UK Onshore Scheme

Environmental Statement

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Chapter 05

The Proposed Underground DC Cable

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Glossary & Abbreviations

Glossary of Terms	
Term	**Meaning**
base scheme design	The design of the UK Onshore Scheme for the purposes of the planning application.
connection point	This is the point on the GB electricity transmission system (Bicker Fen 400 kV Substation) where Viking Link connects to the network.
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.
converter station site	The proposed site occupying approx. 30 ha containing the converter station and associated landscaping, drainage as well as land required for construction.
converter station zone	The proposed zone occupying approx. 8 ha containing the converter station buildings, outdoor electrical equipment and hardstandings within a security fence.
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).
Direct Current (DC)	Electric power transmission in which the voltage is continuous. This is most commonly used for long distance point to point transmission.
DC cable route	The proposed route comprising DC and fibre optic cables from the landfall to the converter station.
ducts	Pipes (typically plastic) which are pre-installed and through which underground cables are then pulled through.
joint bay	Buried concrete pit where adjacent sections of onshore cables are physically jointed together.
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.
Open cut methods	Cable installation methods which require the excavation of a trench into which ducts or cables can be directly laid.
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.

Glossary of Terms	
Term	**Meaning**
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.
Temporary Construction Compound	Compound used by the Contractor for siting of offices, welfare facilities, storage and laydown.
Temporary Construction Facilities	All areas used for temporary construction requirements including compounds, working areas.
Temporary Works Area	Larger working area located on or adjacent to the working width used where construction activities requires a larger area for example at trenchless crossings.
Transition Joint Pit	Buried concrete pit where onshore and submarine cables are physically jointed together.
trenchless methods	Cable installation methods used to cross obstacles such as roads or watercourses and ensure less disturbance at the ground surface.
working width (DC cables)	The 30 m wide working corridor required for the installation of underground DC cables.

List of Abbreviation	
Abbreviation	**Meaning**
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
BBC	Boston Borough Council
CBS	Cement Bound Sand
CEMP	Construction Environmental Management Plan
CTMP	Construction Traffic Management Plan
DC	Direct Current
DTS	Distributed Temperature Sensing
EIA	Environmental Impact Assessment
ELDC	East Lindsey District Council
ES	Environmental Statement
GW	Gigawatt
ha	Hectare
HDD	Horizontal Directional Drilling

List of Abbreviation	
Abbreviation	**Meaning**
HGV	Heavy Goods Vehicle
HVDC	High Voltage Direct Current
km	kilometre
km^2	square kilometre
kV	kilovolt
LoD	Limits of Deviation
LPA	Local Planning Authority
LWS	Local Wildlife Site
m	metres
MLWS	Mean Low Water Springs
MHWS	Mean High Water Springs
MSA	Mineral Safeguarding Area
MW	megawatt
NGVL	National Grid Viking Link
NKDC	North Kesteven District Council
RIGS	Regionally Important Geological Site
SHSP	Soil Handling and Storage Protocol
SHDC	South Holland District Council
SNCI	Site of Nature Conservation Interest
TCC	Temporary Construction Compound
TCF	Temporary Construction Facilities
TCPA	Town and Country Planning Act
TJP	Transition Joint Pit
TPO	Tree Preservation Order
TWA	Temporary Working Area
UGC	Underground Cable
UK	United Kingdom

1 Introduction

1.1 Introduction

1.1.1 This chapter describes the proposed Direct Current (DC) cable route from the proposed landfall at Boygrift, East Lindsey to the proposed converter station at North Ing Drove, South Holland. This chapter provides details of:

- Evolution of design: Following identification of the preferred DC route corridor consideration was given to the proposed DC cable route alignment. Details are provided of the alternative alignments considered and how the base scheme design comprising the indicative alignment, Limits of Deviation (LoD) and Temporary Construction Facilities (TCFs) was arrived at.
- Construction: Provides details of the installation of the proposed DC cable route including a description of the installation methods, construction programme and details of proposed TCFs including Temporary Construction Compounds (TCCs), Temporary Working Areas (TWAs) and access requirements as well as reinstatement methods.
- Operation: Provides details on the likely activities which would be undertaken during operation of Viking Link including monitoring of the proposed DC cable route and, in the unlikely event of a failure, how cable repairs would be undertaken.
- Decommissioning: Provides details of the likely activities which would be undertaken in the event that the proposed DC cable route requires decommissioning should Viking Link ('the Project') cease operation.

1.2 Level of Design Detail

Overview

1.2.1 National Grid Viking Link Limited (NGVL) is seeking full planning permission for the proposed DC cable route including temporary construction requirements between the proposed landfall and proposed converter station. This section sets out the level of design detail which forms the base scheme design for which planning permission is being sought and which has been used to inform the Environmental Impact Assessment (EIA).

Proposed DC cable route

1.2.2 As described in chapter 3 the detailed design of the proposed DC cable route is Contractor-dependent and subject to a competitive tender process. For the purposes of the application for planning permission NGVL has established Limits of Deviation (LoD). The LoD set a corridor, typically up to 100 m wide, within which the working width required for the installation of the DC cable (typically 30 m) will be established. In some places the LoD are wider due to the land take required for specific installation methods, particularly at crossings. The LoD are also wider at

areas to be used for temporary water management (such as settlement ponds) and at areas where additional land is required for installation of temporary and permanent land drainage.

1.2.3 The LoD establish the base scheme design which provides details of the DC cable route and associated temporary working width including access to and across the working width, temporary and permanent drainage and soil storage. This approach strikes a balance, ensuring sufficient information to inform the EIA based on a realistic worst case whilst also providing some flexibility to the Contractor in finalising the detailed design of the proposed DC cable route. The detailed design, including matters such as a fixed DC route alignment and locations of joint bays, will be finalised and discharged by way of planning conditions within the parameters set by the base design.

Temporary Construction Facilities

1.2.4 As noted above, in order to install the proposed DC cable route there will be a requirement for TCFs; some of which will be located on or close to the working width (i.e. within the LoD) whilst others are located remote from the LoD. TCF comprise the following:

- TCCs comprising compounds with provision for site offices, welfare facilities, storage and laydown areas for plant, equipment and materials.
- TWAs comprising locations where a larger construction area is required for installation works such as at trenchless crossings and cable jointing.
- Temporary construction accesses comprising temporary roads required to enable access to the working width, TWAs or TCCs as well as other improvements to enable access.
- Areas for drainage works comprising areas for temporary water management as well as areas required to alter or reinstate existing private land drainage systems within agricultural land.

1.2.5 For the purposes of the application for full planning permission NGVL has identified the number, locations and sizes of TCFs, however, the exact details will be finalised by the Contractor as part of the detailed design.

1.3 Consents Required

1.3.1 Planning permission is being sought under the Town and Country Planning Act 1990 (TCPA) as follows:

- Full planning permission from East Lindsey District Council (ELDC) for the installation of approximately 51.6 km of proposed DC underground cable and associated temporary works.
- Full planning permission from Boston Borough Council (BBC) for the installation of approximately 9.78 km of proposed DC underground cable and associated temporary works.
- Full planning permission from North Kesteven District Council (NKDC) for the installation of approximately 4.8 km of proposed DC underground cable and associated temporary works.
- Full planning permission from South Holland District Council (SHDC) for the installation of approximately 0.98 km of proposed DC underground cable and associated temporary works.

1.3.2 A marine licence is being sought under the Marine Coastal Access Act 2009 (MCAA) from the Marine Management Organisation (MMO) for the UK Offshore Scheme below Mean High Water Springs (MHWS). This overlaps with the UK Onshore Scheme in the intertidal zone.

1.4 Route Description

1.4.1 The planning application boundary comprising all of the UK Onshore Scheme is approximately 1,480 hectares (ha) or 14.80 square kilometres (km^2). The proposed DC cable route (including all land required for TCF) occupies approximately 1,316 ha (13.16 km^2) of the planning application boundary. The application boundary for the proposed DC cable route is illustrated in Figure 5.1.

1.4.2 The application boundary starts at the proposed landfall site at Boygrift in East Lindsey. At the proposed landfall site it extends from Mean Low Water Springs (MLWS) across the intertidal zone with two submarine high voltage DC cables and one fibre optic cable. These will be installed in ducts below the existing flood defences and terminate at a buried transition joint pit (TJP). The TJP will be located inland (west) of the existing flood defences. From the TJP two underground high voltage DC cables (for transmission of electricity) and up to three fibre optic cables (two for monitoring the performance of the DC cables using Distributed Temperature Sensing (DTS) and one for communications between the proposed converter station in Great Britain and Denmark) will be installed to the proposed converter station at North Ing Drove in South Holland.

1.4.3 The total length of the route from the proposed landfall site to the proposed converter station site is approximately 67.16 km. It is routed through rural, predominantly agricultural land in a western or south western direction. As noted above the proposed DC cable route passes through four Local Planning Authority (LPA) areas: ELDC, BBC, NKDC and SHDC.

1.4.4 For the purposes of the EIA the proposed DC cable route has been split into four Route Sections. These are described from the proposed landfall to the proposed converter station as follows:

- Route Section 1 Proposed landfall to Well High Lane (approximately 13.04 km, entirely within ELDC). This Route Section extends from the proposed landfall site where the UK Offshore Scheme comes ashore at Boygrift, to Well High Lane between South Thoresby and Rigsby. It passes through predominantly flat, low-lying agricultural land.
- Route Section 2 Well High Lane to A16/Keal Road (approximately 16.85 km, entirely within ELDC). This Route Section extends down to Keal Road immediately to the west of East Keal. It extends through the Lincolnshire Wolds Area of Outstanding Natural Beauty (AONB) and is in an area of more undulating topography with some steeper slopes present.
- Route Section 3 A16/Keal Road to the River Witham (approximately 22.06 km, within ELDC and BBC). This Route Section extends from East Keal to the west of the River Witham northwest of Boston at Langrick. It extends through flat agricultural land crossing a large number of drains, including West Fen Drain.

- Route Section 4 River Witham to the proposed converter station (approximately 15.21 km, within BBC, NKDC and SHDC). This Route Section extends from west of the River Witham and enters the proposed converter station site at its south west corner. It passes through an area of low lying agricultural land and requires numerous drain crossings.

1.4.5 Figure 5.1 illustrates the start and end point of each of the Route Sections. A detailed description of each Route Section as well as proposed installation methods is contained in subsequent sections of this chapter.

2 Evolution of the DC Cable Route Design

2.1 Introduction

2.1.1 This section describes the evolution of the proposed DC cable route alignment from the identification of the preferred route corridor to the base scheme design that forms the basis of the planning application. Following identification of the preferred route corridor the base scheme design has evolved through an iterative process which considered a range of environmental and engineering factors as well as feedback received from consultation with statutory and non-statutory consultees and the local community, including landowners. This section describes the iterative design process and how the proposed DC cable route has been identified.

2.2 Consideration of Alternative DC Cable Route Designs

2.2.1 Following identification of the 200 m wide preferred route corridor (see Figure 5.2) set out in chapter 2 (ES-2-A.02) of the Environmental Statement (ES), consideration has been given to alternative cable route alignments within it. The development of DC cable route alignments has taken account of the results of EIA studies, engineering requirements as well as feedback received through consultation and landowner discussions. Through this iterative process indicative route alignments have evolved resulting in the identification of the proposed DC cable route. In addition consideration has also been given to temporary construction requirements including access points from the existing road network, the development of off-easement accesses and the identification of locations for compounds, areas for water management and temporary and permanent land drainage requirements.

2.2.2 Key considerations which have informed this identification of the DC route alignment have included:

- The proximity to and potential to impact on residential properties (including their private gardens).
- The proximity to and potential to impact on sites or features of environmental value or interest including designated sites or sites identified within local plans.
- The number of and approach to crossings drains, watercourses, roads, railways and other utilities.
- The application of a minimum horizontal bending radius of 30 m wherever possible to minimise friction on cable pulls during installation.
- The proximity to and limitations of the local road network for use by construction traffic during cable installation.

- Topographical features and underlying ground conditions including steep slopes and high water table.
- The potential to impact on agricultural activities and land drainage.
- The proximity to and potential to impact on other existing or proposed infrastructure.

2.3 Development of the Proposed DC Cable Route – Alternatives

Route Section 1 Proposed Landfall to Well High Lane

2.3.1 The following section describes the alternative alignments considered within Route Section 1 as well as key considerations in relation to temporary construction requirements. Figure 5.3 illustrates the alternative alignments which have been considered.

2.3.2 From the proposed landfall at Boygrift the proposed DC cable route runs west from the proposed TJP in fields to the west of Roman Bank (where the submarine cable and onshore cable will be joined). Provision has been made for a suitable buffer from Boygrift Drain to the north and a known Marsh Harrier nesting site at Sea bank Clay Pits to the south. Routeing to the A52 has taken into account known archaeology, residential properties and a suitable access point from the A52.

2.3.3 To the west of the A52 the route will unavoidably cross the Sutton Branch Line Walkway. Routeing options to the north and south of properties on Crawcroft Lane were considered when assessing the crossing of Boygrift Drain and suitable construction access to the crossing point. The northern option was selected to avoid potential impacts to properties and private gardens on Crawcroft Lane. Two options were also considered for the crossing point of the minor road to Asserby, the route selected requires fewer drain crossings.

2.3.4 To the west of the A1111 the proposed DC cable route avoids commercial and farm properties, small areas of trees/hedgerows to the north and south and an area of potential archaeology adjacent to Wold Drift Drain (identified from aerial photography interpretation). The proposed DC cable route continues west between Saleby and Thoresthorpe, avoiding properties and the areas of known archaeology associated with these settlements, to the A1104 Alford Road at Snape Hill.

2.3.5 To the west of the A1104 the proposed DC cable route has been designed to avoid tree/hedgerow boundaries and minimise watercourse/drain crossings. A minor road will need to be crossed. Three options were considered in the vicinity of the Firsby to Louth Dismantled Railway Site of Nature Conservation Interest (SNCI) including a longer option to the north; the selected route makes use of an existing gap in the vegetation along the dismantled railway allowing a shorter route while minimising the potential impact on the site. The proposed DC cable route continues between Ailby Plantation and Ailby Wood/Rigsby Wood allowing a suitable buffer from the woodland trees.

2.3.6 Well High Lane marks the boundary of the Lincolnshire Wolds AONB. The proposed DC cable route design ensures that TCCs are located outside of the AONB. Consideration has been given to the proximity of the AONB and residential properties when siting the TWA which has been set

back from the road/AONB boundary. Well High Lane has been identified as an access point to a TWA and the working width (east and west).

Route Section 2 Well High Lane to A16/Keal Road

2.3.7 The following section describes the alternative alignments considered within Route Section 2 as well as key considerations in relation to temporary construction requirements. Figure 5.4 illustrates the alternative alignments which have been considered.

2.3.8 From Well High Lane the proposed DC cable route runs south west to the A16 Bluestone Heath Road. The proposed DC cable route design has taken into consideration topography, drain and service crossings and proximity to the roundabout at Ulceby Cross. The A16 has been identified as an access point to a TWA and the working width (east and west).

2.3.9 To the west of the A16 the proposed DC cable route runs to the north of Silver Pits SNCI and then turns south to cross a minor road to the west of Langton Grange Farm. Several DC cable route options have been considered through this area taking into account the topography (valley features), Silver Pits SNCI, a historic landfill site, recorded archaeology (including an undefined Lancaster Bomber crash site) and land management. The route alignment through this area is also influenced by the constraints to cable routeing further south.

2.3.10 To the south of the minor road, constraints to cable routeing include three Scheduled Monuments (Spellow Hills Long Barrow and two other barrow sites), other recorded archaeology, roadside and hedgerow trees, an underground water storage reservoir and land management.

2.3.11 The proposed DC cable route design has considered several options through this area (including east, running parallel with the A16, central and west parallel to the Sheepwalks). The selected route seeks to avoid known nationally designated archaeological sites and minimise the potential for temporary effects on their setting during the cable installation while minimising effects on mature trees and hedgerows and disruption to land management.

2.3.12 Careful consideration has been given to the location of a TWA in this area and the location of an access point onto the A16. This TWA is required to allow access to the top of the slope near Dalby Hill Chalk Quarry (as the minor road between Dalby Bar and Langton is not suitable for construction traffic). The site selected is within the same land parcel as the proposed DC cable route and has taken into consideration the retention of hedgerow boundaries as far as possible.

2.3.13 The proposed DC cable route then crosses a minor road (between Dalby Bar and Langton). To the south of the minor road the proposed DC cable route has been designed to avoid residential properties the ancient woodland of Callow Carr, the disused Dalby Hill Chalk Quarry (Regionally Important Geological Site (RIGS)) and Ring Holt Scheduled Monument. Consideration has also been given to construction on the steep slopes around the Ring Holt. Several route options have been considered through this area. Several routeing options have also been considered to the south of the slope and down to the A158. The route has taken into consideration land management, hedgerow boundaries and watercourse crossings and seeks to avoid known archaeology and areas of woodland.

2.3.14 To the south of the A158, the proposed DC cable route runs west between small areas of woodland to cross the River Lymn and an unnamed minor road between Sausthorpe and Raithby. The proposed DC cable route runs to the west of the road to avoid areas of known archaeology to the east.

2.3.15 To the north of Raithby Crossroads the proposed DC cable route turns southeast back across the minor road and then south to cross Raithby Road and continues south along the east side of the minor road. This alignment has been selected to avoid woodland, ponds and grassland associated with Mavis Enderby Valley SSSI and Manor Farm Local Wildlife Site (LWS). To the south of Raithby Crossroads the proposed DC cable route follows the western field boundary to keep the works as far as possible from residential properties on the edge of Raithby-by-Spilsby village.

2.3.16 Between the B1195 and A16 Keal Road the proposed DC cable route runs parallel and to the east of an unnamed minor road. This alignment has been selected to avoid areas of known archaeology, Wheelabout Wood SNCI, and trees to the west.

2.3.17 Consideration has been given to the proposed DC cable route alignment to the east and west of Mardon Hill. The proposed DC route runs to the west of East Keal Clay Pit LWS, avoiding the locally designated site, allows for trees protected by Tree Preservation Orders (TPOs) to be avoided and crosses the A16 Keal Hill between the villages of West Keal and East Keal.

Route Section 3 A16/Keal Road to River Witham

2.3.18 The following section describes the alternative alignments considered within Route Section 3 as well as key considerations in relation to temporary construction requirements. Figure 5.5 illustrates the alternative alignments which have been considered.

2.3.19 To the south of the A16 Keal Hill the proposed DC cable route runs south between areas of woodland and trees. A number of options have been considered for the second crossing point of the A16 between West Keal and Keal Cotes. The location selected is furthest from residential properties in West Keal while avoiding the need to cross Braygate SNCI.

2.3.20 To the west of the A16 several route alignments have been considered taking into account land management, drain crossings, road crossings, known archaeology, tree features, proximity to the disused military airfield at East Kirkby and residential properties. The proposed DC cable route has sought to avoid and/or minimise effects on these constraints. It runs south west from the A16 crossing Haganby Lane and Drain Bank adjacent to West Fen Catchwater Drain, to the north of Hagnaby Lock.

2.3.21 Continuing west from Hagnaby Lock the proposed DC cable route runs west and then south parallel to Folly Lane, crossing Stickney Lane and a number of minor roads/tracks before turning south west to cross Medlam Drain and the B1183. The alignment has been selected taking into account land management and service crossings; and to avoid residential properties, a solar farm, small tree plantations and to minimise the number of drain crossings.

2.3.22 A TCC will be located to the north of Stickney Lane, this has been located as far from residential properties as practicable.

2.3.23 From the B1183 the proposed DC cable route runs south west crossing a minor road west of Short's Corner, Twenty Foot Drain and Westville Road adjacent to West Fen Drain. The alignment through this area has taken into account land management, drain crossings and tree features.

2.3.24 Between Westville Road and the minor road (C835) from Gipsey Bridge, the proposed DC cable route has been aligned to avoid a Mineral Safeguarding Area (MSA) for Sand and Gravel to the north and residential properties and ecological features to the south.

2.3.25 The proposed DC cable route continues southwest crossing Castle Dyke towards the B1192 and the River Witham. The alignment through this area has been influenced by a suitable crossing point of the River Witham north of Langrick Bridge, avoidance of residential properties and tree features.

Route Section 4 River Witham to the proposed converter station

2.3.26 The following section describes the alternative alignments considered within Route Section 4 as well as key considerations in relation to temporary construction requirements. Figure 5.6 illustrates the alternative alignments which have been considered.

2.3.27 From the River Witham the proposed DC cable route continues southwest to cross North Forty Foot Drain and an adjacent minor road and then Kirton Drove avoiding residential properties.

2.3.28 Between Kirton Drove and Claydike Bank, the main influence on the proposed DC cable route alignment has been drain crossings (Gill Syke in particular), a disused sewage works near Amber Hill and avoidance of residential properties.

2.3.29 From Claydike Bank the proposed DC cable route runs south crossing Skerth Drain (three drains), to the A17. Several options have been considered in this area, the proposed DC route has been selected to minimise the number of drain crossings as well as avoid residential properties and the proposed route of the Triton Knoll Electrical System.

2.3.30 To the south of the A17 the proposed DC cable route has been aligned to minimise the number of land parcels affected and to minimise the number of drain crossings. Other influences on the proposed DC cable route have been the need to cross a gas pipeline and a suitable location to cross the Nottingham to Skegness railway.

2.3.31 Continuing south, the proposed DC cable route runs parallel to the South Forty Foot Drain following field boundaries as far as practicable while avoiding tree features. The proposed DC cable route turns east to cross the South Forth Foot Drain. A number of options have been considered but the proposed DC cable route crosses to the north of Helpringham Eau (avoiding the need to cross Helpringham Eau and properties around Eau End Farm).

2.3.32 To the east of South Forty Foot Drain the proposed DC cable route alignment has taken into account land management requirements. It connects into the proposed converter station site to the north of North Ing Drove.

3 The Underground Cable

3.1 DC Underground Cable

Overview

3.1.1 Viking Link will comprise what is termed a "bipole converter station configuration" with two high voltage DC cables installed alongside each other. Bipole systems transmit power through two high voltage conductors of opposite polarity, in this instance + 525 kV and - 525 kV. The UK Onshore Scheme will comprise two DC cables and up to three fibre optic cables all laid within a single trench. Cables could be laid directly into the trench or duct may be laid in the trench and the cables pulled through these. The exact configuration of the DC and fibre optic cables is subject to detailed design. It should be noted that the terms “proposed DC underground cable route” or “proposed DC cable route” are used throughout this ES to refer to both DC cables and fibre optic cables.

Physical Characteristics

3.1.2 Table 5.1 provides a summary of the key characteristics of the proposed DC cable route. Whilst the exact configuration of the proposed DC cable route is subject to detailed design following appointment of a Contractor, the general characteristics in Table 5.1 below have informed the identification of the base scheme design on which the EIA is based.

Table 5.1 Proposed DC Underground Cable – Key Characteristics

Characteristic	Description
Operating voltage	525 kV
Route length	Approximately 67.16 km
Working width	Typically 30 m (apart from at TWAs)
Permanent easement	Typically 15 m (apart from at crossings)
No. of cables	Two high voltage DC cables and up to three fibre optic cables
DC cable diameter	Approximately 150 mm
No. of trenches	One trench containing two DC cables and up to three fibre optic cables
Trench width	Typically 1.5 m
Trench depth	Typically 1.5 m (subject to local ground conditions and obstacles present)

Table 5.1 Proposed DC Underground Cable – Key Characteristics	
Characteristic	**Description**
Minimum depth of cover	Agricultural land – typically 0.9 m (900 mm) Watercourses – typically 2.0 m (2000 mm) Roads – typically 0.75 m (750 mm) Railways – typically 5 m (5000 mm) Footpaths and non-agricultural verges – typically 0.6 m (600 mm)
Backfill material	Soil and cement bound sand (CBS) or other thermally suitable material
Cable section length	Typically 800 m to 1.5 km (subject to detailed design)
Cable joints	Buried concrete base or pad (up to 84 required)

3.1.3 As note above there will be two DC cables installed as part of the proposed UK Onshore Scheme, each of which will be approximately 150 mm in diameter. These cables will be installed within a single cable trench or within ducts. They will be laid approximately 0.5 to 0.55 m apart to prevent overheating and ensure that the required cable rating is achieved. Two fibre optic cables (one per each DC cable) will be installed in order to monitor the temperature and performance of the DC cables during operation using DTS with a third fibre optic cable enabling communications between the converter stations in Great Britain and Denmark.

3.1.4 The proposed DC cable route will be laid in sections approximately 800 m to 1.5 km in length. These will be connected at buried joint bays. The exact number of joint bays will depend on the detailed design but it has been assumed up to 84 could be required.

3.1.5 There will be no above ground infrastructure required along the proposed DC cable route with the exception of small marker posts. These may be installed at field boundaries, crossings and other locations as appropriate to highlight the presence of the underground DC cable to landowners, asset owners and those undertaking works within the vicinity.

3.2 Installation of Underground DC Cables

Working Width

3.2.1 From the proposed landfall to the proposed converter station, the proposed DC cable route is located within a corridor typically 100 m wide (the LoD). Within the LoD a temporary working width typically 30 m wide will be required for cable installation. Indicative details of the typical working width are contained within Figure 5.7. It comprises:

- One trench approximately 1.5 m wide by 1.5 m deep within which the two DC cables and up to three optic cables will be directly installed or installed within buried ducts.
- Temporary construction haul road, including laybys or passing places, to allow movement of construction traffic within the working width.
- Areas for the temporary storage and management of excavated top-soil and subsoil which will be re-used in reinstating the working width.

- Temporary drainage and water management measures to be implemented during construction.

3.2.2 In some areas the working width (and hence the LoD) is required to be wider in order to accommodate particular construction activities. This includes locations such as crossings, for example the proposed landfall, watercourses, roads and railways where trenchless installation methods will be used, as well as areas where cable drums may be delivered to and areas of construction difficulty (steep slopes or poor ground conditions). These sections are typically identified as TWAs and explained in subsequent sections below.

Installation Methods

3.2.3 The proposed DC cable route will be installed by a combination of open cut and trenchless methods. Open cut methods will be utilised in open agricultural land and trenchless methods typically utilised where the proposed DC cable route crosses obstacles; for example roads, railway lines, buried utilities and watercourses or in areas where ground conditions or environmentally sensitivities are required to be avoided. A Schedule of Crossings is contained in Appendix 5.1 (ES-4-B.01).

3.2.4 In sections installed by open cut the cables could be laid in one of two ways; they could either be laid directly into the trench, or a duct could be laid into the trench after which the cables will be then pulled through the pre-laid duct. In sections installed using trenchless methods a duct or ducts will be installed through which the cables will be then pulled.

3.2.5 The precise method of installation is subject to detailed design following appointment of a Contractor, however, the EIA has taken account of the potential installation methods described in **Error! Reference source not found.**.

Cable Jointing

3.2.6 The cable will be installed in sections between 800 m and 1.5 km long. The sections of cable are pulled off the cable drums into the trenches (and/or pulled through ducts) and adjacent sections are joined together at joint bays. These are buried concrete pads, the exact sizes of which are subject to detailed design.

3.2.7 Cable jointing requires to be undertaken in a clean controlled environment. The joint bay provides a clean base over which temporary cabins or enclosures are installed for the duration of the jointing process. These require a power supply, air conditioning and temporary lighting. Due to the precise nature of jointing operations it may require continuous 24 hour working for short periods.

3.2.8 For the purpose of the EIA it has been assumed that up to 84 joint bays will be required along the proposed DC cable route (approximately one joint bay every 800 m), however the exact number is subject to detailed design.

Table 5.2 Proposed DC Cable Likely Installation Methods	
Method	**Description**
Open cut trench and direct burial	· Top soil stripped from entire working width and stockpiled. · Trench dug utilising hydraulic excavators (or by hand in areas of known buried utilities). Excavated sub-soil and top soil will be stockpiled separately. · Install base layer of cement bound sand (CBS). Trench is left open for cable pulling. · Cables laid in trench by 'pulling' from cable drum, with the aid of rollers placed within the trench. · Cables are bedded in with CBS. · Protective tiles are placed along the width of the trench. · Trench is back filled with excavated sub-soil or thermally suitable material where required (to avoid the alteration of local environmental temperatures around the cables). · Warning tapes will be place 100mm above the protective tiles vertically inline with the cable poles · Topsoil will be reinstated to original soil profile and land re-seeded or released to the farmer for cultivation as it was found.

Table 5.2 Proposed DC Cable Likely Installation Methods	
Method	**Description**
Open cut trench and ducting	· Top soil stripped from entire working width and stockpiled. · Trench dug utilising hydraulic excavators (or by hand in areas of known buried utilities). Excavated sub-soil and top soil will be stockpiled separately. · Install base layer of cement bound sand (CBS). Trench is left open for duct laying. · Ducts are bedded in with CBS. · Protective tiles are place along the width of the cable trench · Trench is back filled with excavated sub-soil or thermally suitable material where required (to avoid the alteration of local environmental temperatures around the cables). · Warning tapes will be place 100mm above the protective tiles vertically inline with the duct/cable poles · Topsoil will be reinstated to original soil profile and land re-seeded or released to the farmer for cultivation as it was found. · Joint bay locations are excavated along the route (800m to 1500m, dependent on detailed design), which will act as pulling locations for the cable · Cables are installed in the duct/trench by 'pulling' from cable drum between joint bays. · Small inspections/lubrication pits may be excavated between the joint bays to aid with the pulling activity.

Table 5.2 Proposed DC Cable Likely Installation Methods	
Method	**Description**
Trenchless Method Pipe Jacking (horizontal auger boring)	· Hydraulic ram or jack and associated boring equipment located at launch pit. The size and depth of the launch pit is dependent upon the depth of the cable (deeper cable requires a deeper and larger pit). · Tunnel created by progressively inserting clay pipes behind the drill head (driven by the hydraulic jack), with material returned to the launch site (typically via a screw-shaped shaft). One tunnel is required for each cable. · Direction of the tunnel is determined by the set-up equipment in launch pit and is continuously surveyed. · Drilling continues to the reception pit (also constructed prior to drilling, to a depth relative to the depth of cable). · Launch pit and reception pit may require sheet piling and further works to ensure a dry and stable working environment. · The launch pit and reception pit would be backfilled on completion of the crossing and the area reinstated. · Topsoil will be reinstated to original soil profile and land re-seeded or released to the farmer for cultivation as it was found.
Trenchless Method Horizontal Directional Drilling (HDD)	· HDD rig and associated equipment set up at launch site. This includes electricity supply, drill mud filter, control unit and welfare facilities. Rig may need to be anchored in place. · Drilling utilises drill bit, drill head and drilling fluid. Drilling fluid (typically bentonite slurry) assists the drilling process, as well as lubricating and cooling the drill head. · A pilot hole is typically drilled first, followed by a series of increasing size bores until the final drill diameter is achieved. The final bore diameter will be able to accommodate a cable duct of approximately 254 mm (internal diameter). · Location and direction of drilling can be monitored using the HDD locating system to ensure drilling follows the pre-planned path. · Ducting is pulled back through the drilled hole towards the HDD rig. · One cable duct is required for each cable. It is likely that spare ducts will be installed to allow for ease of replacement should any faults be identified in future. Ducts can be capped to ensure no attenuation of water or sediment or prevent use by animals if left prior to cable pulling. · The launch site would be reinstated on completion. Topsoil will be reinstated to original soil profile and land re-seeded or released to the farmer for cultivation as it was found.

Table 5.2 Proposed DC Cable Likely Installation Methods	
Method	**Description**
Trenchless Method Micro Boring	· This method is similar to pipe jacking, however utilises a steerable tunnel boring machine (TBM) to tunnel between a launch pit and a reception pit. · Lengths of pipe are inserted behind the TBM as it progresses and a hydraulic jack is used to drive the pipe forward. · Water or mud mix is utilised to fluidise excavated material which is pumped to the launch pit. · Cable ducting pulled through the pipe tunnel following tunnelling through to the reception pit. One pipe tunnel/ bore required for each cable. · Launch pit and reception pit require concrete bases to ensure a clean working environment and prevent water entering the working area. Launch pit also requires a concrete back wall for the hydraulic jack to work against. · The launch pit and reception pit would be backfilled on completion of the crossing and the area reinstated. · Topsoil will be reinstated to original soil profile and land re-seeded or released to the farmer for cultivation as it was found.

Access during Installation

3.2.9 An assessment has been carried out of the existing public road network to identify which roads are suitable for access by Heavy Goods Vehicles (HGVs) and cable delivery vehicles which would be classed as Abnormal Indivisible Loads (AILs). The assessment has taken into account various factors including the size and condition of the roads, railway level crossings, bridges, traffic restrictions (vehicle weight, height, width or length), gradients, settlements (proximity of buildings, residential properties and community facilities) and other factors such as overhead lines (electricity and telecommunications); as well as accident records.

3.2.10 In general access points have been identified directly from the public road network to the working width. Access points have been positioned to allow suitable visibility splays for safe access and egress and avoid the need for excessive manoeuvring within the highway. In some locations to avoid additional vegetation removal required for visibility splays temporary traffic management measures will be used to control access and egress.

3.2.11 In some locations new temporary access roads connecting the proposed working width with the existing highway network are proposed. Visibility splays and temporary off-road accesses have been included within the planning application boundary.

3.2.12 To minimise the use of local public roads as much as possible, the temporary haul road within the working width will be utilised by construction traffic (including AILs) as far as practicable. Allowance has been made within the base scheme design for vehicle movements within and along the working width, TCCs and TWAs.

3.2.13 Vehicle access along the working width will require the installation of temporary bridges across some watercourses and drains. Following consultation with the Internal Drainage Boards (IDBs) and Environment Agency (EA) single span bridges will be used which places limitations on the maximum span of bridges allowed to take construction and AIL traffic. It has therefore been assumed that watercourses that are navigable or that cannot be crossed with a single span bridge will not be crossed by temporary bridges (e.g. installation works will be undertaken from either side of the watercourse). As a result additional temporary accesses are required either side of larger watercourse crossings.

3.2.14 The exact method of cable delivery will depend on the detailed design and the Contractor. The base scheme design has been developed to accommodate the likely delivery methods based on similar projects. Cable delivery vehicles will only use approved delivery routes and/or the temporary haul road within the working width. A Construction Traffic Management Plan (CTMP) (Ref 5.1) has been prepared which identifies the proposed routeing of construction traffic.

3.2.15 Cable sections (typically between 800 m and 1.5 km) will be loaded onto drums delivered to the working width on a cable trailer. In sections where the working width is wider (for example at TWAs) the cable trailer can be manoeuvred so that it is perpendicular to the proposed DC cable route and cables pulled from the drum and laid directly into the trench or pulled through pre-laid ducts.

3.2.16 Cable sections could also be delivered in shorter lengths (typically less than 800 m) on cable trailers pulled by a tractor unit. A cable drum would be loaded onto a trailer at a storage area (for example a TCC) and then transported along the public highway and then the temporary construction haul road before being pulled from the drum and laid directly into the trench or pulled through pre-laid ducts.

3.2.17 There may also be instances where cable drums are transported by a low loader, however, these are likely to be rare due to the requirement to use cranes to unload cable drums.

Site Environmental Management

3.2.18 During construction, the Contractor will be required to undertake all works in accordance with a Construction Environmental Management Plan (CEMP) (Ref 5.2). As a minimum, the CEMP will implement the mitigation measures identified within this Environmental Statement (ES). The CEMP will set out a variety of control measures for mitigating the potential environmental effects of construction works including control and management of noise, dust, surface water runoff, waste and pollution control.

3.2.19 The Contractor will employ an Environmental Clerk of Works (ECoW) who will be responsible for the implementation of the CEMP. The ECoW will be supported by environmental specialists such as ecologists or archaeologists as required.

3.3 Other Temporary Construction Requirements

3.3.1 To enable construction activities additional space is required for compounds, laydown and storage areas, water management as well as areas for land drainage (temporary and permanent). These areas, collectively referred to as TCF, have been defined as follows:

- TCCs: These are typically larger areas utilised for the storage of plant and machinery and stockpiling materials, as well as the provision of site management offices, welfare facilities for staff (kitchen facilities, store rooms, toilet facilities), parking, and plant and material storage. There are two types of TCC proposed; primary and secondary. The function of the two is the same however there are minor variances in the size and potential duration of operation. Primary TCCs will be larger in size (approximately 1.5 ha) and will be in place for the duration of cable construction. Secondary TCCs will be approximately 1.1 ha and will likely be in place for the majority of construction, but not the full duration. Within the base scheme design allowance has been made for up to 10 TCCs at locations along the length of the proposed DC cable route.
- TWAs: These are required at various locations along the proposed DC cable route. These are typically located at areas where works require a larger area than the typical working width such as at locations where trenchless construction methods are proposed. These are smaller than the TCCs and will cover an area of approximately 0.43 ha. They will be utilised for laydown of construction plant and equipment and storage whilst works are being undertaken in the vicinity. It is therefore unlikely that the TWAs will be in place for the construction

programme. Within the base scheme design allowance has been made for up to 16 TWAs along the length of the proposed DC cable route.

- Land Drainage: Where possible land drainage information has been obtained from consultation with landowners and site survey with the results used to inform the base scheme design and develop a conceptual land drainage design. This demonstrates how existing land drainage will be intercepted prior to construction to maintain the integrity of the existing land drainage systems during the construction of the proposed DC cable route. It also shows how the land drainage will be reinstated post construction. This will require new land drainage outfalls. Where access has been available for survey, the proposed land drainage outfall locations have been identified and have been included within the planning application boundary. Where access has not been possible for survey, whole fields have been included within the application boundary within which land drainage works would need to be undertaken.
- Water Management: It is expected that groundwater controls such as dewatering will be required in some areas during trench excavation, trenchless crossings and open cut crossings. Measures will also be required to be employed to control surface water run-off during the construction phase to provide attenuation and prevent direct release of sediment loaded discharges into watercourses. At TCCs and TWAs this will include controls on potentially polluting activities such as Cement-Bound Sand (CBS) preparation and fuel storage and/or dispensing areas. The exact requirements will be confirmed as part of detailed design, however, allowance has been made within the base scheme design to provide attenuation measures and sediment capture during these operations.

Reinstatement

3.3.2 All topsoil and sub-soil excavated during the installation of the proposed DC cable route will be stored and managed as per the requirements of a Soil Handling and Storage Protocol (SHSP) (Ref 5.3). Top soil and sub-soil will be stockpiled separately with measures put in place to prevent erosion or degradation of the soil including seeding, dampening and monitoring. These procedures will be implemented to minimise adverse impacts on the quality of soil resources during construction.

3.3.3 Following completion of cable installation, excavated trenches will be filled in with the excavated sub-soil, the temporary construction haul road will be removed and top soil re-distributed over disturbed areas. Land will then be reinstated to its former use and agricultural areas returned to the land owner for cultivation during the first available planting season following completion of construction.

3.3.4 Any trees or hedgerows removed to facilitate construction activities will be replanted with native tree and hedgerow mix. Where appropriate to the local landscape character, and where technically feasible, specimen and hedgerow trees and woodland planting would be incorporated as part of reinstatement based on a tree replacement policy of four to one. These would consist of a variety of native species, typical of those found within the local area.

3.3.5 Other vegetation along the proposed DC cable route and in areas temporarily disturbed by construction would also be reinstated. Pasture, road verges and other areas temporarily affected will be seeded with a species rich wildflower or grass seed mix.

3.3.6 As noted above reinstatement will also include the removal of temporary construction drainage and reinstatement of field drains impacted by construction activities.

Installation Programme

3.3.7 Cable installation does not require to be undertaken sequentially; as a result installation could occur in multiple sections along the length of the proposed DC cable route in parallel. This will limit the extent and duration of construction activity at any given location including the length of time that land remains disturbed for. The exact programme will depend on a number of factors including the underlying ground conditions and installation methods used.

3.3.8 Typically the construction of a 1 km length of cable will take approximately 4 to 9 months dependent on the complexity of the installation. This timeframe includes for the pre-construction site set up as well as the reinstatement of the land following completion of installation. This assumes that the season after cable burial is completed is suitable for undertaking reinstatement. For the purposes of the EIA it has been assumed that installation of the proposed DC cable route will take between two and three years.

3.3.9 Table 5.3 below provides an overview of the timescales for the likely installation methods.

Table 5.3 Proposed DC Cable Duration of Likely Installation Methods

Likely Installation Method	Approximate Duration
Open cut trench and direct burial	30 days per km
Open cut trench and ducting	20 days per km
Trenchless methods*	7 to 20 days per crossing
Jointing	10 to 12 days per joint bay.

* The duration of construction of crossings will depend on the exact trenchless method utilised, the ground conditions encountered and the length of the crossing required.

3.4 Route Section 1 Proposed Landfall to Well High Lane

Description of Route Section 1 Proposed Landfall to Well High Lane

3.4.1 Route Section 1 of the proposed DC cable route extends westwards from the proposed landfall site at Boygrift. The planning application boundary within Route Section 1 is illustrated in Figure 5.8. From MLWS two submarine cables and one fibre optic cable will be installed within pre-laid ducts across the intertidal zone to the TJP located on the landward side of the flood defence. From the TJP onwards the proposed DC cable route comprises two underground cables and up to three fibre optic cables until it reaches the proposed converter station.

3.4.2 From the TJP the proposed DC cable route extends west, south of the settlements of Hannah and Markby on the A1111/Sutton Road and continues west across the A1104 between the settlements of Saleby (to the north) and Thoresthorpe (to the south). At the crossing of the Wold Grift Drain, west of the A1104, the proposed DC cable route heads to the southwest (north of Ailby) towards Driby Top. The boundary with Route Section 2 of the proposed DC cable route is located close to the boundary of the Lincolnshire Wolds AONB. Route Section 1 is mostly within flat, low-lying agricultural land, with the exception of the western mort part of the Route Section which includes the lower reaches of Langton Hill where the land begins to rise up.

3.4.3 This Route Section is approximately 13.04 km in length and for the majority of this the LoD is 100 m wide. In some areas within the LoD is wider including at crossing points such as at the proposed landfall (where the flood defences are crossed), at Crawcroft Lane and Boygrift Drain and at the A1111. At these locations the wider LoD provides some flexibility for the detailed design taking account cable bends and installation methods.

3.4.4 A summary of the key features of Route Section 1 including the number and location of TCCs, TWAs and access requirements is provided in Table 5.4 and illustrated in Figure 5.9. Reference should also be made to the Works Plans which accompany the planning application.

Table 5.4 DC Cable Route Section 1 Proposed Landfall to Well High Lane

Key Feature	Details
Section length	13.04 km
Relevant LPA(s)	ELDC
Approximate temporary land take	1.4 km^2 (140.3 ha)
No. of TCCs	2 (1 Primary, 1 Secondary)
No. of TWAs	4
Approximate no. of access and crossing points to/from working areas	11
Approximate no. of crossings (watercourses, drains, roads, utilities)	70

Details of Installation in Route Section 1

Temporary Land Take

3.4.5 Temporary land take is required for two TCCs and four TWAs within this section. The first of the TCCs (S1) is located adjacent to of west of the A52. The second TCC (P1) is located to the south of Saleby, to the east of the A1104. The four TWAs are located at the proposed landfall site (T1), the crossing of Crawcroft Lane (T2), west of the A1111 (T3) and east of Haugh (T4).

3.4.6 At Crawcroft Lane the LoD are wider. In this location the proposed DC cable route is required to cross Crawcroft Lane (north to south) and then Boygrift Drain (east to west). The LoD allows for some flexibility in the detailed design such that both crossings could be combined into a single longer crossing (north east to south west). Similarly the LoD are wider north of Asserby and

south of Markby to provide some flexibility in how crossings of existing utilities are finalised within the detailed scheme design.

3.4.7 There are a number of spurs from the LoD within Route Section 1. These are typically required to undertake land drainage works (for both pre and post construction drainage) as well as areas which are required for water management during construction (for dewatering and managing surface water runoff). At the proposed landfall a spur has been included on the beach running north-south adjacent to Roman Bank. This is to allow the Contractor to lay ducts outs during landfall installation works.

3.4.8 Additional land is also required to provide access during construction. This includes adjacent to the A52, at Crawcroft Lane, at the A1111, at the A1104 and at Well High Lane. At the A52 land take is required to enable access to the working width and TCC (S1). At Crawcroft Lane sections of the existing access tracks will need to be improved to enable access to the TWA (T2). At the A1111 and A1104 access is required to a TWA (T3) and TCC (P1) respectively. At Well High Lane additional land take is required to provide access to the working width and adjacent TWA (T4).

Access Arrangements

3.4.9 No access will be permitted to the proposed landfall site via Roman Bank. Access to this area will be from the A52 and the temporary haul road installed within the working width. However Roman Bank is a crossing point and will require to be crossed by construction vehicles and therefore this section will be controlled through traffic management measures.

3.4.10 Access to the beach will be via an existing private access point through the Sandilands Golf Course from Sea Bank/Roman Bank. Emergency access will be via an existing beach replenishment access point further south, also off Sea Bank/Roman Bank.

3.4.11 The TCCs will be accessed via the A52 (S1) and the A1104 (P1). Improvement works will be undertaken on the existing access track from Crawcroft Lane to enable access to the TWA (T2) in this location. To the west the next TWA (T3) is located immediately adjacent to, and will be accessed from the A1111. The fourth TWA (T4) will be accessed from working width via an access point on Well High Lane.

3.4.12 Where the proposed DC cable route crosses roads (crossing points) construction traffic may also be required to cross with temporary traffic management measures installed. Where the proposed DC cable route crosses watercourses and drains temporary crossing structures (single span bridges) may be put in place to allow for movement of construction traffic.

Installation Methods

3.4.13 To avoid impacting the existing flood defence the submarine DC and fibre optic cables at the proposed landfall site will be installed using Horizontal Directional Drilling (HDD). HDD will be used to drill from a position close to the TJP on the land-ward (west) side of the flood defence.

The HDD will drill below the flood defence, Sandilands Golf Course and across the intertidal zone to a breakout point between MHWS and MLWS.

3.4.14 Ducts will be inserted through the drilled holes and then submarine cables pulled through these. Four drills/ducts are proposed comprising two ducts for the DC submarine cables (one each), one for the fibre optic cable and a fourth 'spare' duct. Table 5.6 provides a summary of the main physical characteristics of the landfall installation works.

Table 5.5 Proposed Landfall Installation Details

Key Feature	Design Assumption	Comments
Maximum number of ducts	Four	DC submarine cables (2 ducts), fibre optic cable (1 duct) and spare (1 duct).
Maximum diameter of ducts	Approximately 0.75m	Subject to detailed design. Smaller ducts will be installed where possible.
Maximum length of ducts	Up to 400 m	Subject to detailed design by Contractor.
Burial depth of ducts	Between 5 m and 20 m below ground level	Subject to detailed design by Contractor.

3.4.15 The ends of the ducts will be located below the beach level pending the submarine DC and fibre optic cables. The likely duration of these works is 1-2 months. Beach access may be required during this operation for inspection of the ends of the ducts. If required, an excavator would excavate a pit with a footprint typically 5 m x 5 m. Small sections of the beach will be inaccessible to the public for limited period, although transit along the beach will still be possible.

3.4.16 The ends of the ducts will be dug out using an excavator prior to arrival of the submarine cables. There may be a requirement for a temporary coffer dam on the beach for excavation of the duct and installation. Material excavated will be left adjacent to the pit and refilled after the cable pull-in. The submarine cables would then either be floated to the ends of the ducts, or lowered onto the beach and pulled along the beach using an excavator and/or rollers. An alternative solution is for the cable barge to ground itself on the beach at low tide.

3.4.17 The submarine cables would then be connected to the messenger wires pre-installed in the ducts, and winched from a position close to the TJP at the western end of the pre-installed duct whereupon it can be jointed to the onshore cables at the TJP.

3.4.18 On the beach, the cables are installed in sea-ward direction either using a plough or trencher or via excavator to MLWS. The typical excavated trench would be 1 m wide, with the material replaced after cable installation. Beach access will be required during the pull-in of the submarine cables. For this, excavators would be required and small sections of the beach will be inaccessible to the public for a limited period, although transit along the beach will still be possible. The likely duration for each cable pull will be from 1-2 days to one week. As the offshore installation sequence has not been decided, the temporary works on the beach may be

removed between cable pull-in operations. For further information about landfall installation reference should be made to the UK Offshore Environmental Statement (Ref 5.4).

3.4.19 Moving east from the TJP the proposed DC cable route will be installed by a combination of both open trench and trenchless installation methods. Trenchless methods will be utilised to cross a number of roads, watercourses and other utilities. Whilst the exact design of the proposed DC cable route is subject to the Contractor and detailed design for the purpose of the EIA it has been estimated that approximately 6.89 km of this Route Section will be installed by open cut methods and approximately 6.15 km installed using trenchless methods.

Crossing Schedule

3.4.20 As referenced in Table 5.4 there are 70 crossings in Route Section 1 which are predominantly drains and other utilities. There are also crossings of roads including three A-roads; the A52, A1111 and A1104. A full breakdown of the crossings is provided in Appendix 5.1 Schedule of Crossings.

Details of Reinstatement

3.4.21 Any areas where trenches have been dug will be backfilled with the material originally excavated where suitable. Any hedgerows removed to facilitate construction activities will be replanted with native hedgerow mix. Any trees which are removed to enable construction works will be replaced following a four to one replacement policy using native trees. Pasture, road verges and other areas temporarily affected will be seeded with a species rich wildflower or grass seed mix.

3.4.22 Any temporary construction drainage that was installed prior to or during construction will be removed and any field drains impacted by construction activities will be reinstated.

3.5 Route Section 2 Well High Lane to A16/Keal Road

Description of Route Section 2 Well High Lane to A16/Keal Road

3.5.1 Route Section 2 of the proposed DC cable route extends across the Lincolnshire Wolds AONB from Well High Lane to the A16 at East Keal. The planning application boundary within Route Section 2 is illustrated in Figure 5.10. The proposed DC cable route follows a south westerly/southern direction south of Driby Top and then south between the settlements of Langton and Dalby before heading south to the A158/Partney Road. At the A158 the proposed DC cable route heads to the west to Raithby Road and follows Raithby Road to the south to the junction with the A16 at East Keal where the section ends.

3.5.2 This Route Section is more undulating and steep in places, rising to around 95 m Above Ordnance Datum (AOD). This highest point of the section is at Langton Hill and the area adjacent to Sutterby in the northern half of the route section. Gradients and elevations gradually decrease at the route section moves further to the south.

3.5.3 Route Section 2 is approximately 16.85 km in length and for the majority of this length the LoD are 100 m wide. Where the LoD are wider is typically at crossing points or where the proposed route is close to known constraints, such as the high point at Langton Hill, the crossing of River Lymn and also at Raithby Road.

3.5.4 A summary of the key features of Route Section 2 including the number and location of TCCs, TWAs and access requirements is provided in Table 5.6 and illustrated in Figure 5.11. Reference should also be made to the Works Plans which accompany the planning application.

Table 5.6 DC Cable Route Section 2 Well High Lane to A16/Keal Road

Key Feature	Details
Section length	16.85 km
Relevant LPA(s)	ELDC
Approximate temporary land take	1.78 km^2 (178.41 ha)
No. of TCCs	1 (1 Secondary)
No. of TWAs	5
Approximate no. of access and crossing points to/from working areas	20
Approximate no. of crossings (watercourses, drains, roads, utilities)	108

Details of Installation in Route Section 2

Temporary Land Take

3.5.5 Within Route Section 2 there will be temporary land take required for one TCC and five TWAs within. The TCC (S2) has been located outside of the Lincolnshire Wolds AONB to prevent impacts on it. It is located south of the boundary of the AONB at the junction of the unnamed road from Sausthorpe to Raithby and Raithby Road. The five TWAs are evenly spread across the remaining length of the proposed DC cable route within this section. Two of the TWAs are located within the Lincolnshire Wolds AONB (T5 adjacent to the A16 at Driby Top and T6 at Dalby) and a third (T7) on the southern boundary of the AONB on the A158/Partney Road. The other two TWAs are located outside of the AONB on the B1195 (T8) and close to the end of Route Section 2 north of East Keal (T9).

3.5.6 In a small number of places the LoD are wider to provide some flexibility in finalising the detailed scheme design. This includes east of Langton adjacent to the A16 where some flexibility is required due to the steeper slopes and at Raithby Road where multiple crossings of roads and utilities are required.

3.5.7 There is some temporary land take also required for land drainage works and water management during construction. These are identified as spurs or small areas from or off the LoD. The majority of these located at the western/southern end of Route Section 2 where topography

becomes flatter and field drains become more prevalent. In the eastern/northern end of Route Section 2 there are fewer drains.

3.5.8 Additional land is also required to provide access during construction. This includes adjacent to the A16 on Bluestone Heath Road to access a TWA (T5), further south on the A16 to access a TWA (T6), on Raithby Road at the access to a TCC (S2), the B1195/Raithby Hill to access a TWA (T8) and on Raithby Road to access a TWA (T9).

Access Arrangements

3.5.9 The TCC (S2) will be accessed via Raithby Road. Access to the two TWAs within the Lincolnshire Wolds AONB (T5 and T6) will be directly from the A16. The third TWA located on the southern boundary of the Lincolnshire Wolds (T7) will be accessed from the A158/Partney Road (south of Sausthorpe). The final two TWAs will be accessed from the B1195/Raithby Hill. The TWA located to the south of Raithby will be located immediately adjacent to B1195 (T8), with the final TWA (T9) being accessed via Raithby Road.

3.5.10 Where the proposed DC cable route crosses roads (crossing points) construction traffic may also be required to cross with temporary traffic management measures installed. Where the proposed DC cable route crosses watercourses and drains temporary crossing structures (single span bridges) may be put in place to allow for movement of construction traffic.

Installation Methods

3.5.11 The proposed DC cable route will be installed by a combination of both open trench and trenchless installation methods. Trenchless methods will be utilised to cross a number of roads, watercourses and other utilities. Whilst the exact design of the proposed DC cable route is subject to the Contractor and detailed design for the purpose of the EIA it has been estimated that approximately 11.62 km of this Route Section will be installed by open cut methods and approximately 5.23 km installed using trenchless methods.

Crossing Schedule

3.5.12 As referenced in Table 5.6 there are 108 crossings in Section 2. Due to the steeper, more undulating landscape the proportion of drainage crossings is lower than the other sections. Crossings in Route Section 2 are predominantly crossings of utility services (76). The cable route section also crosses the River Lymn, as well as two A-roads (A16 and A158) and one B-road (B1195). The A16 requires two crossings, at Bluestone Heath Road and again at Keal Hill. A full breakdown of the crossings is provided in Appendix 5.1 Schedule of Crossings.

Details of Reinstatement

3.5.13 Any areas where trenches have been dug will be backfilled with the materially originally excavated where suitable. Any hedgerows removed to facilitate construction activities will be replanted with native hedgerow mix.

3.5.14 Given much of this section extends through the Lincolnshire Wolds AONB, specimen and hedgerow trees and woodland planting would be incorporated as part of reinstatement where this is appropriate to the local landscape character, and where technically feasible. These would consist of a variety of native species, typical of those found within the local area.

3.5.15 Pasture, road verges and other areas temporarily affected will be seeded with a species rich wildflower or grass seed mix.

3.5.16 Reinstatement also includes the removal of temporary construction drainage and reinstatement of field drains impacted by construction activities.

3.6 Route Section 3 A16/Keal Road to River Witham

Description of Route Section 3 A16/Keal Road to River Witham

3.6.1 The proposed DC cable route continues south from Route Section 2 adjacent to the A16 at West Keal before crossing the A16 and heading to the southwest between East Kirkby airfield and Stickford and across Drain Bank. The planning application boundary within Route Section 3 is illustrated in Figure 5.12. The proposed DC cable route then heads south between the B1183/Main Road (Carrington) and the A16 (Stickney). North of Frithville the alignment heads in a south westerly direction to the River Witham, crossing Westville Road (and West Fen Drain), Leagate Road, Castle Dike and the B1192. With the exception of the north-eastern end of this route section, at the foot of the Lincolnshire Wolds AONB, this section is located within flat, low lying agricultural land.

3.6.2 Route Section 3 is approximately 22.06 km in length and the LoD through much of this length is 100 m wide. The LoD is wider in this section at crossings and where there are constraints on bends and some flexibility is required such as the section north of Keal Cotes routed around properties and where there are several drains, the section adjacent to Folly Lane which includes a right angled turn, and the sequence crossing Medlam Drain, the B1183/Main Road and Hackerley Bridge. The application boundary is also wider in places in Route Section 3 where access to identify land drainage requirements has not been permitted. As a result the application boundary includes whole fields in which land drainage works may be required.

3.6.3 There are a large number of crossings within this section of the proposed DC cable route including 46 main drains and watercourses. As such the alignment includes a number of bends to ensure that the watercourses are crossed at right angles. In places the LoD have been widened to optimise the alignment of crossings in order to reduce friction during cable pulls.

3.6.4 A summary of the key features of Route Section 3 including the number and location of TCCs, TWAs and access requirements is provided in Table 5.7Table 5.7 and illustrated in Figure 5.13. Reference should also be made to the Works Plans which accompany the planning application.

Table 5.7 DC Cable Route Section 3 A16/Keal Road to River Witham

Key Feature	Details
Section length	22.06 km
Relevant LPA(s)	ELDC, BBC
Approximate temporary land take	2.25 km^2 (224.87 ha)
No. of TCCs	4 (1 Primary, 3 Secondary)
No. of TWAs	3
Approximate no. of access and crossing points to/from working areas	23
Approximate no. of crossings (watercourses, drains, roads, utilities)	117

Details of Installation in Section 3

Temporary Land Take

3.6.5 There are four TCCs and three TWAs within Route Section 3. Three of the four TCCs are located in the northern part of the section adjacent to the A16, these are located to the south of West Keal (P2), west of Stickford (S3) and west of Stickney (S4). The fourth is located further south adjacent to the crossing of Westville Road/West Fen Drain (S5). The three TWAs are located in the southern half of the section between the B1183 and the River Witham. These are adjacent to the B1193 (T10), Leagate Road (T11) and the B1192 (T12), respectively.

3.6.6 In a small number of places the LoD are wider to provide some flexibility in finalising the detailed scheme design. This includes south of East Keal, west of Hagnaby Lock and at Leagate Raod where the LoD have been widened to allow for the cable alignment to be optimised for cable pulling.

3.6.7 As with Route Sections 1 and 2, there is additional temporary land take required for undertaking land drainage works and for water management during construction. Through this route section there are several fields adjoining the proposed DC cable route identified for water management given the flat topography of the area. This includes large areas adjacent to Stickford (Drain Bank) and between Stickney and Carrington. Additional areas are also required between Carrington Road and Westville Road/West Fen Drain.

3.6.8 Additionally there is temporary land take required to provide access during construction. This includes land adjacent to the A16 south of West Keal to provide access to a TCC (P2), development of a temporary haul road from an unnamed road to a TCC (S3), land on Stickney Lane to provide access to the working width and nearby TCC (S4), land on Westville Road

providing access to the working width and TCC (S5) and at Langrick Road providing access to a TWA (T12).

Access Arrangements

3.6.9 There are seven access points to the working width in Route Section 3 each of which is associated with a TCC or TWA.

3.6.10 The three northern TCCs will be accessed from the A16 (P2 directly from the A16). The TCC adjacent to Stickford (S3) will require traffic to use of the unnamed road southeast of Drain Bank (which requires improvement) and the TCC south of this (S4) will require traffic to use Stickney Lane to join the A16. The final TCC (S5) is located on Westville Road for transport west to the B1192 (vehicles will only be allowed to travel north from the working width at this point).

3.6.11 Access to the three TWAs will be directly from the road which they are immediately adjacent to; B1193 (T10), Leagate Road (T11) and the B1192 (T12) (north only when exiting this point of the working width) respectively.

3.6.12 Where the proposed DC cable route crosses roads (crossing points) construction traffic may also be required to cross with temporary traffic management measures installed. Where the proposed DC cable route crosses watercourses and drains temporary crossing structures (single span bridges) may be put in place to allow for movement of construction traffic.

Installation Methods

3.6.13 The proposed DC cable route will be installed by a combination of both open trench and trenchless installation methods. Trenchless methods will be utilised to cross a number of roads, watercourses and other utilities Whilst the exact design of the proposed DC cable route is subject to the Contractor and detailed design for the purpose of the EIA it has been estimated that approximately 12.68 km of this Route Section will be installed by open cut methods and approximately 9.38 km installed using trenchless methods.

Crossing Schedule

3.6.14 As set out in Table 5.7 there are 117 crossings in Route Section 3. As this section is almost entirely through rural agricultural land notable crossings include smaller roads and water bodies. Hagnaby Beck, West Fen Catchwater Drain and River Witham are crossed in this section, as well as a greater proportion of B-roads, such as Stickney Lane, B1183 Carrington Road and B1192 Longrick Road. A full breakdown of the crossings is provided in Appendix 5.1 Schedule of Crossings.

Details of Reinstatement

3.6.15 Any areas where trenches have been dug will be backfilled with the materially originally excavated where suitable. Any hedgerows removed to facilitate construction activities will be

replanted with native hedgerow mix. Any trees which are removed to enable construction works will be replaced following a four to one replacement policy using native trees. Pasture, road verges and other areas temporarily affected will be seeded with a species rich wildflower or grass seed mix.

3.6.16 Any temporary construction drainage that was installed prior to or during construction will be removed and any field drains impacted by construction activities will be reinstated.

3.7 Route Section 4 River Witham to the proposed converter station

Description of Route Section 4 River Witham to the proposed converter station

3.7.1 The planning application boundary within Route Section 4 is illustrated in Figure 5.14. From the River Witham the proposed DC cable route continues in a south-westerly direction north of Amber Hill and east of East Heckington. Following the crossing of the A17 the alignment kinks to the west to avoid a Second World War monument and then runs parallel to the western bank of South Forty Foot Drain to the south. The proposed DC cable route crosses the South Forty Foot Drain to the east and then again heads south to North Ing Drove and the proposed converter station site. As with Route Section 3, land within this section is flat, low-lying agricultural land.

3.7.2 Route Section 4 is approximately 15.21 km in length. The LoD for the majority of this length is 100 m wide. Where the LoD is wider is typically at crossing points or where the proposed DC cable route has a more acute angle bend (such as at the crossing of the South Forty Foot Drain).

3.7.3 A summary of the key features of Route Section 4 of the proposed DC cable route including the number and location of TCCs, TWAs and access requirements is provided in Table 5.8 and illustrated in Figure 5.15. Reference should also be made to the Works Plans which accompany the planning application.

Table 5.8 DC Cable Route Section 4 River Witham to the proposed converter station

Key Feature	Details
Section length	15.21 km
Relevant LPA(s)	BBC, NKDC and SHDC
Approximate temporary land take	1.78 km^2 (178.41 ha)
No. of TCCs	2 (1 Primary, 1 Secondary)
No. of TWAs	4
Approximate no. of access and crossing points to/from working areas	18
Approximate no. of crossings (watercourses, drains, roads, utilities)	103

Details of Installation in Route Section 4

Temporary Land Take

3.7.4 Within this Route Section there are two TCCs and four TWAs. The first of the TCCs (P3) is located northeast of Amber Hill between North Forty Foot Bank and Kirton Drove. The second TCC (S6) is located adjacent (south) to the A17 to the east of East Heckington. The first of the four TWAs is located to the west of Amber Hill on Claydyke Bank (T13), the second TWA is further to the south, south of the railway line at South Forty Foot Drain (T14). The last two TWAs are located at the southern end of the proposed route, one adjacent to the South Forty Foot Drain at Little Hale Drove (T15), and the other adjacent to the proposed converter station site (T16).

3.7.5 In a small number of places the LoD are wider to provide some flexibility in finalising the detailed scheme design. This includes north of the Nottingham-Skegness Railway Line and where the proposed DC cable route crosses the South Forty Foot Drain. At these locations the LoD have been widened to allow for the cable alignment to be optimised for cable pulling.

3.7.6 Additional land take is required throughout the route section for undertaking land drainage works as well as for water management during construction. The application boundary is also wider in places in Route Section 4 where access to identify land drainage requirements has not been permitted. As a result the application boundary includes whole fields in which land drainage works may be required.

3.7.7 Additional land take is also required for temporary construction access. This includes at Kirton Drove to provide access to a TCC (P3), at Claydyke Bank to access a TWA (T13), at the A16 to enable access to a TCC (S6) and the working width, and on the private road at the TWA (T14) south of the railway line west of Swineshead Bridge.

Access Arrangements

3.7.8 There are five access points to the working width within this section of the proposed DC cable route.

3.7.9 The first TCC (P3) will be accessed from Kirton Drove (from the south only), to then connect to the A1121. The second TCC (S6) will be accessed directly from the A17.

3.7.10 The first (most northern) TWA (T13) will be accessed from the south only from Claydyke Bank via the A1121. The second TWA (T14) will be accessed from the A17 and then Great Hale Drove, Carter Plot Lane and a private road (which will be improved).

3.7.11 The last two TWAs (T15 and T16) will be accessed from the temporary haul road constructed within the working width. The last TWA (T16) may also be accessed via North Ing Drove and the permanent access road constructed for access to the proposed converter station site form the A52 (see chapter 19).

3.7.12 Where the proposed DC cable route crosses roads (crossing points) construction traffic may also be required to cross with temporary traffic management measures installed. Where the proposed

DC cable route crosses watercourses and drains temporary crossing structures (single span bridges) may be put in place to allow for movement of construction traffic.

Installation Methods

3.7.13 The proposed DC cable route will be installed by a combination of both open trench and trenchless installation methods. Trenchless methods will be utilised to cross a number of roads, watercourses and other utilities. Whilst the exact design of the proposed DC cable route is subject to the Contractor and detailed design for the purpose of the EIA it has been estimated that approximately 7.57 km of this Route Section will be installed by open cut methods and approximately 7.55 km installed using trenchless methods.

Crossing Schedule

3.7.14 As referenced in Table 5.8 there are 103 crossings in Route Section 4. These are predominantly drains (33) and other utilities (49). Skerth Drain and South Forty Foot Drain are the main rivers that are crossed in this route section. The route section also includes a crossing of a railway line between Boston and Sleaford, to the west of Swineshead Bridge. A full breakdown of the crossings is provided in Appendix 5.1 Schedule of Crossings.

Details of Reinstatement

3.7.15 Any areas where trenches have been dug will be backfilled with the materially originally excavated where suitable. Any hedgerows removed to facilitate construction activities will be replanted with native hedgerow mix. Any trees which are removed to enable construction works will be replaced following a four to one replacement policy using native trees. Other vegetation within this section temporarily disturbed by construction would also be reinstated. Pasture, road verges and other areas temporarily affected will be seeded with a species rich wildflower or grass seed mix.

3.7.16 Any temporary construction drainage that was installed prior to or during construction will be removed and any field drains impacted by construction activities will be reinstated.

3.8 Operation of the DC Cable Route

3.8.1 Following completion of construction a 15 m wide permanent easement will apply to land over and adjacent to the proposed DC underground cable (e.g. typically 7.5 m either side of the proposed DC cable route). The purpose of the easement is for the protection and maintenance of the proposed DC cables during operation. Note that the easement may need to be widened above trenchless crossings where underground cables need to be spaced further apart to prevent heating effects.

3.8.2 Once operational activity along the proposed DC cable route would generally be limited to non-intrusive inspections and cable repairs. The latter would only be required in the unlikely event of

a cable fault. Where a fault does occur the location of the fault would be identified and the faulty section of cable replaced. The activities involved in cable repair would be similar to those outlined above for installation albeit over a much smaller section.

3.9 Decommissioning of the DC Cable Route

3.9.1 In the event that Viking Link ceases operation the proposed underground DC cable would be decommissioned. Dependent on the requirements at the time the redundant cables could either be left in-situ or all or some parts of the cables could be removed for recycling. Where this is not possible removed cables would be disposed of in accordance with the relevant waste disposal regulations at the time of decommissioning.

4 References

Ref 5.1 National Grid Viking Link (December 2016) UK Onshore Scheme: Construction Traffic Management Plan (Proposed DC Cable Route)

Ref 5.2 National Grid Viking Link (August 2017) UK Onshore Scheme: Construction Environmental Management Plan

Ref 5.3 National Grid Viking Link (August 2017) UK Onshore Scheme: Soil Handling and Storage Protocol

Ref 5.4 National Grid Viking Link (March 2017) UK Offshore Scheme: Environmental Statement

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