshire
5	Killingholme 400 kV Substation	Existing	North Lincolnshire
6	Humber Refinery 400 kV Substation	Existing	North Lincolnshire
7	South Humber Bank 400 kV Substation	Existing	North East Lincolnshire
8	Grimsby West 400 kV Substation	Existing	North East Lincolnshire
9	Keadby 400 kV Substation	Existing	North Lincolnshire
10	West Burton 400 kV Substation	Existing	Nottinghamshire
11	Cottam 400 kV Substation	Existing	Nottinghamshire
12	Bicker Fen 400 kV Substation	Existing	Lincolnshire
13	Spalding North 400 kV Substation	Existing	Lincolnshire
14	Walpole 400 kV Substation	Existing	Norfolk
15	Bramford 400 kV Substation	Existing	Suffolk
16	Norwich Main 400 kV Substation	Existing	Norfolk
17	Sizewell 400 kV Substation	Existing	East Suffolk
18	Necton 400 kV Substation	Proposed	Norfolk
19	Eye 400 kV Substation	Proposed	Suffolk

2.4.6 NGET's assessment identified that nine of the above existing substations (Options 1 to 9 in Table 2.1) would require extensive system reinforcement. The need for additional network reinforcement could have a number of potential technical, economic and environmental impacts which could delay or present a significant risk to the Project. On this basis, the connection points that would require reinforcement works were discounted which reduced the possible connection points to the following:

10. West Burton 400 kV Substation.
11. Cottam 400 kV Substation.
12. Bicker Fen 400 kV Substation.
13. Spalding North 400 kV Substation.
14. Walpole 400 kV Substation.
15. Bramford 400 kV Substation.
16. Norwich Main 400kV Substation.
17. Sizewell 400 kV Substation.
18. Necton 400 kV Substation.
19. Eye 400 kV Substation.

2.4.7 Following further consideration, due to the two existing power stations connected at Spalding North 400 kV Substation, NGET considered that connection of the Project at Spalding North 400 kV Substation would also require system reinforcement. Preliminary work undertaken by NGVL identified that connecting into Walpole 400 kV Substation would require routeing of the submarine cable through The Wash, which is designated a Special Area of Conservation (SAC) and Special Protection Area (SPA) for its nature conservation value. It was considered that Viking Link could not be developed in these designated areas without resulting in a significant impact on their qualifying features and interests which in turn would adversely impact the likelihood of obtaining the necessary consents for the Project. On this basis, Spalding North and Walpole were not considered any further.

2.4.8 The remaining eight possible connection points were subject to a comparative study to consider the costs of the various connection point options and to determine the optimal connection point which presents the overall best value to the consumer. The comparative project cost for each of the possible connection points were considered by NGVL.

2.4.9 NGET also conducted an economic appraisal to compare potential future cost impacts. The analysis identified that there could be a significant increase in future operating costs for the high voltage electricity transmission network if the connection point was at Necton, Norwich Main, Eye or Sizewell. This reduced the viable connection point options to the following three:

10. West Burton 400 kV Substation.
11. Cottam 400 kV Substation.
12. Bicker Fen 400 kV Substation.

2.4.10 All three of the viable connection points would require a landfall being made along the Lincolnshire coastline north of The Wash. At the strategic scale of the connection point study consideration of routeing requirements for each of the three connection points was based on a direct route only; e.g. it took no account of the deviations which may be required due to environmental or technical constraints that would increase route lengths. On the basis of direct routes, a connection at either the existing West Burton 400 kV Substation or the existing Cottam 400 kV Substation would require a longer underground cable route in excess of 70 km whilst a connection to the existing Bicker Fen 400 kV Substation would require an underground cable route of approximately 50 km. The additional cable length would represent an increase in capital cost to the Project, extend the construction programme and increase disruption during construction.

The Preferred Connection Point

2.4.11 Based on consideration of a range of factors, the existing Bicker Fen 400 kV Substation was identified as the connection point which would best achieve an appropriate balance between the technical, economic and environmental obligations applicable to both NGET and NGVL. As a result it was identified as the preferred connection point and was taken forward on this basis. By connecting to the existing Bicker Fen 400 kV Substation no wider network reinforcement works, for example additional transmission circuits (e.g. overhead lines) directly attributable to the need to connect Viking Link to the NETS, are required.

3 Detailed Alternatives: The UK Onshore Scheme

3.1 Overview

3.1.1 Following the identification of the connection point at the existing Bicker Fen 400 kV Substation detailed alternatives comprising alternative landfall sites, alternative converter station sites and alternative DC cable route corridors have been developed and assessed. The remainder of this chapter of the ES describes the alternatives considered as part of the identification of the UK Onshore Scheme. Alternatives considered in the identification of the UK Offshore Scheme are described in chapter 3 of the UK Offshore ES (Ref 2.4).

3.1.2 The remainder of this chapter comprises a summary of information reported as during the identification and assessment of alternative landfall and converter station sites and DC cable route corridors. Reference should be made to the following for more detailed descriptions:

- UK Onshore Scheme: Site Selection Report (April 2016) (Ref 2.5).
- UK Onshore Scheme: Preferred Sites Report (August 2016) (Ref 2.6).
- UK Onshore Scheme: Phase 1 Consultation Feedback Report (August 2016) (Ref 2.7).
- UK Onshore Scheme: Route Corridor Selection Report (September 2016) (Ref 2.8).
- UK Onshore Scheme: Preferred Route Corridor Report (December 2016) (Ref 2.9).
- UK Onshore Scheme: Phase 2 Consultation Feedback Report December 2016) (Ref 2.10).

3.2 Approach to the Development of the UK Onshore Scheme

3.2.1 The overall approach to the development of the UK Onshore Scheme, including some of the specialist studies and consultation activities which have informed its development and design, are illustrated in **Error! Reference source not found.**. This shows the main steps in the development of the UK Onshore Scheme from identification of the connection point, through the assessment of alternative landfall and converter station sites, the assessment of alternative DC cable route corridors, and EIA to the point arriving at a base scheme design and making the necessary full planning applications.

3.2.2 The development of the UK Onshore Scheme has comprised two main steps; firstly, the identification and assessment of alternative landfall and converter station sites (Siting) and secondly the identification and assessment of alternative cable routes (Routeing). The approach to identifying and assessing alternative sites and routes has ensured the integrated and iterative consideration of potential impacts on the environment and local communities alongside technical and engineering considerations and at key stages has also drawn upon feedback received from statutory and non-statutory consultees and members of the public. The overall aim of this approach has been to identify sites or routes which best balance these factors in order to establish the preferred landfall and converter stations sites and preferred DC cable route corridor in which the UK Onshore Scheme will be finalised.

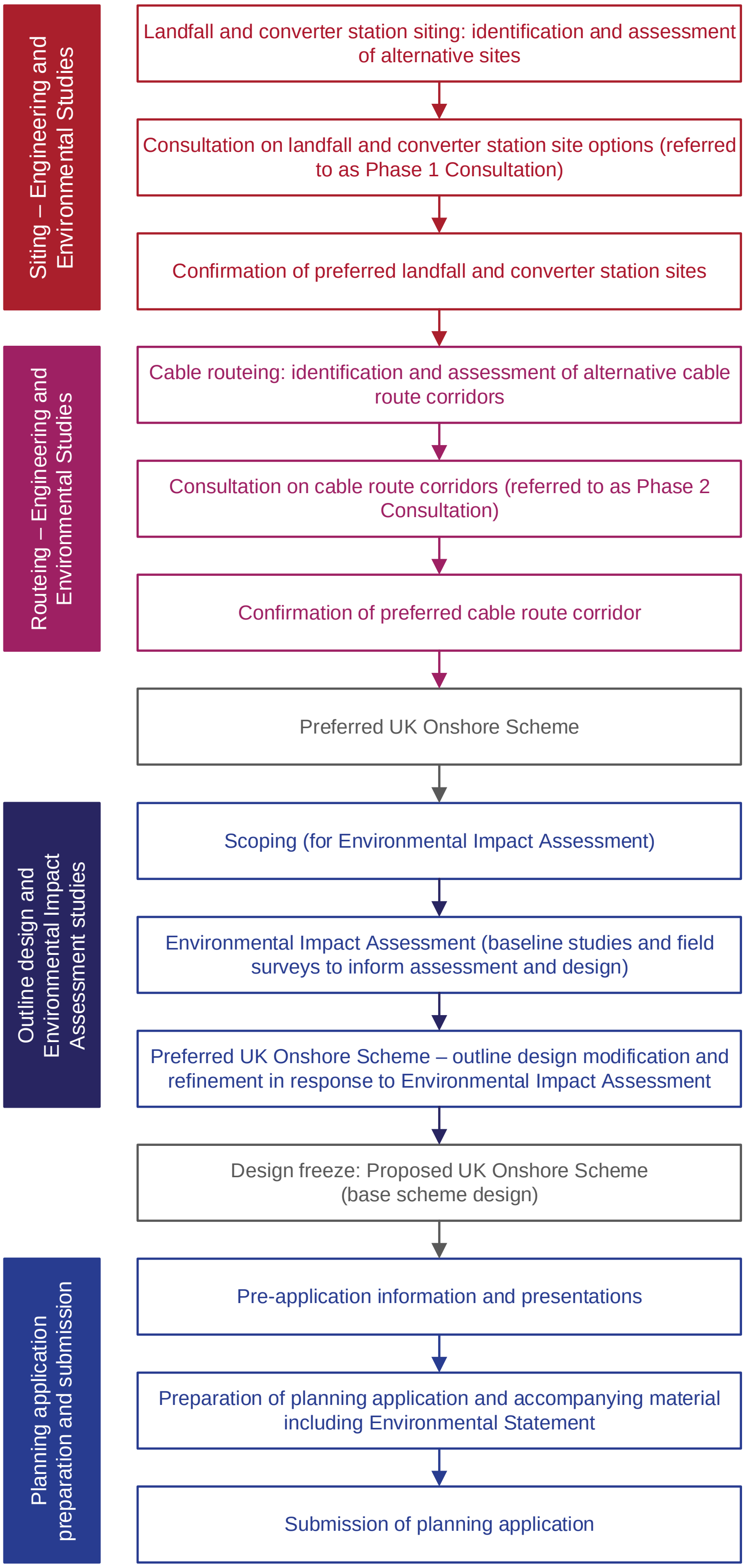

Figure 2.2 Approach to development of UK Onshore Scheme

3.3 Key Siting and Routeing Considerations

Environmental and Community Considerations

3.3.1 Table 2.2 provides a summary of the key environmental considerations which have informed the identification and assessment of alternative landfall and converter station sites and DC cable route corridors. This included consideration of the physical environment including built and natural heritage as well as potential impacts on local communities and key land uses.

Table 2.2 Summary of Key Environmental Siting & Routeing Considerations

Consideration	Description
Acoustics	Consideration of the proximity of alternative sites and/or routes to potential Noise Sensitive Receptors (NSRs) including local communities, residential properties and visitor attractions.
Traffic & Transport	Consideration of the proximity of alternative sites and/or routes to existing main roads (in particular A-class roads) as well as and potential access routes to alternative sites and/or routes.
Geology	Consideration of the solid and drift geology resources underlying alternative sites and/or routes as well as the potential to encounter existing contaminated land or unexploded ordnance (UXO).
Hydrology	Consideration of the proximity of alternative sites and/or routes to, or extent within flood risk zones, as well as the locations or crossings of water courses, drains or other surface water features.
Agriculture	Consideration of the of Agricultural Land Classification (ALC) and soils underlying alternative sites and/or routes as well as proximity to Agri-Environment Stewardship (AES) schemes.
Landscape & Visual	Consideration of the potential impact of alternative sites and/or routes on landscape designations and landscape character including Areas of Outstanding Natural Beauty (AONB) and registered parks and gardens.
Ecology	Consideration of the potential impact of alternative sites and/or routes on designated and non-designated sites, priority and other important habitats such as woodland and grazing marshes.
Archaeology & Cultural Heritage	Consideration of the potential direct and indirect impact of alternative sites and/or routes on designated and non-designated archaeological or heritage assets as well as the potential to encounter unrecorded archaeology.

Technical and Engineering Considerations

3.3.2 Table 2.3 below sets out the key technical and engineering considerations which have informed the identification and assessment of alternative landfall and converter station sites and cable route corridors. This included consideration of the constructability of alternative sites and/or routes as well as the land required to build, operate and maintain them.

Table 2.3 Summary of Key Technical & Engineering Siting& Routeing Considerations	
Consideration	**Description**
Constructability	The feasibility of construction taking into account potential physical and environmental constraints such as topography or other obstacles to be crossed including watercourses, roads, railways and other infrastructure.
Land take	The land or space provided by alternative sites and/or routes and the extent to which they can accommodate required temporary (construction) and permanent (operation) land take.
Accessibility	Accessibility for construction taking into account the local road network, , obstacles to construction access and the potential need for new temporary or permanent access roads to be established.

3.4 Role of Consultation

3.4.1 Stakeholder engagement with key parties including Local Planning Authorities (LPAs), statutory bodies and stakeholder organisations as well as parish councils and local communities has been a key consideration in the development of the UK Onshore Scheme. To support the approach to siting and routeing, a phased approach to consultation has been adopted to allow feedback from stakeholders to be fed into the decision-making process at points where it could influence siting and routeing.

3.4.2 Key consultation activities have comprised:

- Phase 1 Consultation. This was held over a six-week period in April and May 2016. During this consultation statutory and non-statutory consultees, stakeholder organisations, landowners and members of the public were asked for their views on the selection of shortlisted landfall and converter station sites.
- During July and August 2016 in advance of routeing, NGVL held a series of public participation events to introduce the UK Onshore Scheme to the local residents, landowners and other stakeholders across a large cable route search area between alternative landfall and converter station sites.
- Phase 2 Consultation took place over a six-week period from September to October 2016. During this consultation statutory and non-statutory consultees, stakeholder organisations, landowners and members of the public were asked for their views on the selection of a cable route corridor as well as potential design styles for the converter station.
- At various points during the identification and assessment of alternative landfall and converter station sites and DC cable routes NGVL held briefings, meetings and workshops with statutory and non-statutory consultees, stakeholder organisations as well as LPA members to inform the identification of the UK Onshore Scheme.

3.4.3 Further information on the key issues raised by stakeholders and how they have influenced the development of the Scheme can be found in the Statement of Community Involvement (SCI) (Ref 2.11) which accompanies the planning application.

4 Detailed Alternatives: Landfall Siting

4.1 Introduction

4.1.1 A number of alternative landfall sites were considered in developing the UK Onshore Scheme. This section provides a summary of the approach to and assessment of alternative landfall sites and how the proposed landfall has been identified. More detailed information is contained in the UK Onshore Scheme: Site Selection Report (Ref 2.5) which describes how NGVL determined which landfall sites to take forward to Phase 1 Consultation and the UK Onshore Scheme: Preferred Sites Report (Ref 2.6) which describes how the proposed landfall site was selected taking into account the results of technical and environmental assessments as well as feedback from consultation.

4.2 Approach to Landfall Siting

4.2.1 The overall objective of the landfall siting assessment was the identification of a preferred site to bring the submarine cables ashore and connect to the onshore cables. The identification of the preferred landfall informs the location of the Transition Joint Pit (TJP); that is the buried pit where submarine cables are connected to onshore cables. The approach to selecting a preferred landfall site is illustrated in Figure 2.. It comprised the identification and assessment of alternative landfall sites, consultation on shortlisted alternatives and then selection of a preferred landfall site.

4.2.2 The approach combined consideration of potential impacts on the environment and local communities alongside technical and engineering considerations in order to identify feasible alternative landfall sites which were then subject to consultation (referred to as 'Phase 1 Consultation'). Feedback received from consultation as well as the findings of environmental and technical assessments then informed the selection of the preferred landfall site.

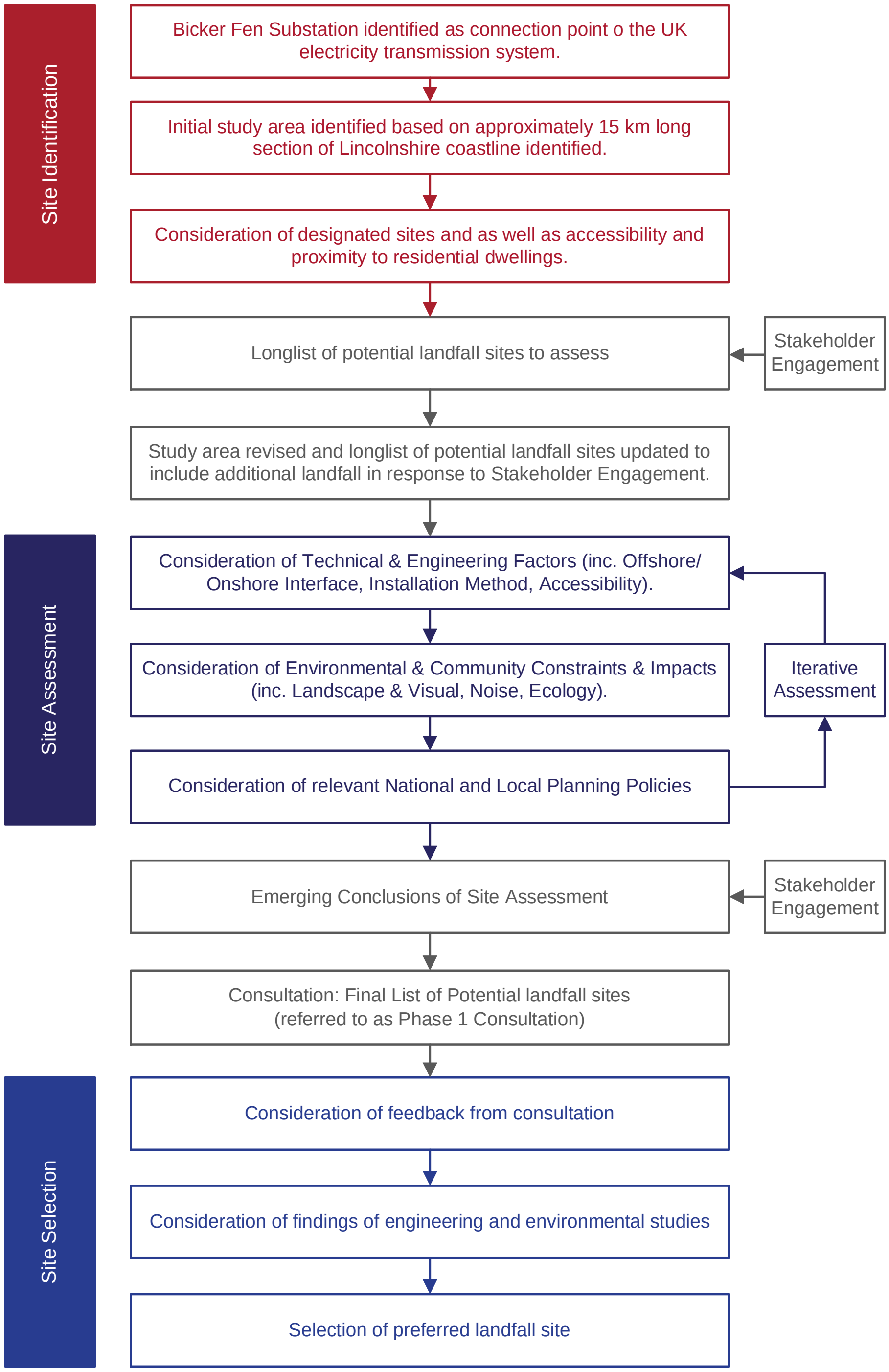

Figure 2.3 Approach to Landfall Siting

4.3 Identification and Assessment of Landfall Sites

Identification of Alternative Landfall Sites

4.3.1 Following the identification of the connection point at the existing Bicker Fen 400 kV Substation a study area extending between Sutton on Sea in the north and Skegness in the south was established. This allowed for the identification of potential landfall sites which would facilitate the development of (1) feasible and economic underground DC cable routes to potential converter station sites in the vicinity of the connection point and (2) feasible and economic submarine DC cable routes to Denmark.

4.3.2 The Wash is designated a SAC and SPA for its nature conservation value. As a result of these designations this section of coastline was not considered further in terms of potential landfall siting. It was considered that Viking Link could not be developed in these designated areas without resulting in a significant impact on their qualifying features and interests which in turn would adversely impact the likelihood of obtaining the necessary consents for the Project.

4.3.3 The identification of potential landfall sites took into account a range of environmental and technical constraints at a high level including the proximity of settlements and sites designated for their landscape, ecological and/or archaeological value as well as technical considerations such as accessibility and the nature of the coastline (for example rocky or sandy). As a result of this and initial engagement with consultees five potential landfalls were identified with a sixth option emerging during the assessment. All six landfalls are illustrated in Figure 2.4.

Assessment of Alternative Landfall Sites

4.3.4 An assessment of the six potential landfall sites (Figure 2.4) was undertaken to assess the potential impacts on the environment and local community, alongside preliminary technical and engineering factors. The results of this assessment are reported in UK Onshore Scheme: Site Selection Report (April 2016) (Ref 2.5). The assessment resulted in three of the landfall sites (LF3, LF4 and LF5) being discounted for a combination of technical and/or environmental reasons. The three remaining potential landfall sites (LF1, LF1a and LF2) were considered to be feasible options and were therefore shortlisted and taken forward to Phase 1 Consultation with the local community, statutory consultees and other stakeholders.

4.3.5 Table 2.5 provides a summary of the landfall siting assessment.

Table 2.4 Summary of Landfall Siting Assessment

Landfall	Key Findings	Conclusion
LF1	Relatively distant from settlement and provides opportunities to avoid direct impacts on LCGM and develop a direct access from the A52 avoiding settlement.	Shortlisted

Table 2.4 Summary of Landfall Siting Assessment		
Landfall	**Key Findings**	**Conclusion**
LF1a	Relatively distant from settlement but constraints lie to the north (Marine Conservation Zone) and to the south (onshore – LCGM and offshore – designated bathing waters).	Shortlisted (Preferred)
LF2	In close proximity to settlement increasing potential impact of construction. Partly adjacent to designated bathing waters. Inland routeing would require to cross LCGM.	Shortlisted
LF3	In close proximity to settlement including holiday parks and therefore has potentially greater impact during construction. Constrained by lack of direct access to the landfall.	Discounted
LF4	Significant engineering constraints including the requirement for the subsea cable to cross multiple cables as well as proximity to settlement and the potential impact during construction.	Discounted
LF5	Potential for significant ecological impacts, proximity to Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC and SSSI and Humber Estuary SPA and Ramsar) and require extensive route through LCGM.	Discounted

4.4 Preferred Landfall Site

4.4.1 Taking into account the findings of the technical and environmental assessments of the shortlisted landfall sites as well as the feedback received in response to Phase 1 Consultation, NGVL identified LF1a as the preferred the landfall site. This is illustrated in Figure 2.5. This site meets the requirements of NGVL; it is technically feasible from and onshore and offshore point of view and, compared to alternative landfall sites, it provides the opportunity to avoid or reduce the potential impact on nearby communities and other coastal environmental constraints such as the Lincolnshire Coastal Grazing Marshes (LCGM) and designated bathing waters.

4.4.2 The UK Onshore Scheme: Preferred Sites Report (August 2016) (Ref 2.6) provides an explanation of the selection of LF1a as the preferred landfall, in summary the main reasons were:

- Compared to alternative landfall sites it is more distant from residential properties and would therefore result in the least disturbance during construction of the landfall.
- It is mainly located outside of and away from environmental designations including the LCGM and ensures that direct impacts can be avoided in developing the detailed route alignment.
- Compared to alternative landfall sites it provides the opportunity to develop a direct temporary access and would prevent or reduce the amount of traffic utilising local roads in closer proximity to residential properties.
- Compared to alternative landfall sites it is more distant from facilities connected with tourism and recreation activities including designated beach access and bathing waters and would therefore result in the least disturbance during construction of the landfall.

5 Detailed Alternatives: Converter Station Siting

5.1 Introduction

5.1.1 A number of alternative converter station sites were considered in developing the UK Onshore Scheme. This section provides a summary of the approach to and assessment of alternative converter station sites and how the proposed converter station site has been identified. More detailed information is contained in the UK Onshore Scheme: Site Selection Report (Ref 2.5) which describes how NGVL determined which converter station sites to take forward to Phase 1 Consultation and the UK Onshore Scheme: Preferred Sites Report (Ref 2.6) which describes how the proposed converter station site was selected taking into account the results of technical and environmental assessments as well as feedback from consultation.

5.2 Approach to Converter Station Siting

5.2.1 The overall objective of the converter station siting assessment was the identification of a preferred site at which the DC cables would terminate and where electricity would be converted back to AC and which would then be connected to the NETS at the existing Bicker Fen 400 kV Substation by AC cables. The approach to selecting the preferred converter station site is illustrated in Figure 2.6. It comprised the identification and assessment of alternative converter station sites, consultation on feasible alternatives and then selection of a preferred converter station site. The approach combined consideration of potential impacts on the environment and local communities alongside technical and engineering factors in order to identify feasible alternative converter station sites which were then subject to Phase 1 Consultation. Feedback received from consultation as well as the findings of environmental and technical assessments then informed the selection of the preferred site in which to develop the design of the converter station.

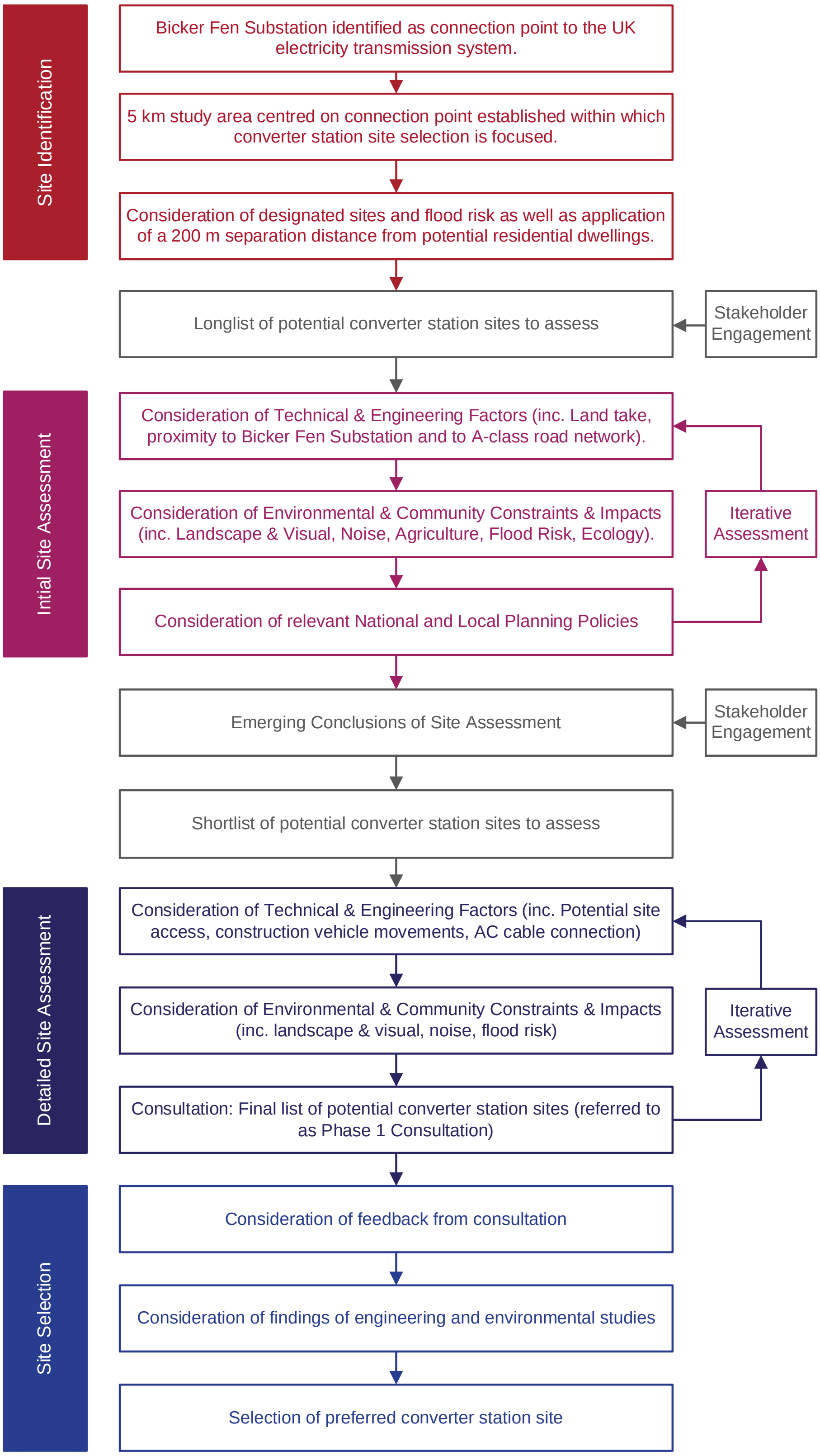

Figure 2.6 Approach to Converter Station Siting

5.3 Identification and Assessment of Converter Station Sites

Identification of Alternative Converter Station Sites

5.3.1 Following the identification of the connection point at the existing Bicker Fen 400 kV Substation a study area extending out 5 km in all directions from the connection point was established. This was based on the technical requirements of the Project. At distances greater than 5 km the converter station would require additional specialist equipment to make up for power losses incurred during the transmission of electricity which would require it to increase in footprint.

5.3.2 The identification of potential converter station sites took into account a range of environmental and technical constraints at a high level including the proximity of settlements, individual residential properties and sites designated for their landscape, ecological and/or archaeological interests or value and areas of flood risk as well as technical considerations such as the approximate footprint of a converter station and accessibility. This resulted in the identification of twenty one potential converter station sites as illustrated in Figure 2.7.

Assessment of Alternative Converter Station Sites

5.3.3 The assessment of the 21 potential converter station sites considered the potential impacts on the environment and the local community alongside preliminary technical and engineering factors. The results of this assessment are reported in UK Onshore Scheme: Site Selection Report (April 2016) (Ref 2.5).

5.3.4 The assessment was undertaken in a number of stages, initial assessment of the 21 sites which resulted in 13 sites being discounted for a combination of technical and/or environmental reasons (CS2, CS7, CS8, CS11, CS12, CS13, CS14, CS15, CS16, CS18, CS19, CS20 and CS21). The eight remaining potential converter station sites were subject to a further more detailed assessment which resulted in a further four sites being discounted (CS4, CS6, CS10 and CS17). The four remaining potential converter station sites (CS1, CS3, CS5 and CS9) were considered to be feasible options and were therefore shortlisted and taken forward to Phase 1 Consultation with the local community, statutory consultees and other stakeholders.

5.3.5 Table 2.5 provides a summary of the converter station siting assessment.

Table 2.5 Summary of Converter Station Siting Assessment

Landfall	Key Findings	Conclusion
CS1	Remote from larger settlements with potential to reduce noise and visual impacts on individual properties in closer proximity. In key views seen in the context of existing developments at Bicker Fen but visually separate from it. Whilst requiring a new access road this would benefit from providing separation between local road users and construction traffic. In an area of potentially higher flood risk but considered to be mitigable.	Shortlisted (Preferred)

Table 2.5 Summary of Converter Station Siting Assessment		
Landfall	**Key Findings**	**Conclusion**
CS2	In combination the high risk of flooding and location of the site south of the railway line present significant environmental and technical constraints.	Discounted
CS3	Remote from larger settlements with potential to reduce noise and visual impacts on individual properties in closer proximity. In key views seen in the context of existing development at Bicker Fen with opportunity for integration. Whilst requiring a new access road this would benefit from providing separation between local road users and construction traffic.	Shortlisted
CS4	Close to a residential properties and settlement and whilst considered to be mitigable with regards noise and visual impacts it would affect more of the community. Benefits from short direct access from the A17 with potential to provide separation between local road users and construction traffic. Development would be prominent with little to no context/relationship with existing development at Bicker Fen.	Discounted
CS5	Close to larger settlements and whilst considered to be mitigable with regards noise and visual impacts it would affect more of the community. Benefits from short direct access from the A17 with potential to provide separation between local road users and construction traffic. Development would be prominent with little to no context/relationship with existing development at Bicker Fen.	Shortlisted
CS6	Close to larger settlements and whilst considered to be mitigable with regards noise and visual impacts it would affect more of the community. Benefits from short access from the A17 via local road. Development would be prominent with little to no context/relationship with existing development at Bicker Fen.	Discounted
CS7	Limited accessibility with significant engineering works required to enable access. Remote to Bicker Fen 400 kV Substation requiring approximately 4.5km AC cable route connection including a crossing of South Forty Foot Drain.	Discounted
CS8	Limited accessibility with significant engineering works required to enable access. Potential for disturbance including noise and/or visual impacts to affect a larger number of receptors due to proximity to local communities. Remote to Bicker Fen Substation requiring approximately 4.5km AC cable route connection including a crossing of South Forty Foot Drain.	Discounted

Table 2.5 Summary of Converter Station Siting Assessment		
Landfall	**Key Findings**	**Conclusion**
CS9	Remote from larger settlements with potential to reduce noise and visual impacts on individual properties in closer proximity. In key views seen in the context of existing development at Bicker Fen with opportunity for integration. Whilst requiring the use of an existing haul road with potential to extend via a new haul/access road this would benefit from providing some separation between local road users and construction traffic. In an area of high flood risk but considered to be mitigable.	Shortlisted
CS10	Close to larger settlements and whilst considered to be mitigable with regards noise and visual impacts it would affect more of the community. Benefits from short direct access from the A17 or A52 with potential to provide separation between local road users and construction traffic. Development would be prominent with little to no context/relationship with existing development at Bicker Fen. Onsite constraints including flood risk and overhead line constrain micro-siting options.	Discounted
CS11	Existing utilities significantly constrain the amount of land available for development which would prevent development of a converter station within this site.	Discounted
CS12	Existing utilities significantly constrain the amount of land available for development which would prevent development of a converter station within this site.	Discounted
CS13	Existing utilities significantly constrain the amount of land available for development which would prevent development of a converter station within this site.	Discounted
CS14	Existing utilities significantly constrain the amount of land available for development which would prevent development of a converter station within this site. Additionally in closer proximity to settlement so increased potential for noise and visual impacts.	Discounted
CS15	Limited accessibility with significant engineering works required to enable access. Remote to Bicker Fen 400 kV Substation requiring approximately 4.5km AC cable route connection including a crossing of South Forty Foot Drain.	Discounted
CS16	The proximity to the Wash SPA and land take involving a higher level and organic entry level environmental stewardship scheme are considered to result in greater environmental impacts than alternatives. The distance from Bicker Fen Substation also means that this option would require longer DC and AC cable routes resulting in more disturbance than alternatives.	Discounted

Table 2.5 Summary of Converter Station Siting Assessment		
Landfall	**Key Findings**	**Conclusion**
CS17	Close to larger settlements and whilst considered to be mitigable with regards noise and visual impacts it would affect more of the community. Whilst requiring a new haul/access road and use of an existing haul road this would benefit from providing separation between local road users and construction traffic. Development would be prominent with little context/relationship with existing development at Bicker Fen in some views.	Discounted
CS18	Limited accessibility with significant engineering works required to enable access. Remote to Bicker Fen 400 kV Substation requiring approximately 4.5km AC cable route connection including a crossing of South Forty Foot Drain.	Discounted
CS19	Limited accessibility with significant engineering works required to enable access. Remote to Bicker Fen 400 kV Substation requiring approximately 4.5km AC cable route connection including a crossing of South Forty Foot Drain.	Discounted
CS20	In closer proximity to a larger section of the local community including settlements and individual properties than alternatives so greater potential for noise and/or visual impacts.	Discounted
CS21	Land available for development is more constrained reducing flexibility for converter station design.	Discounted

5.4 Preferred Converter Station Site

5.4.1 Taking into account the findings of the technical and environmental assessments of the shortlisted converter station sites as well as the feedback received in response to Phase 1 Consultation, NGVL identified CS1 as the preferred converter station site. This is illustrated in Figure 2.8. Whilst CS1 would require an overall longer DC cable route; on balance of the different factors evaluated, this site is considered to best meet the requirements of NGVL. It is technically feasible and, compared to the alternative sites considered, it provides the opportunity to mitigate potential impacts on the environment and local community through planning and design.

5.4.2 The UK Onshore Scheme: Preferred Sites Report (August 2016) (Ref 2.6) provides an explanation of the selection of CS1 as the preferred converter station site but in summary the main reasons were:

- The preferred site is relatively remote from larger settlements and whilst there are a small number of residential properties within 250 to 300m of the site there are opportunities to mitigate potential noise and visual impacts through the design and layout of the converter station respectively.

- In order to reduce disruption due to traffic, there is the potential for the site to be accessed via a new access road directly from the A52. The use of a new road to access the converter station site would provide some benefits by diverting construction traffic away from the local road network and smaller settlements.
- Whilst landscape and visual impacts are unavoidable (and are for all sites due to size of the converter station) the location and size of the preferred site provides opportunities to mitigate impacts through the detailed siting, layout and design of the converter station as well as the development of boundary planting to screen and filter views.
- There is potential for unknown archaeology to be present at all potential converter station sites. Further investigation will be required in relation to cropmarks which are present within the site prior to construction to mitigate potential impacts.
- There are no significant ecological or agricultural constraints related to CS1. Whilst there would be some disturbance associated with the site access and AC cable route to the connection point this is considered, on balance, to be less than the alternative sites.

5.5 Converter Station Design Styles

5.5.1 Following identification of the preferred converter station site at CS1; during the Phase 2 Consultation NGVL sought feedback from statutory and non-statutory consultees, stakeholder organisations, landowners and members of the public as to the design of the converter station. Alternative design styles comprising a contextual style and a functional style were consulted on:

- Contextual style: This was based on the converter station assimilating an appearance based on agricultural buildings which are more common in the wider landscape, illustrated in Figure 2.9.
- Functional style: This was based on the converter station assimilating an appearance based on typical electricity transmission infrastructure such as substations, illustrated in Figure 2.9.

5.5.2 Feedback on the alternative design styles is reported in UK Onshore Scheme: Phase 2 Consultation Feedback Report December 2016) (Ref 2.10). No clearly preferred design style was identified as a result of feedback. Further consideration of the approach to design was given in consultation with South Holland District Council (SHDC). Further details of the design of the proposed converter station are set out in Chapter 19 of the ES.

6 Detailed Alternatives: Underground Cable Routeing

6.1 Introduction

6.1.1 A number of alternative DC cable route corridors were considered in developing the UK Onshore Scheme. This section provides a summary of the approach to and assessment of alternative cable route corridors and how the proposed DC cable route has been identified. More detailed information is contained in the UK Onshore Scheme: Route Corridor Selection Report (Ref 2.8) which describes how NGVL determined which DC cable route corridors to take forward to Phase 2 Consultation and the UK Onshore Scheme: Preferred Route Corridor Report (Ref 2.9) which describes how the preferred DC cable route corridor was selected taking into account the results of technical and environmental assessments as well as feedback from consultation.

6.2 Approach to Underground Cable Routeing

6.2.1 The overall objective of the routeing assessment was the identification of a preferred route corridor within which the detailed alignment of the DC cables would be finalised. The approach to selecting the preferred route corridor is illustrated in Figure 2.10. It comprised the identification of a cable route search area (based on shortlisted landfall and converter station sites), the identification and assessment of alternative route corridors, consultation on route corridors (based on preferred landfall and converter station sites) and then selection of a preferred route corridor. The approach combined consideration of potential impacts on the environment and local communities alongside technical and engineering factors in order to identify feasible alternative route corridors which were then subject to consultation (referred to as 'Phase 2 Consultation'). Feedback received from consultation as well as the findings of environmental and technical assessments then informed the selection of the preferred DC route corridor in which to develop the finalised alignment.

6.2.2 A staged approach was taken to develop the DC cable route corridors taking into account consideration of potential impacts on the environment and the local community, existing and emerging planning policy, other existing and proposed developments as well as technical and engineering design information. The aim of the approach was to balance consideration of these factors and identify potential route corridor options which formed the focus of the Phase 2 Consultation and within which the detailed alignment of the onshore cable route could be finalised.

6.2.3 The approach to cable routeing comprised three steps:

- Step 1 – Identification of the Cable Route Search Area: identification of a search area based on the shortlisted landfall and converter station sites and taking into account environmental constraints including designated sites (landscape, ecology and archaeology), physical constraints, communities as well as proximity to the road network.

- Step 2 – Development and Assessment of Cable Route Corridors: identification and assessment of potential cable route corridors considering potential impacts on the environment and local communities alongside basic technical and engineering factors including installation methods and access requirements.
- Step 3 – Development of Route Alignment: (i) identification of a preferred cable route corridor and (ii) development of a final cable route alignment within the preferred route corridor taking into account further consultation with land owners and relevant consultees and consideration of impacts on the environment and local communities along with detailed technical and engineering requirements.

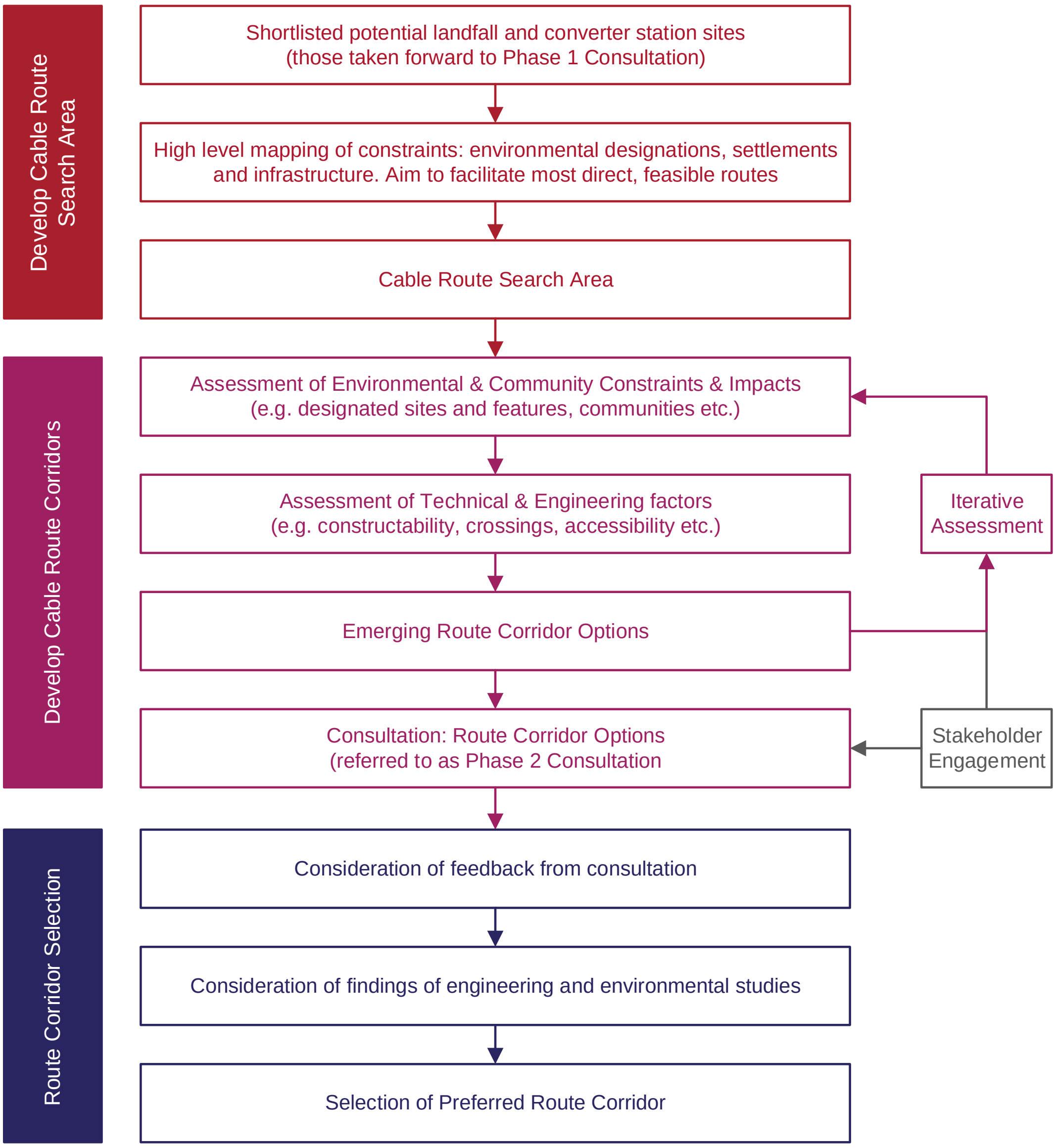

Figure 2.10 Approach to Cable Routeing

6.3 Identification and Assessment of Underground Cable Route Corridors

Identification of Underground Cable Route Corridor

6.3.1 At the outset of the identification of the UK Onshore Scheme a large study area was established extending from the Lincolnshire coastline to the connection point at the existing Bicker Fen 400 kV Substation. This is illustrated in Figure 2.11. In order to ensure underground cable routeing was appropriately focused a review of the study area was undertaken. The review considered the locations of potential landfalls and converter station sites as well as environmental and technical constraints including designated sites, settlements, roads and topography and watercourses. From this a Cable Route Search Area was identified that would facilitate the identification of alternative route corridors between shortlisted landfall and converter station site options which were the subject of Phase 1 Consultation. The Cable Route Search Area is also illustrated in Figure 2.11.

6.3.2 A review of the Cable Route Search Area resulted in the identification of five route corridors as illustrated on Figure 2.11. Three route corridors were identified (A, B and C) which provide alternative routes from the Phase 1 Consultation shortlisted landfalls and onwards around the different constraints which are present in the east of the study area including the Lincolnshire Wolds AONB, Gunby Estate and the LCGM at Burgh le Marsh. In forming a continuous route corridor from the landfall to converter station only one of these corridors would be required. To the west of this point two route corridors (D and E) connect from corridors A, B and C in the vicinity of Stickford on the A16 and from here provide opportunities to connect to the Phase 1 Consultation shortlisted converter stations.

6.3.3 These initial route corridors are illustrated in Figure 2.12 and a brief description is provided in Table 2.6 below:

Table 2.6 Initial Cable Route Corridors

Option	Description	Approximate Length
Route Corridor A (RCA)	From the Phase 1 Consultation Landfalls (LF1a, LF1 and LF2) to north of Stickford. This is the most northern route corridor.	29 km (from most northern landfall to north of Stickford)
Route Corridor B (RCB)	From the Phase 1 Consultation Landfalls (LF1a, LF1 and LF2) to the east of Stickford. This is the central option of the three route corridors from the coast.	28 km (from most northern landfall to east of Stickford)
Route Corridor C (RCC)	From the Phase 1 Consultation Landfalls (LF1a, LF1 and LF2) to the east of Stickford. This is the most southern route corridor from the landfalls.	32 km (from most northern landfall to east of Stickford)

Table 2.6 Initial Cable Route Corridors		
Option	**Description**	**Approximate Length**
Route Corridor D (RCD)	From Stickford to Swineshead Bridge. This is a wide corridor which would allow for onward routes to be developed from A, B or C to the north of search area for converter stations.	24 km (from Stickford to Swineshead Bridge)
Route Corridor E (RCE)	From Swineshead Bridge to the Phase 1 Consultation Converter Stations (CS1, CS3, CS5 and CS9).	5 km (from Swineshead Bridge to the most southern converter station)

6.3.4 Through an iterative assessment of the potential impacts on the environment and local communities, alongside technical and engineering factors RCA, RCB, RCD and RCE were all identified as providing feasible opportunities to develop a cable route. RCC was discounted as it is considered to be less preferable taking into account technical and environmental considerations.

6.3.5 As shown in Figure 2.12 different combinations of these route corridors result in a continuous route corridor which connects the preferred landfall site (LF1a) to the preferred converter station site (CS1). These combinations were identified as the Purple Route Corridor (comprising parts of RCA, RCD and RCE) and the Orange Route Corridor (comprising parts of RCB, RCD and RCE), both of which were taken forward to Phase 2 Consultation.

Assessment of Alternative Route Corridors

The Purple Route Corridor

6.3.6 The Purple Route Corridor is illustrated in Figure 2.13. Subject to detailed routeing it is up to 63.9 km long and is routed through the administrative areas of East Lindsey District Council (ELDC), Boston Borough Council (BBC), North Kesteven District Council (NKDC) and South Holland District Council (SHDC).

6.3.7 From the preferred landfall to the east of Stickford the Purple Route Corridor is in more elevated land through the Lincolnshire Wolds AONB. Within the AONB the Purple Route Corridor comprised two alternative sub-options for avoiding an area of settlement and some technically challenging topography close to Langton. From where the sub-options re-join the Purple Route Corridor it descends south west into the lower lying fens where land is almost entirely agricultural. It is routed through agricultural land until it reaches the preferred converter station site. There are two alternative sub-options approaching the preferred converter station site, east or west of South Forty Foot Drain.

6.3.8 The results of an assessment of the Purple Route Corridor are reported in the UK Onshore Scheme: Route Corridor Selection Report (Ref 2.8).

The Orange Route Corridor

6.3.9 The Orange Route Corridor is illustrated in Figure 2.14. Subject to detailed routeing it is up to 67.4 km long and is routed through the administrative areas ELDC, BBC, NKDC and SHDC.

6.3.10 From the preferred landfall to the east of Stickford the Orange Route Corridor is in low lying coastal plains. In this area in order to avoid Gunby Hall and its surrounding estate land the Orange Route Corridor comprises two sub-options, the first sub-option requiring an approximate 3 km route corridor through the AONB and the second sub-option which avoids the AONB comprising a longer route corridor crossing more watercourses, closer to a number of settlements and routed through the Burgh le Marsh Target Area of the LCGM. From where the sub-options re-join the Orange Route Corridor it follows a western route through the lower lying fens where land is almost entirely agricultural. It is routed through agricultural land until it reaches the preferred converter station. There are two alternative sub-options approaching the preferred converter station site, east or west of South Forty Foot Drain.

6.3.11 The results of an assessment of the Orange Route Corridor are reported in the UK Onshore Scheme: Route Corridor Selection Report (Ref 2.8).

6.4 Preferred Cable Route Corridor

6.4.1 Routeing would typically seek to avoid designated sites or where they are unavoidable seek to reduce the route within these designations as much as possible. The Purple Route Corridor comprised two sub-options both of which would require routeing through the AONB (for approximately 9 km), whilst the Orange Route Corridor comprised two sub-options one which would require routeing through the AONB (for approximately 3 km) and one which would avoid it.

6.4.2 Given its potential to avoid the AONB, or at least require a shorter crossing of it, the Orange Route Corridor has been examined in detail and assessed against the Purple Route Corridor having close regard to great weight attributable to the AONB designation and the consequent need to demonstrate exceptional circumstances in justification for the routing of the cable corridor through this area.

6.4.3 NGVL recognise that the AONB is a significant and important policy designation and that planning permission should be refused for major developments in these designated areas except in exceptional circumstances and where it can be demonstrated they are in the public interest. In this context, it is accepted that the provision of the cable corridor as part of the Scheme has the potential to be a major development and that it is necessary to undertake an assessment of:

- The need for the development, including in terms of any national considerations, and the impact of permitting it, or refusing it, upon the local economy;
- The cost of, and scope for, developing elsewhere outside the designated area, or meeting the need for it in some other way; and
- Any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated.

The Need for the Project

6.4.4 An explanation of the need for and benefits of Viking Link is described in the Planning Statement (Ref 3.2) which accompanies the planning application. In this context, NGVL have undertaken a detailed examination of the need for the Project and this is provided in summary at chapter 3 (ES-2-A.03) of this ES. In summary, the development of the Project is supported by European, national and local policy and provides clear and substantial benefits for both Great Britain and Denmark in meeting national and European objectives. These include:

- Affordability: Viking Link will connect electricity networks in Great Britain and Denmark and in turn connect both countries to the wider European electricity market. This should help create downward pressure on wholesale electricity prices in both Britain and Denmark through cross border trade in electricity and shared use of the cheapest generation sources. It will help stimulate competition in the European market and facilitate the optimal use of resources across European Union (EU) Member States. Viking Link will benefit both countries by increasing the market for electricity generators (i.e. providing access to larger pool of consumers) and by providing consumers with more affordable electricity (i.e. providing access to a larger pool of suppliers).
- Security of supply: Interconnection provides access to a wide range of electricity generation sources and is a means to import or bring in extra electricity when not enough is being generated to meet demand at that time (similarly when there is a surplus it is a means to export electricity). This increases energy continuity and security if demand rises or electricity generation falls suddenly in one country. It will also act as an important balancing tool helping to improve the stability of the British and Danish electricity transmission systems.
- Sustainability: Interconnectors are an important means to help manage the fact that electricity cannot be stored efficiently at a large scale and not all electricity sources can generate consistently and predictably. They do this by providing a means to transfer surplus energy between countries when too much is generated at once to be used domestically. This should make a significant contribution in the transition to a low carbon economy in Great Britain, Denmark and Europe by helping with the challenge of integrating low carbon and renewable sources of electricity and retiring fossil fuel and nuclear plants.

6.4.5 NGVL are satisfied that there is a clear and robust European, national and local policy imperative for the delivery of Viking Link and that its development will have no significant adverse impacts upon the local economy. This latter issue is considered in further detail and confirmed in chapter 24 of the ES (ES-2-C.08).

The Cost and Scope of an Alternative Route Corridor

6.4.6 The key reasons for the discounting the Orange Route Corridor and selecting the Purple Route Corridor are summarised in UK Onshore Scheme: Preferred Route Corridor Report (December 2016) (Ref 2.9). This assessment concludes that the Purple Route Corridor is preferable to the

Orange Route Corridor on the basis of environmental impact and technical and engineering feasibility.

6.4.7 The key constraints affecting the Orange Route Corridor compared to the Purple Route Corridor relate to mainly to a combination of topography, surface and groundwater as well as proximity to settlement and access from the local road network. These constraints adversely affect different sections of the Orange Route Corridor both inside and outside of the AONB. Key constraints or issues are as follows:

- Due to being within lower lying land outside of the AONB the Orange Route Corridor requires over 100 more crossings of watercourses and drains compared to the Purple Route Corridor. Construction works would therefore be more complex requiring additional plant and machinery for trenchless crossings. This would result in:
  - In environmental terms as a result of increased construction activity increased impacts on the local community (including noise, visual and dust effects), on agricultural land as a result of greater land take and increased traffic movements as a result of the need for additional plant and machinery.
  - In engineering terms the construction works would be more difficult taking longer to be completed and costing more compared to the Purple Route Corridor. This is due to the increased number of crossings which also increases the number of joint bays which would be required.
- Outside of the AONB the Orange Route Corridor is in closer proximity to a number of settlements increasing the number of residents who would be affected by construction related disturbance. This would be further amplified by the extended construction programme which would be required as well as the proximity of the Orange Route Corridor to Triton Knoll Offshore Wind Farm's export cable which would also result in potential cumulative effects as a result of overlapping construction programmes. The Purple Route Corridor is generally located further away from settlements as well as avoiding Triton Knoll Offshore Wind Farm's Electrical System. As a result of this and the shorter construction programme the impacts of the Purple Route Corridor on local residents are considered to be less.
- The impact on agricultural land would be greater in the Orange Route Corridor due to more sensitive soils which are present. These soils are also more difficult to reinstate which could lead to longer term impacts on agricultural land. The impact on agricultural activities in the Orange Route Corridor would be further amplified by a combination of the increased temporary land take required to undertake construction works and the extended construction programme which would delay returning affected land to agricultural use. In the Purple Route Corridor soils are less sensitive and in combination with less land take and shorter construction programme impacts are considered to be less.
- The Orange Route Corridor, particularly in sections outside of the AONB, is in much lower lying land where a higher water table is present. In order to excavate trenches and install the cable this would require more extensive dewatering and water management than would be required in the Purple Route Corridor. Similar to the impact of additional watercourse crossings this would result in:

  - Greater environmental effects as a result of increased construction activity and greater land take for dewatering and water management areas. This includes impacts on local residents as a result of increased construction activity, on agricultural land as a result of greater land take and on hydrology as a result of dewatering.
  - In engineering terms the construction works would be more difficult requiring additional land take for plant and machinery as well as settlement lagoons and as a result construction within the Orange Route Corridor would take longer to be completed and cost more compared to the Purple Route Corridor.
- Access to the Orange Route Corridor both inside and outside of the AONB is more constrained than the Purple Route Corridor which broadly follows the A16. In order to access the Orange Route Corridor construction traffic would be required to use smaller, local roads increasing the impact of construction of local residents and/or would require the development of additional temporary access roads which would increase land take and environmental impacts (including temporary loss of agricultural land and additional requirements for dewatering as outlined above).
- Construction works within the Orange Route Corridor have the potential to affect a larger number of watercourses and maintained drains compared to the Purple Route Corridor. A large number of these provide an important function in relation to land use and flood risk management. Having fewer crossings is considered to be preferable as it results in less interaction with current and future management of maintained drains.
- Sections of the Orange Route Corridor would require routeing within peat deposits which are avoided by the Purple Route Corridor. In engineering terms peat does not provide suitable cover for the cable as it is subject to shrinkage which could reduce the cover and hence protection of the cable. Once operational this would require greater monitoring to ensure sufficient cover and protection is provided.
- The Orange Route Corridor has greater potential to affect sensitive ecological sites or habitats such as the Burgh-le-Marsh LCGMP. A route avoiding settlements in order reduce impacts on local residents would require to partly cross the LCGMP. The requirement to undertake dewatering as part of construction could impact on these habitats in the long term as reinstatement would be more difficult. In comparison the Purple Route Corridor generally avoids sensitive ecological sites and those which it is in close proximity to would not be impacted in the longer term.
- Whilst the Orange Route Corridor either avoids or requires a shorter crossing of the AONB compared to the Purple Route Corridor it is considered that the impacts on the AONB can be mitigated through micro-routeing to avoid its key features or characteristics such that they are unlikely to be significant.

6.4.8 In summary, NGVL consider that the development of any alternative route corridor avoiding the AONB would, as result of the increased engineering requirements, carry a disproportionate cost burden and would result in greater environmental impacts and more substantial disruption to local residents and businesses than the proposed route through the AONB.

Mitigating the impacts upon the Environment

6.4.9 In selecting the preferred route corridor NGVL considered that potential environmental impacts on the AONB would be temporary, of short duration and could be mitigated through careful micro-routeing and selection of installation methods to minimise disturbance. The potential environmental impacts of the proposed DC cable route have been assessed in detail as part of the EIA and are considered reported in subsequent chapters of this ES. In summary these confirm that it will not result in any detriment to the AONB in the medium to long term:

- Landscape (chapter 11 (ES-2-B.07)): The installation of the proposed DC cable route will not result in any significant adverse effects on landscape character including the AONB. Impacts would be highly localised and temporary occurring during construction only. Impacts would be mitigated through landscape reinstatement.
- Visual (chapter 11 (ES-2-B.07)): The installation of the proposed DC cable route will not result in any significant adverse effects on visual amenity within the AONB. The visual assessment considers the impact on views from four viewpoints within the AONB and concludes that whilst construction activity will be noticeable in views effects will be temporary.
- Recreation (chapter 13 (ES-2-B.09)): The installation the proposed DC cable route will not in any significant adverse effects on recreation within the AONB. Impacts on Public Rights of Way (PRoW) which are within or close to the AONB will be temporary occurring for short periods during construction. Diversions would be provided for the duration of any closure.
- Noise (chapter 15 (ES-2-B.11)): The installation the proposed DC cable route is predicted to have no significant impacts on users of PRoW within the AONB. Potential noise impacts will be temporary and mitigated as much possible through the use of Best Practicable Means (BPM).
- Ecology (chapter 10 (ES-2-B6)): The installation the proposed DC cable route will not in any significant adverse effects on ecological interests such as habitats or protected species within the AONB. As much as possible through routeing sensitive habitats have been avoided. Those which cannot be avoided such as hedgerows would be reinstated.

6.4.10 NGVL are satisfied that the promotion of a Scheme which requires the proposed DC cable route to cross the AONB is appropriate in this instance and can be secured in compliance with the exceptional circumstances test identified in national and local policy.

6.5 Refinement of the Preferred Cable Route Corridor

6.5.1 Following selection of the preferred route corridor further technical and environmental studies were undertaken to refine the route corridor including confirmation of the sub-options and narrowing the route corridor from 1 km wide. In March 2017 NGVL confirmed the preferred route corridor illustrated in Figure 2.16. This included confirmation of:

- Selection of the eastern sub-option at Langton. In engineering terms it was considered to be preferable as it benefits from better more direct access and requires fewer crossings. In environmental terms both sub-options encounter landscape, ecological and archaeological constraints but were considered to be avoidable.

- Selection of the western sub-option at South Forty Foot Drain. This reduces the impact on local residents in proximity to the eastern sub-option as a result of construction activity and traffic and also reduces the interaction with Triton Knoll Offshore Wind Farm's Electrical System. Whilst a western option encounters a number of Local Wildlife Sites (LWS) these comprise drains which would be crossed using trenchless installation techniques so direct impacts would be avoided.
- Narrowing of the route corridor along the majority of its length from 1 km to 200 m in order to focus development of the proposed DC cable route.

6.5.2 It is within the narrower 200 m wide preferred route corridor that the proposed DC cable route (described in chapter 5 of the ES (ES-2-B.01)) has been finalised.

7 Summary

7.1 The Preferred UK Onshore Scheme

7.1.1 As a result of siting and routeing studies and taking into account feedback received from consultation with statutory and non-statutory consultees, stakeholder organisations, landowners and members of the public, NGVL identified the preferred UK Onshore Scheme. This comprised a landfall site at Boygrift in East Lindsey connected to a converter station site at North Ing Drove in South Holland connected by a route corridor approximately 68 km long passing through the administrative areas of ELDC, BBC, NKDC and SHDC. The preferred UK Onshore Scheme is illustrated in Figure 2.17.

7.1.2 Whilst the preferred Scheme established the general location and arrangement of its components, further refinement has been undertaken in parallel with the EIA to inform a greater level of design definition and further consider potential environmental impacts and opportunities for mitigation. This has included the identification of design mitigation; that is mitigation which is embedded within and forms an integral part of the base design of the UK Onshore Scheme. This includes the development of the proposed DC cable route and temporary working requirements within the preferred route corridor and the proposed location and layout of the converter station within the preferred site. Design mitigation is described in more detail in subsequent chapters of the ES. In addition to the above it should be noted that there will be further design refinement, controlled by planning conditions, within the envelope of the base scheme design following appointment of a Contractor.

7.2 Conclusions

7.2.1 In identifying the UK Onshore Scheme NGVL has given consideration to a range of alternatives at both a strategic and detailed level. This has included consideration of alternative transmission technologies, alternative connection points to the NETS, alternative landfall and converter station sites and alternative cable route corridors. In assessing these alternatives NGVL has undertaken a series of specialist studies considering technical, environmental and economic factors as well as undertaken consultation with statutory and non-statutory consultees, stakeholder organisations, landowners and members of the public.

7.2.2 The results of these specialist studies and feedback received from consultation have informed decision making. Through consideration of alternatives NGVL has established a preferred UK Onshore Scheme which is considered to best balance technical, environmental and economic factors with feedback received from consultation. The preferred UK Onshore Scheme comprising a landfall site at Boygrift in East Lindsey connected to a converter station site at North Ing Drove in South Holland connected by a route corridor between 67 and 68 km long.

8 References

Ref 2.1 National Grid Viking Link (August 2017) UK Onshore Scheme: Planning Statement

Ref 2.2 National Grid Viking Link (April 2016) Strategic Options Report

Ref 2.3 National Grid Electricity Transmission (July 2015) Connection Point Selection Report

Ref 2.4 National Grid Viking Link (March 2017) UK Offshore Environmental Statement

Ref 2.5 National Grid Viking Link (April 2016) UK Onshore Scheme: Site Selection Report

Ref 2.6 National Grid Viking Link (August 2016) UK Onshore Scheme: Preferred Sites Report

Ref 2.7 National Grid Viking Link (August 2016) UK Onshore Scheme: Phase 1 Consultation Feedback Report

Ref 2.8 National Grid Viking Link (September 2016) UK Onshore Scheme: Route Corridor Selection Report

Ref 2.9 National Grid Viking Link (December 2016) UK Onshore Scheme: Preferred Route Corridor Report

Ref 2.10 National Grid Viking Link (December 2016) UK Onshore Scheme: Phase 2 Consultation Feedback Report

Ref 2.11 National Grid Viking Link August 2017) UK Onshore Scheme: Statement of Community Involvement

Ref 2.12 Department for Communities and Local Government (March 2012) National Planning Policy Framework

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