The Great Grid Upgrade

North Humber to High Marnham

Issue 1

North Humber to High Marnham

Corridor Preliminary Routeing and Siting Study

June 2023

nationalgrid

Contents

Table

Figures

Appendices

Table 1.1 – Abbreviations

Abbreviations	Definition
AIL	Abnormal Indivisible Load
AONB	Area of Outstanding Natural Beauty
CPRSS	Corridor Preliminary Routeing and Siting Study
CROW	Countryside and Rights of Way
CTM	Conventional Tunnelling Method
DNO	Distribution Network Operator
ECML	East Coast Main Line
EPS	European Protected Species
ESO	Electricity System Operator
FEED	Front-End Engineering Design
FES	Future Energy Scenarios
FRA	Flood Risk Assessment
GIS	Geographical Information Systems (or Gas Insulated Switchgear dependent upon context)
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
ILA	Important Landscape Area
LCA	Landscape Character Assessment
LCT	Landscape Character Type(s)
MPA	Mineral Planning Authority
NCA	National Character Area
NCN	National Cycle Network
NETS	National Electricity Transmission System
NGED	National Grid Electricity Distribution Plc
NGET	National Grid Electricity Transmission Plc
NPS	National Policy Statement
OfGEM	Office of Gas and Electricity Markets
OS	Ordnance Survey
PRoW	Public Right of Way

Abbreviations	Definition
RAG	Red, Amber, Green
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SEC	Sealing End Compound
SGT	Super Grid Transformer
SINC	Site of Importance for Nature Conservation
SPA	Special Protection Area
SQSS	Security and Quality of Supply Standards
SSSI	Site of Special Scientific Interest
TBM	Tunnel Boring Machine

Table 1.2 – Glossary of Terms

Term	Definition
ZDA	A 400kV transmission route from a point on the Drax – Thorpe Marsh route west of Thorne, to Keadby substation in North Lincolnshire and from Keadby Substation to Staythorpe substation in Newark (with connections to West Burton, Cottam and High Marnham Substations in the Trent Valley).
ZZI	A 400kV double circuit transmission route from Thorpe Marsh Substation in Doncaster District, to the ZDA overhead line west of Thorne (carrying part of the Drax-Keadby-Thorpe Marsh circuits).
4TM	A 400kV double circuit transmission route from West Burton substation in Bassetlaw to Keadby substation in North Lincolnshire.
4VC	A 400kV double circuit transmission route from Thornton Substation, west of Market Weighton in the East Riding of Yorkshire, to Drax Substation in Selby District.
4VE	A 400kV double circuit transmission route from West Burton Substation in Bassetlaw that connects to an existing line south of High Marnham Substation (with an intermediate connection to Cottam Substation in Bassetlaw).
4ZH	A 400kV double circuit transmission route from Thorpe Marsh Substation, in Doncaster District, to Brinsworth substation in Rotherham.
4ZM	A 400kV double circuit transmission route from West Burton Substation in Bassetlaw to Walpole Substation in Kings Lynn and West Norfolk.

Term	Definition
4ZR	A 400kV double circuit transmission route from Thornton Substation, west of Market Weighton in the East Riding of Yorkshire, to Creyke Beck Substation in Cottingham.
4ZQ	A 400kV double circuit transmission route from Creyke Beck in Cottingham to Keady in North Lincolnshire.
XE	A 275kV single circuit transmission route from High Marnham Substation to the XEA and YLL overhead lines east of Rotherham (carrying part of the High Marnham – Thurcroft – West Melton Circuits).
Corridor	A broad area, within which the new transmission infrastructure (overhead lines, underground cables (UGC) and sealing end compounds (SEC)) could be routed or sited.
Distribution Network Operator (DNO)	A Distribution Network Operator is the company that owns and operates the overhead power lines and infrastructure that connects the National Grid electricity transmission system to properties and businesses. The DNOs in proximity to the Project are Northern Power Grid (NPG) and National Grid Electricity Distribution Plc (NGED).
East Coast Main Line (ECML)	Electrified railway between London and Edinburgh.
Electricity System Operator (ESO)	The Electricity System Operator plans and operates the transmission system in Great Britain but does not own the transmission assets such as the overhead lines and substations. These are developed, owned and maintained by National Grid Electricity Transmission and other 'Transmission Owner' companies. Generation and interconnector customers apply to National Grid ESO when they wish to connect to the network. The ESO is a wholly independent company within the wider National Grid Group.
Electricity Transmission System	In England and Wales the electricity transmission system is made up largely of 400kV and 275kV assets connecting separately owned generators, interconnectors, large demands fed directly from the transmission system, and distribution systems. The electricity transmission system is designed to make sure there is sufficient transmission capacity to ensure that the system can be operated in an economic and efficient way by the ESO, ensuring power can be moved from where it is generated to demand centres across Britain. The planning and development of the electricity transmission system is governed by the Security and Quality of Supply Standard (SQSS) which ensures that the network is developed and operated securely and is resilient to any foreseeable network faults and disruption.
Future Energy Scenarios (FES)	Published annually by the ESO to indicate possible future power requirements and where future connections may occur across the network.
Holford Rules	A series of guideline rules around overhead line routeing. The guidelines were initially developed in 1959 and have been reviewed on a number of occasions by National Grid and by the other UK transmission licence holders. One of the reviews was against the Electricity Act 1989. The

Term	Definition
	Guidelines provide a set of design criteria that have stood the test of time and become accepted industry best practice in overhead line routeing. The guidelines now form an important part of national planning policy relating to the development of electricity networks, as set out in National Policy Statement EN-5[1].
Horlock Rules	A series of guideline rules for the siting and design of new substations, or substation extensions, including consideration of line entries and SECs. The guidelines were initially developed in 2003 and have been reviewed on a number of occasions by National Grid, with a revised version issued in 2009. The Horlock Rules provide a set of principles which avoid, or reduce the environmental impacts associated with the development of substation infrastructure.
North Humber to High Marnham (the Project)	Located in the Humber and East Midlands region of England, the Project comprises major reinforcement of the electricity transmission system. This will allow increased north-south power flows and facilitate the connection of new sources of clean offshore power that will land on the Yorkshire coast. The Project is expected to comprise a new overhead electricity transmission line and may include the use of underground cables. There will be associated works to connect the new route into substations at either end, and to alter existing infrastructure crossed by the route, including crossings of existing 400kV transmission lines.
National Grid	Throughout this Report the term National Grid is used to refer to National Grid Electricity Transmission Plc (see below). The wider National Grid Group comprises several businesses, including National Grid Ventures and National Grid Electricity Distribution. These businesses are not licenced Transmission Owners and do not develop the national transmission system.
National Grid Electricity System Operator (ESO)	National Grid ESO is the Electricity System Operator for the whole of Great Britain. National Grid ESO ensures electricity is always where it is needed, and the network remains stable and secure in its operation. Generators apply to National Grid ESO when they wish to connect to the network and National Grid ESO leads the work to consider how the network may need to evolve to deliver a cleaner, greener future.
National Grid Electricity Distribution Plc (NGED)	In June 2021 Western Power Distribution was acquired by National Grid Group. It remains a separate company from NGET, operating within the wider National Grid Group and recently rebranded as National Grid Electricity Distribution. NGED is a DNO operating in proximity to the Project.
National Grid Electricity Transmission Plc (NGET)	National Grid Electricity Transmission Plc (NGET) owns and maintains the network in England and Wales, transporting electricity supplies from generating stations to local distribution network operator companies. NGET does not distribute electricity to individual premises, but its role in

1 National Policy Statement for Electricity Networks Infrastructure (EN-5).

Term	Definition
	the wholesale market is vital to ensuring a reliable, secure and quality supply to all.
National Policy Statement (NPS)	Government planning policy relating to the development of Nationally Significant Infrastructure Projects (NSIPs) is set out in the relevant National Policy Statement (NPS). NSIPs should be developed in accordance with the relevant NPS. In the case of new transmission routes the relevant energy-related NPS are EN-1; Overarching NPS for Energy[2] and EN-5; Electricity Networks[1].
National Site Network	Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) in the UK no longer form part of the EU's Natura 2000 ecological network. The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 have created a national site network on land and at sea, including both the inshore and offshore marine areas in the UK. The national site network includes: • Existing SACs and SPAs; and • New SACs and SPAs designated under these Regulations. Designated Wetlands of International Importance (known as Ramsar sites) do not form part of the national site network. Many Ramsar sites overlap with SACs and SPAs, and may be designated for the same or different species and habitats. All Ramsar sites remain protected in the same way as SACs and SPAs.
Northern Power Grid (NPG)	A power distribution company operating in northeast England and Yorkshire. NPG is a DNO operating in proximity to the Project.
Options Appraisal	A robust and transparent process used to compare options and to assess the potential impacts they may have across a wide range of criteria including environmental, socio-economic, technical and cost factors.
Options Identification and Selection	Work undertaken to determine the emerging preferred corridor and preliminary routeing options for the Humber Trent Green Energy Enablement (GREEN) Project. It is intended to demonstrate how National Grid's statutory duties, licence obligations, policy considerations, environmental, socio-economic, technical, cost, and programme issues have been considered and to provide information on the approach to the identification and appraisal of corridors.
Overhead Line	An above ground electricity line that safely and securely transmits electricity through a series of conductors (wires). An overhead line comprises a series of components including: supporting structures, such as pylons; line fittings, such as electrical insulators and conductor spacers; an earthwire (to protect the line from electrical faults and carry control data) and; the conductors themselves.
Project Need Case	Sets out the reasons why the Project is required.

[2] Overarching National Policy Statement for Energy (EN-1).

Term	Definition
Pylon	Overhead line structure used to carry overhead electrical conductors, insulators and fittings.
Ramsar Site	An area of land designated under the Ramsar Convention to conserve wetlands, especially those providing waterfowl habitat.
Sealing End Compound	A secure compound within which the transition between underground cables and overhead lines is made. Buried cables are brought to the surface and directed vertically through insulated post structures before connecting onto overhead line conductors (wires) secured (via insulators) to anchor blocks or gantry structures.
Security and Quality of Supply Standard (SQSS)	The SQSS sets out a coordinated set of criteria and methodologies for planning, constructing and operating the National Grid Electricity Transmission System (NETS).
Site of Special Scientific Interest (SSSI)	An area of land designated by Natural England as of special interest by reason of its flora, fauna or geological or physiographical features.
Special Area of Conservation (SAC)	An area of land designated under the under Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora to protect one or more special habitats and/or species.
Special Protection Area (SPA)	An area of land designated under the Directive 79/409 on the Conservation of Wild Birds to protect the habitats of migratory birds and certain particularly threatened birds.
Strategic Proposal	The outcome of the strategic options appraisal process; the Strategic Proposal is taken forward to the Options Identification and Selection sStage.
Substation	A secure node on the electricity system where: switching may be undertaken to direct power flows; operating voltages may be altered through the use of electricity transformers and; sources of electricity import, generation and/or demand can be connected, Substations may be located either outdoors or within a building but will always be enclosed by a secure perimeter fence.
Tee	The point at which two electrical routes connect together.
Underground Cable	An insulated conductor carrying electric current designed for underground installation.
Wirescape	Caused by multiple overhead lines running in different angles or the proximity of multiple overhead lines.

North Humber to High Marnham Document Control

Document Properties	
Organisation	National Grid
Author	National Grid, WSP, LUC, LSTC, Mott MacDonald and Monui
Approved by	Amy Crabtree, Senior Project Manager
Title	Corridor and Preliminary Routeing and Siting Study (CPRSS)
Document Register ID	CGNC-NG-CNS-REP-0001
Published Document Ref	CGNC-NG-CNS-REP-0001
Data Classification	Public

Version History

Document	Version	Status	Description / Changes
June 2023	1.0	Final	For non-statutory consultation.

Executive Summary

nationalgrid

Executive Summary

National Grid Electricity Transmission plc (NGET) own, build and maintain the high-voltage electricity transmission network in England and Wales. NGET is responsible for making sure electricity is transported safely and efficiently from where it's produced to where it's needed.

The North Humber to High Marnham Project (the 'Project') is a proposed network reinforcement that is currently being developed by NGET. The Project, located in the Humber and East Midlands regions, is required to help deliver the UK Government's Net Zero targets. It forms part of a major programme of reinforcement of the electricity transmission system to provide additional north-south power flows, helping take power generated from low-carbon sources, especially from offshore wind to areas of consumer demand. The Project comprises of a 400kV electricity transmission connection between new substations to be built in the vicinity of Creyke Beck Substation and the former High Marnham Power Station site, a straight-line distance of approximately 68km. NGET will also need to replace a short section of existing 400kV overhead line with underground cables and commission local changes to the lower voltage distribution networks in order to facilitate the construction of the new overhead line.

The broad location for the proposed reinforcement was identified through a Strategic Options Appraisal undertaken at the Strategic Proposal Stage (Stage 1). This considered a wide range of options for providing the necessary north-south power flows.

This report is the Corridor Preliminary Routeing and Siting Study for the Project, which details the work undertaken at the Options Identification and Selection Stage (Stage 2). This includes the development and refinement of preliminary corridor options and the comparative assessment of these to identify NGET's proposed corridor: the broad location of the new infrastructure required to meet the Project need.

This report will be used to inform the non-statutory consultation and engagement with key stakeholders, including landowners. The non-statutory consultation will take place in Spring and Summer 2023.

For the Project, four preliminary overhead line corridors were identified and appraised. The four preliminary corridors were divided in sections, links and loops for appraisal and the identification of an emerging preferred corridor. Following the appraisal of the sections, links and loops in isolation an end-to end solution review was then undertaken between Creyke Beck and High Marnham. This review considered each progressed section, link or loop of the preliminary corridor in the context of the wider end-to-end solution and ensured that the reasoning and justification for progressing one part of the emerging preferred corridor did not incorrectly impact on the decision made for the next section, link or loop of the corridor. The wider end-to-end solution review also incorporated cost performance. The review did not cause any amendments to the preferred emerging corridor.

To summarise the emerging preferred corridor for a new overhead line:

- broadly follows the existing 4ZQ 400kV overhead line from the eastern edge of the Yorkshire Wolds to near Luddington (Lincolnshire) including crossing the River Ouse alongside the existing overhead line river crossing;
- from Luddington, loops west around Keadby Windfarm to pass east of Ealand and then parallels the two existing 400kV overhead lines south from near Beltoft to a point near the crossing of the Warping Drain, south-east of Haxey; and

- from there loops west to pass west of Misterton, then south, passing west of the line of villages along the edge of the Trent valley (Wallingham, Beckingham, Sturton le Steeple, North and South Leverton, Tresswell and Woodbeck) to pass west of East Drayton then approach High Marnham from the north-east.

The conclusion was drawn that routeing the new overhead line closely parallel to existing 400kV network would minimise the overall environmental impacts – concentrating impacts in areas already impacted rather than spreading them more widely. The main exceptions to this are at Keadby with the technical constraints around the Keadby Windfarm and south of Haxey, identifying a new corridor three to four kilometres west of the existing 400kV overhead lines in the Trent Valley where the increasing numbers of existing lines form a broad and complex network.

The emerging preferred corridor broadly looks to close parallel with existing electricity transmission infrastructure. Close paralleling would minimise overall environmental and socio-economic impacts, whilst avoiding areas of highest engineering challenge. The deviations from close parallel make little difference to the overall length of the emerging preferred corridor which is close to the shortest practicable given the constraints posed by the Humber Estuary. Overall, the emerging preferred corridor is considered to offer the optimum balance between environmental, technical, cost and socio-economic considerations.

A graduated swathe has been prepared for the emerging preferred corridor. The graduated swathe represents the current thinking on where the Project infrastructure is more or less likely to be located. This will be informed by feedback received during non-statutory consultation and therefore there is the potential for the final design of the Project to extend beyond the graduated swathe. This will be fully considered through the development of the Project, whilst maintaining the principles used to develop the current graduated swathe, for instance, the avoidance of areas of highest constraint such as settlements.

During the non-statutory consultation period, NGET will be inviting feedback from local communities and stakeholders about our work to date, the proposed corridor and graduated swathe and matters that they would like NGET to have regard to as they further develop more detailed proposals. The feedback from non-statutory consultation, along with information from surveys undertaken to obtain baseline data and ongoing design studies, will inform the further development of the Project. The developed design will be subject to an Environmental Impact Assessment, statutory public consultation and design development prior to submission of the application for a Development Consent Order.

1. Introduction

1. Introduction

1.1 Overview

1.1.1 National Grid Electricity Transmission Plc (NGET) owns and maintains the high-voltage electricity transmission system in England and Wales. NGET is responsible for making sure electricity is transported safely and efficiently from where it's produced to where it's needed and for developing upgrades to the network as agreed with the industry regulator, Office of Gas and Electricity Markets (OfGEM).

1.1.2 The National Grid Electricity System Operator (ESO) controls and operates the high-voltage electricity transmission system in England and Wales. National Grid ESO is a legally separate business, balancing supply and demand to ensure homes and businesses in Great Britain have the electricity they need 24/7.

1.1.3 National Grid's transmission system in England and Wales consists of approximately 7,250km of overhead lines and a further 1,450km of underground cabling, operating at 400kV and 275kV[3]. The 275kV grid was developed in the 1950s to provide a national transmission system and then further developed from the mid 1960s, at 400kV to increase the power carrying capacity. The overhead lines and cables connect around 300 substations to form a highly interconnected network. The substations provide points of connection to the local distribution networks, which operate at voltages from 132kV down to 240V (the voltage at which the power is distributed to domestic consumers). The distribution networks are owned by Distribution Network Operators (DNOs), including Northern Power Grid and NGED in the Humber and Lincolnshire regions.

1.1.4 The North Humber to High Marnham Project (the 'Project') is being developed by NGET. The Project, located in the Yorkshire and Humber and East Midlands regions, is required to reinforce the electricity transmission system to help deliver the UK Government's Net Zero targets. It forms part of a major programme of reinforcement of the electricity transmission system to accommodate substantial increases in north-south power flows, helping take power generated from low-carbon sources (especially from offshore wind) to areas of consumer demand. The Project location is shown in **Figure 1-1**.

[3] National Grid, (2022), Network and Infrastructure. Available at https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure. Accessed 08 June 2022.

Figure 1-1 – North Humber to High Marnham Project Location

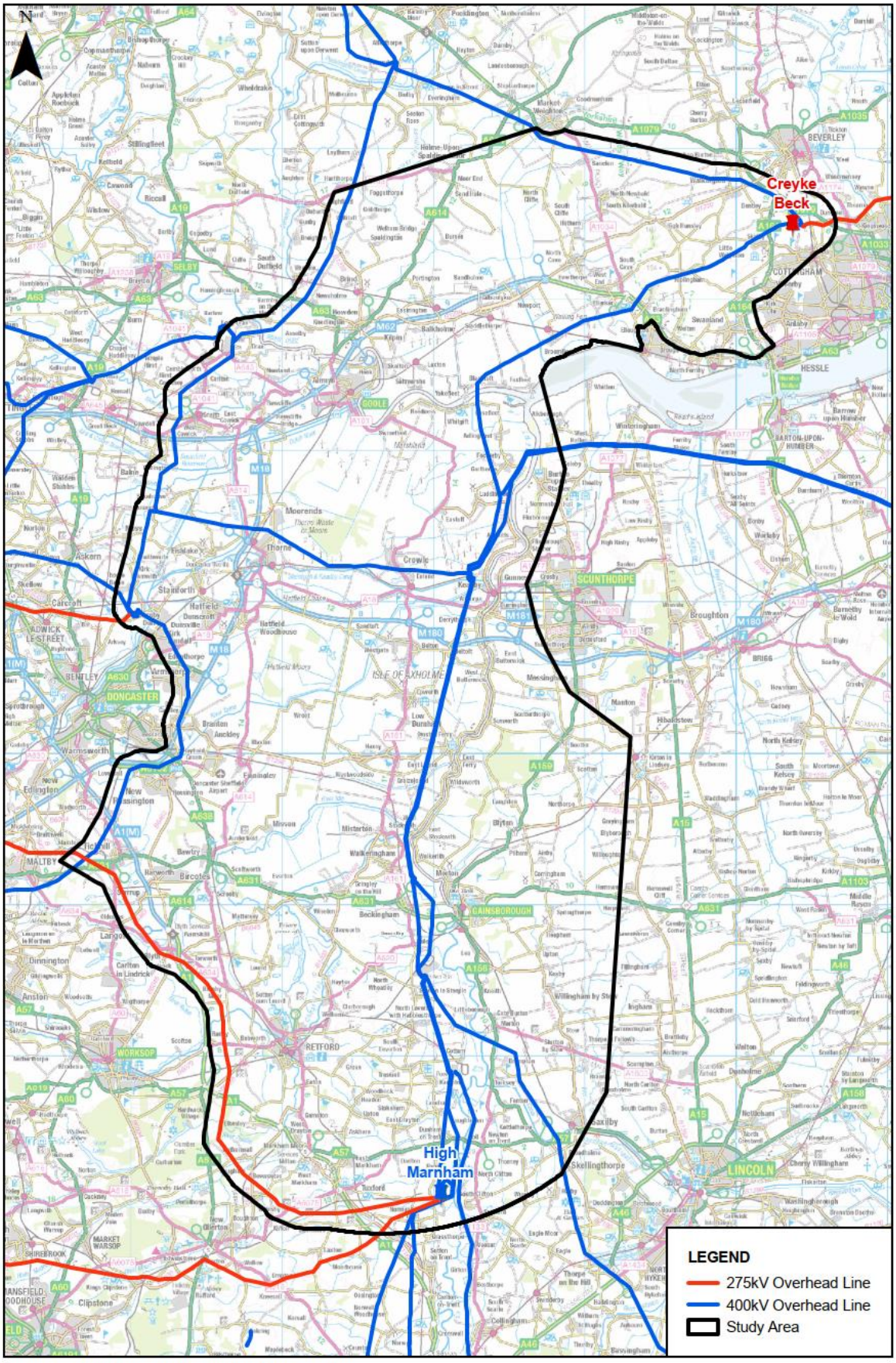
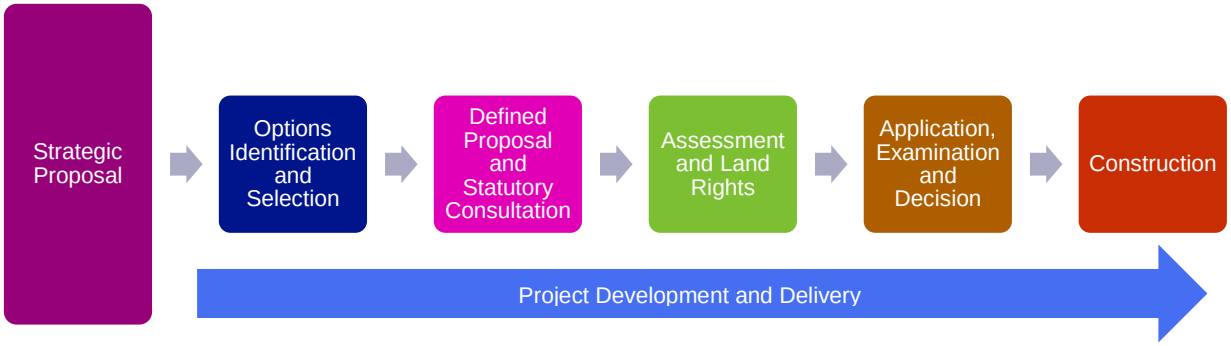


Figure 1-1 – North Humber to High Marnham Project Location

1.1.5 National Grid's Approach to Consenting[4] outlines the project development process, divided into six stages, for major infrastructure projects; Strategic Proposal, Options Identification and Selection, Defined Proposal and Statutory Consultation, Assessment and Land Rights, Application, Examination and Decision and Construction. With Strategic Proposal being Stage 1 and Construction being Stage 6. **Figure 1-2** presents an overview of National Grid's Approach to Consenting stages, which is explained in more detail in **Chapter 3** of this CPRSS.

Figure 1-2 – National Grid's Approach to Project Development and Delivery



1.1.6 Example images of NGET's transmission system are shown in **Figure 1-3** overleaf.

1.1.7 The need for the Project was first identified by the National Grid ESO. NGET then undertook a Strategic Options Appraisal at the Strategic Proposal Stage (Stage 1) which identified the most appropriate strategic solution to bring forward. This considered a wide range of options for providing the necessary north-south power flows and concluded that the establishment of a new electricity transmission route between East Yorkshire and Nottinghamshire represented the most appropriate solution. The Strategic Options Appraisal is reported in the Strategic Options Report[5].

1.1.8 The Project will establish a new 400kV transmission connection between new substations to be built in the vicinity of Creyke Beck Substation and the former High Marnham Power Station site. The connection is expected to wholly or largely comprise of a new overhead line. NGET will also need to replace a short section of existing 400kV overhead line with underground cables and commission local changes to the lower voltage distribution networks in order to facilitate the construction of the new overhead line.

[4] National Grid develops projects through a six-stage process set out in the Approach to Consenting (April 2022) guidance available at https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure/planning-and-development. Accessed 26 July 2022. The process is detailed further in Chapter 3 of this report.

[5] National Grid, (2023), Strategic Options Report.

Figure 1-3 – Example Images of NGET's Transmission System

1.2 Purpose

1.2.1 This report is the Corridor Preliminary Routeing and Siting Study (CPRSS), which has been undertaken to facilitate gathering feedback from all interested parties as part of the Project (non-statutory consultation). The CPRSS reports the process undertaken as part of the Options Identification and Selection Stage (Stage 2) to identify an emerging preferred corridor within which the required infrastructure for the Project may be located. A description of the proposed Project infrastructure within the scope of this CPRSS is set out in **Chapter 2**.

1.2.2 This CPRSS sets out the routeing and siting activities undertaken to date, including the identification, refinement and assessment of options for preliminary corridors (hereafter referred to as 'corridors') and explains NGET's emerging preferences for the broad location of new infrastructure to meet the need case for the Project, as set out below. These emerging preferences are presented as a 'graduated swathe'.

1.2.3 The graduated swathe is a way of showing the areas within the emerging preferred corridor where the required Project infrastructure is considered more or less likely to be located. The corridor is shown with a colour shading, with the depth of shading indicating NGET's emerging view of where infrastructure would be better located: darker shading indicating more likely locations, lighter shading indicating less likely locations.

1.2.4 The use of the graduated swathe is intended to emphasise the preliminary nature of judgements made to date. The feedback received from the non-statutory consultation will be taken into account in the detailed routeing and siting work for the Defined Proposal and Statutory Consultation Stage (Stage 3). This feedback may also lead to modification of the emerging preferred corridor.

1.3 Background and Summary of Need

Background

1.3.1 The UK Government has set targets of 50GW of offshore wind generation by 2030[6] and up to 140GW by 2050[7]. There is particular growth forecast in offshore wind capacity in Scotland and the north-east of England, as well as interconnectors to and from European power grids. This will put pressure on the existing network such that reinforcement of the network in the Yorkshire and Humber and Lincolnshire areas have been identified as necessary to ensure optimal operation of the transmission system and reliable economic long-term supply.

Needs for the Project

1.3.2 The Project is needed to:

- Enable future customer connections at Creyke Beck / North Humber;
- Ensure Security and Quality of Supply Standards (SQSS) compliance; and
- Provide a cost-beneficial level of boundary uplift across network transmission boundaries B7a and B8 in order to improve transfer capability facilitating north to south power flows and reduce generation constraints.

1.3.3 The network transmission boundaries across the UK are shown in **Figure 1-4**[8].

1.3.4 In considering the need for the Project NGET had due regard to the policy, projects and investment decisions for the transmission system set out within 2020 Future Energy Scenarios (FES 2020), the Electricity Ten Year Statement 2020 (ETYS 2020) and Network Options Assessment 2020 / 2021 (NOA 2020 / 2021). NGET also had regard to government targets for offshore wind and any emerging outcomes from the Offshore Transmission Network review to ensure the options identified and selected are future proofed and able to facilitate net zero targets.

1.3.5 Other proposed projects that would reinforce the transmission system between the north of England and the Midlands and southern England were also taken into account. These include proposals to increase the operating voltage of the existing transmission

---

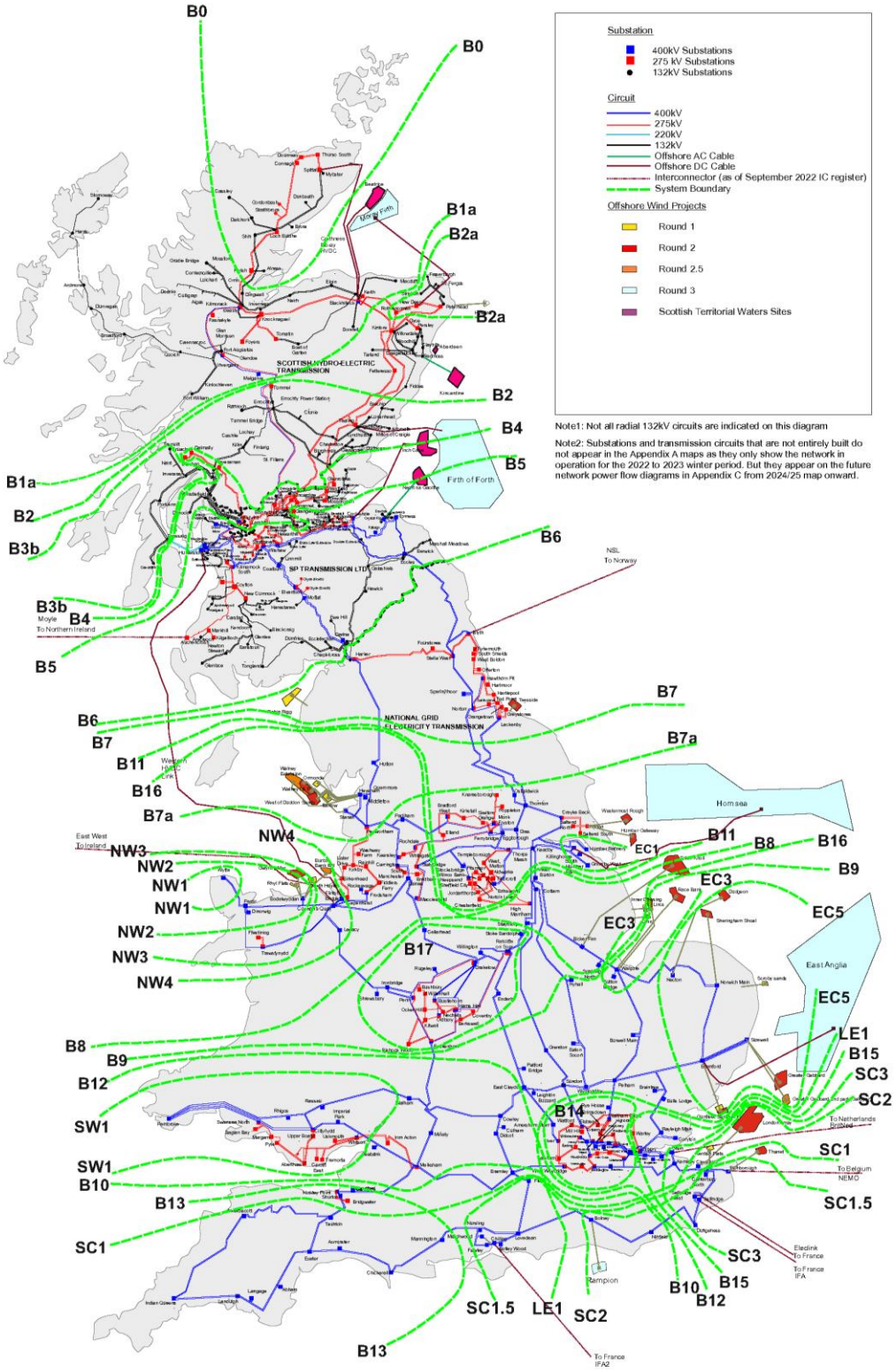
6 UK Government, (2022), British Energy Security Strategy. Available at https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy. Accessed 26 July 2022.

7 Committee on Climate Change, (2020), The Sixth Carbon Budget. Available at https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf. Accessed 09 June 2022.

8 National Grid, (2017), Electricity Ten Year Statement 2017. Available at https://www.nationalgrid.com/sites/default/files/documents/ETYS%202017%20Appendix%20A.pdf. Accessed 08 June 2022.

line between Brinsworth (near Sheffield), Chesterfield and High Marnham, referred to in the ESO's latest Network Options Assessment[9] with the project code EDEU.

Figure 1-4 – Network Transmission Boundaries



[9] Network Options Assessment 2021/22 Refresh (July 2022).

1.4 Structure of this Report

1.4.1 The report is structured as follows:

- **Chapter 2**: **Aspects of the North Humber to High Marnham Project** – summarises the key components of the Project;
- **Chapter 3: National Grid's Approach to Routeing and Siting** – an overview of National Grid's guidance, its statutory duties and relevant policy.
- **Chapter 4: Option Identification and Selection Process (Stage 2)** – sets out the process used to identify, appraise and select corridors, following National Grid's guidance and in line with relevant policy.
- **Chapter 5: Study Area and Corridor Definition** – details the steps undertaken to identify the study area for Project and to define the corridors for appraisal (including sections, links and loops).
- **Chapter 6: Options Appraisal – Corridor 1** – provides the key environmental and technical constraints for Corridor 1.
- **Chapter 7: Options Appraisal – Corridor 2** – provides the key environmental and technical constraints for Corridor 2.
- **Chapter 8: Options Appraisal – Corridor 3** – provides the key environmental and technical constraints for Corridor 3.
- **Chapter 9: Options Appraisal – Corridor 4** – provides the key environmental and technical constraints for Corridor 4.
- **Chapter 10: Cost and Programme Performance** – shows the range of the best and worst performing cost and programme estimates for each of the corridors.
- **Chapter 11: Option Selection** – provides comparative analysis of the corridors to identified those emerging as preferred.
- **Chapter 12: Development of Graduated Swathe** – summarises the approach to taken to developing the graduated swathe for the Project and its intended use.
- **Chapter 13: Summary and Next Steps** – the conclusions of the CPRSS and outlines the next steps in the North Humber to High Marnham Project.

2. Aspects of the North Humber to High Marnham Project

2. Aspects of the North Humber to High Marnham Project

2.1 Introduction

2.1.1 The objective of the Project is to reinforce the electricity transmission system to help deliver the UK Government's Net Zero targets. It forms part of a major programme of reinforcement of the electricity transmission system to accommodate major increases in north-south power flows, helping take power generated from low-carbon sources (especially from offshore wind) to areas of consumer demand.

2.1.2 The Project would establish a new 400kV transmission connection between new substations to be built in the vicinity of Creyke Beck Substation and the former High Marnham Power Station site. The connection is expected to wholly or largely comprise of a new overhead line. NGET would also need to replace a short section of existing 400kV overhead line with underground cables and commission local changes to the lower voltage distribution networks in order to facilitate the construction of the new overhead line.

2.1.3 At its northern end the new 400kV transmission connection would begin at a new transmission substation that NGET expects to build in the vicinity of the existing Creyke Beck Substation, to the north of the village of Cottingham and north-west of the city of Hull. At its southern end the new 400kV transmission connection would connect to a second new transmission substation that NGET will build in the vicinity of the former High Marnham Power Station site, located approximately 14 km south-east of Retford in Nottinghamshire.

2.1.4 This chapter provides more information regarding the new 400kV transmission connection and other improvements needed to facilitate the construction of the Project. Such improvements will be to the transmission system and electricity distribution networks operated by NGET, Northern Power Grid (NPG) and National Grid Electricity Distribution Plc (NGED).

2.1.5 The chapter also includes information relating to the two new transmission substations which NGET expect to have constructed by the mid-2020s, in advance of construction activities commencing on the Project. The two new transmission substations do not form part of the Project and have been referenced solely for the purpose of completeness.

2.1.6 This chapter also briefly references other related and unrelated works that NGET expects to carry out in the same locality and within similar timescales to the Project. As with the two new transmission substations, these works do not form part of the Project and have been referenced solely for the purpose of completeness.

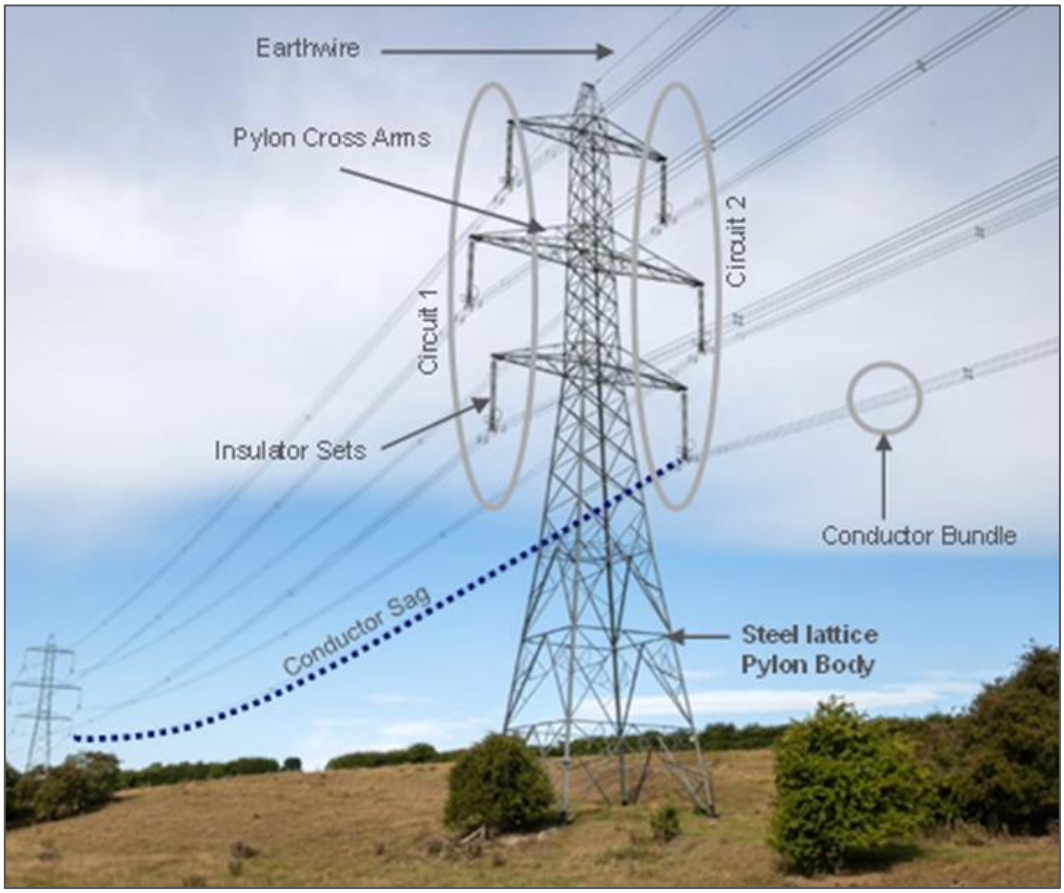
2.2 Overhead Lines

Pylons and Conductors

2.2.1 Pylons are overhead line structures which carry overhead electrical conductors, insulators and fittings. The main components of an overhead line are shown in **Figure 2-1** below. **Figure 2-1** shows a typical steel lattice pylon. Other pylon types are discussed further in this section.

2.2.2 Like most overhead lines owned and maintained by NGET, the Project will carry a voltage of 400kV. The overhead line for the Project will carry two discrete electrical circuits that can be operated independently of one another, increasing the resilience of the transmission system.

Figure 2-1 – Components of a Typical Transmission Connection



2.2.3 Electrical power will be transmitted through conductors (often referred to as ‘wires’). The conductors are attached to the end of a set of insulators that hang from the pylon cross arms and electrically isolate the conductors from the pylon cross arms and the main structure. On a typical pylon, as shown in **Figure 2-1**, three pylon cross arms are stacked above each other and each supports a bundle of conductors which together form a single electrical circuit. Two circuits are therefore carried, with one on either side of the pylon (indicated by ‘Circuit 1’ and ‘Circuit 2’ in **Figure 2-1**). The top of the pylons support a single smaller earthwire that carries data between substations and also provides shielding from lightning strikes for the conductors below. The Project is likely to

comprise a maximum of three conductors per bundle, a total of 18 conductors per pylon together with the earthwire.

2.2.4 The conductors will be a minimum height above the ground. The height will be maintained by pylons spaced intermittently along the route.

2.2.5 The minimum heights[10] between the conductors, the ground and various other features must be maintained, to ensure safe operation. The minimum clearance required between the conductors and the ground is typically between 7-8m at the maximum sag, as shown in **Figure 2-1**. In order to maintain these sags pylons need to be a minimum height at the point that the lowest conductor is attached to the pylon arms. This height is dependent upon a range of factors including the distance between pylons, planned operating temperature and conductor wire composition, the intervening topography and the use of the land being crossed. For example, crossings of major navigable waterways such as the River Ouse may require far greater clearances (and hence greater pylon heights) to allow vessels to pass beneath.

2.2.6 To a lesser extent, the overall pylon height will also be influenced by pylon types. The pylon illustrated in **Figure 2-1** above is a suspension pylon, with the conductors hanging on insulator sets beneath the pylon arms. Where the route of the overhead line changes direction the use of such a pylon would see the conductors deviate in vertical arrangement. Where this occurs angle pylons are required to accommodate the additional sideways strains with the insulators tensioning the conductors horizontally to keep conductors aligned. At the end of overhead lines where they connect with substations or underground cables it is necessary to use terminal pylons, they are of greater bulk in order to ensure stability.

2.2.7 **Figure 2-2** below illustrates the difference between these three main pylon types.

2.2.8 A typical pylon operating at 400kV is approximately 50m in height[11]. A typical span distance between pylons is approximately 350m. In broad terms there are typically three pylons for every kilometre of overhead line.

2.2.9 Major construction activities tend to be focussed at the base of each pylon and to either side of tension pylons from where the conductors are winched into position. The major impacts of overhead lines are generally considered to be visual, due to the height of the pylons in relation to most buildings and trees.

---

10 Electrical Networks Association TS 43-8 details the legal clearances for NGET owned and maintained overhead lines. Third party guidance for working near overhead lines is available at: https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure/working-near-our-assets. Accessed 20 November 2022.

11 Localised requirements may prompt the need for taller pylons. For example, the existing pylons either side of the crossing of the River Ouse at Ousefleet, are some 110 meters in height.

Figure 2-2 – Suspension Pylon (Left) and Angle Pylon (Right)

Pylon Type and Design

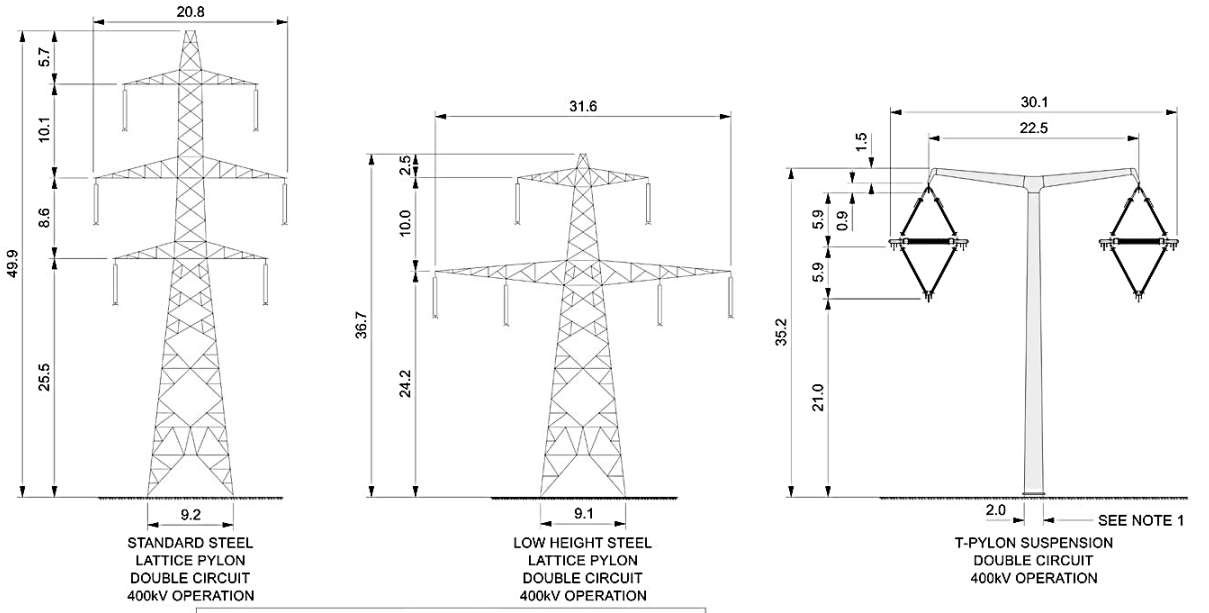
2.2.10 Whilst the vast majority of transmission lines in Britain use lattice steel pylons with three sets of cross arms (as shown first in **Figure 2-2**), alternative pylon types have been approved for use which may achieve the technical performance required for the Project[12]. These two alternatives types are illustrated in **Figure 2-3**.

2.2.11 The first alternative pylon type is a lower height form of lattice steel pylon. This removes the top cross arm, with two bundles of conductors supported on the lowest cross arm. This requires the widening of the lowest cross arm resulting in a shorter but wider pylon when compared to the standard lattice steel pylons. The overall height of this type of pylon is approximately 37m. This pylon type has tended to be used in proximity to airports and airfields, to avoid flight paths. This pylon type can also help to reduce the extent of affected views, especially in rolling or wooded landscapes.

12 With the potential exception of localised requirements, such as major river crossings.

2.2.12 The second alternative pylon type is the ‘T-pylon’. Rather than being of lattice steel construction the ‘T-pylon’ is formed from a single steel monopole (similar to a modern wind turbine) supporting a single cast cross arm at the top, which together form a ‘T’ shape. The conductors are hung from this cross arm in two larger groups of three bundles, kept apart by solid insulating rods that together form a diamond configuration. These pylon types are also lower in height than the standard lattice steel pylons, at approximately 35m. The monopole is a solid structure, approximately 2m in diameter, in contrast to the less striking and more open lattice form of the two lattice steel pylons.

Figure 2-3 – Alternative Pylon Types



CHARACTERISTIC	PYLON TYPE: STANDARD LATTICE PYLON	PYLON TYPE: LOW HEIGHT LATTICE PYLON	PYLON TYPE: T-PYLON	
STANDARD HEIGHT	49.9m	36.7m	35.2m	
STANDARD PYLON DESIGN WIDTH	20.8m	31.6m	30.1m	
STANDARD BASE DIMENSIONS	9.2m SQUARE	9.1m SQUARE	2m DIAMETER	SEE NOTE 1
MIN & MAX PYLON HEIGHTS	43.9m - 67.9m	32.23m - 45.73m	32.2m - 38.2m	
MIN & MAX PYLON BASE WIDTHS	7.96m - 13.32 SQUARE	7.93m - 11.26m SQUARE	APPROX 2m MIN to MAX	SEE NOTE 1

NOTE 1

1. FOR T-PYLON SUSPENSION, 2m IS MEASURED ABOVE BASEPLATE. EXACT DIMENSION AT GROUND LEVEL MAY VARY.

2.2.13 In previous projects the visual benefits of utilising standard lattice steel pylons has been recognised, especially when siting a new overhead line close to existing lines that use this pylon type. In proximity to this Project this is the case with the overhead lines from Creyke Beck through the Yorkshire Wolds, the Humberhead Levels and the lower Trent Valley. The standard lattice steel pylon also have slightly lower construction costs when compared to the other two pylon types.

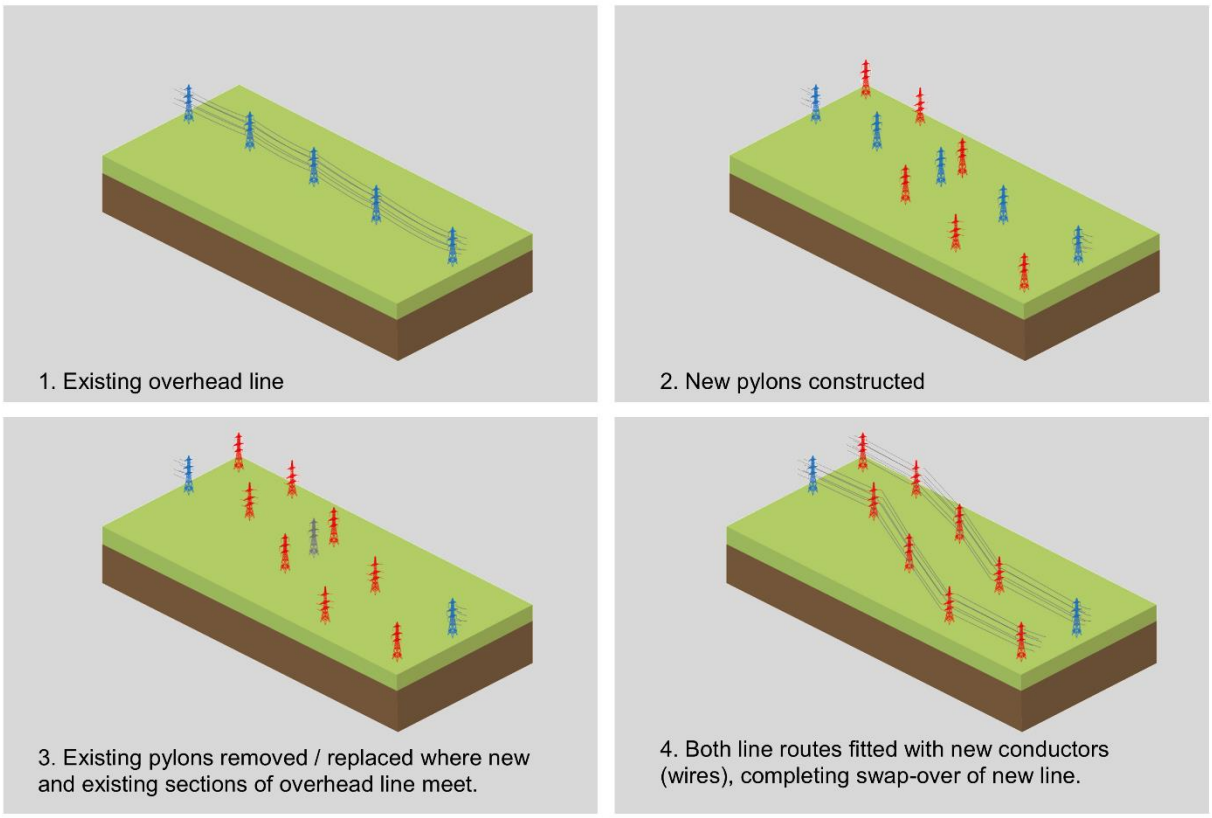
2.2.14 The type of pylons proposed for the Project will be determined through feedback from non-statutory consultation, information from surveys and ongoing design studies.

Line Swap Overs

2.2.15 Where two overhead electricity line routes have to cross, a number of specific design considerations arise. This need might arise where an existing overhead line crosses the route of a new overhead line, or where local constraints to the routeing of an overhead line preclude its construction on the same side of an existing line throughout its entire length.

2.2.16 Where the design of existing pylons is compatible and the direction of power flows across the electricity system allow it, a 'line swap over' can be considered. This is done through the removal of a length of the existing overhead line, allowing the two newly formed 'ends' of existing overhead line to be connected to two lengths of new route located on different sides of the existing line. The two resultant routes would then both comprise lengths of newly built and original overhead line. This is illustrated schematically in **Figure 2-4** below.

Figure 2-4 – Sequence of Works to Achieve Line Swap Over of New and Existing Overhead Lines



2.2.17 Where the existing and new overhead lines connect to different points of the transmission system it may be necessary to swap the route back before the destination substation is reached to maintain the same start and end points.

2.2.18 The 'line swap over' of the route of a new overhead line from one side of an existing overhead line to the other can be achieved on adjacent pylons, resulting in up to four angle pylons being located in close proximity. Alternatively, it may be possible to utilise existing angle pylons on the current overhead line to partly form the 'line swap over', or to extend the distance over which a 'line swap over' is achieved. In this way the change of route direction would be more gradual, with greater separation between the angle pylons.

2.2.19 As part of the first round of public consultation NGET has indicated zones where a 'line swap over' with the new route could be made[13], which would allow the new overhead line to be sited on different sides of the existing overhead line. These 'line swap over' are explained in **Chapter 12**.

2.2.20 Where NGET must maintain electricity supplies through the existing overhead line whilst 'line swap over' works are being undertaken it may be necessary to locally install one or more temporary overhead lines. These lines would act as a by-pass route for the power whilst the permanent overhead line arrangement is constructed. The temporary lines would be removed, and the land reinstated upon completion.

2.2.21 Any 'line swap over' would increase the technical complexity, cost and potential duration of any new overhead line build but may introduce greater opportunities to reduce environmental and social impacts.

2.3 Underground Cables

2.3.1 Electricity can be transmitted through buried cables as well as through overhead conductors. However, at the transmission voltage of 400kV the use of buried cables represents a significant technical complexity. The size and complexity of the underground cables required is far greater than those that operate at lower voltages[14]. As a result, direct buried transmission cables at the capacity required for the Project are typically around 10 times the cost compared to an equivalent overhead line.

2.3.2 For these reasons the National Planning Policy (EN-5) relating to transmission routes supports, in most instances, the development of overhead lines rather than underground cables[15]. This policy position is further supported in the revised policy, published for consultation in March 2023[16]. The consultation period is due to end on the 25th May 2023.

---

13 Subject to further design studies.

14 More information can be found in National Grid's publication 'Undergrounding high voltage electricity transmission lines. The technical issues'.

15 The existing National Policy Statement for Electricity Networks Infrastructure (EN-5) (2011) states at paragraph 2.8.9 that consent should only be refused for *"overhead line proposals in favour of an underground or sub-sea line if it is satisfied that the benefits from the non-overhead line alternative will clearly outweigh any extra economic, social and environmental impacts and the technical difficulties are surmountable. In this context it should consider: the landscape in which the proposed line will be set, (in particular, the impact on residential areas, and those of natural beauty or historic importance such as National Parks, AONBs and the Broads)"*.

16 The Draft National Policy Statement for Electricity Networks Infrastructure (EN-5) (2023) states at paragraph 2.9.20 that *"Although it is the government's position that overhead lines should be the strong starting presumption for electricity networks developments in general, this presumption is reversed when proposed developments will cross part of a nationally designated landscape (i.e. National Park, The Broads, or Area of Outstanding Natural Beauty)"*.

Underground Cable Installation Methods

2.3.3 There are a number of different underground cable installation methods available including direct buried, ducted, surface troughs and trenchless crossings. The most appropriate for a given Project, or location within a Project, is subject to environmental, land use, cost and technical factors.

2.3.4 Where conditions allow cables are normally installed in excavated trenches. A cement-bound sand mix is used as backfill to protect the cables and help dissipate any heat generated by the cables in operation.

2.3.5 For a new 400kV transmission, the working width of the land required for construction is typically between 40m and 120m, subject to a range of factors such as the number of circuits and the number and size of cables needed. For a low-capacity single circuit this could require only three cables. For a high capacity two circuit route up to 18 individual cables could be required. An example of a cable construction is shown at **Figure 2-5** below.

Figure 2-5 – Example Cable Construction

2.3.6 Due to the weight and size of underground cables operating at 400kV the maximum single cable length that can be transported to a Project location by road is typically between 800m and 1,000m. To achieve cable routes in excess of these lengths individual cables must be joined together on site. This necessitates joint bays at intervals along the route. Where joint bays are located the working width may need to be wider than 120m.

2.3.7 Works to install an underground cables take considerably longer than the works associated with installing an equivalent length of overhead line. In addition, they have the potential for greater adverse impacts upon any archaeological resource, soils and drainage, agricultural operations, vegetation and wildlife along the working width. However effective restoration of the underground cable route following construction can result in less long-term landscape and visual impacts in comparison with an overhead line.

2.3.8 Where specific environmental or infrastructure features preclude the use of underground cables, as described above, it may be practicable to install ducts using a trenchless installation technique such as horizontal directional drilling (HDD). In this instance cables are pulled into pre-installed ducts. The maximum length of HDD installed ducts is limited by the weight of the cables to be installed. Where trenchless techniques are required, the working width may need to be wider than 120m.

2.3.9 Where HDD is not technically viable then a tunnelled solution for underground cables can be considered. Tunnels can be constructed using a variety of techniques, but all involve major civil engineering activities, which result in substantial additional costs, increased construction risks and extended programme durations. Typically, permanent buildings are required at either end of the tunnel section to support operation, including access to and potential ventilation of the tunnel and cooling of the underground cables.

2.3.10 Further information on the environmental, technical, and cost implications of these trenchless installation techniques can be found in **Appendix A**.

Sealing End Compound (SEC)

2.3.11 A SEC is needed where a section of underground cable resurfaces to connect to an overhead line. Within these secure compounds the buried cables are brought to the surface through vertical sealing end structures. These are connected horizontally at a height of approximately 10m with a set of solid bars (referred to as ‘bus bars’). The conductor wires from the overhead line drop down to connect onto the solid bars within the secure compound.

2.3.12 In order to accommodate the one-way tension of the conductor wires where an overhead line ends, a heavier pylon is needed. Alternatively, the conductors may enter the compound at a slacker angle, connecting onto lower height gantries.

2.3.13 SECs typically extend to around 30m by 80m for a double circuit 400kV transmission, but this will vary dependent upon local considerations. Examples of SECs are shown in **Figure 2-6** below.

Figure 2-6 – Example 400kV Sealing End Compounds

2.4 Other Improvements

2.4.1 In order to construct the two new transmission substations a range of other minor temporary and permanent improvement works will need to be carried out to facilitate the construction of the Project. Such improvements will be to the transmission system and electricity distribution networks operated by NGET, Northern Power Grid (NPG) and NGED.

2.4.2 A number of the more significant elements of these improvement works are detailed below.

Crossing Existing Transmission Overhead Lines

2.4.3 Due to the geography of existing transmission lines in Yorkshire and Lincolnshire the Project route will need to cross one or more existing 400kV overhead lines. Of particular note is the existing 400kV ZDA overhead line that runs west-east, perpendicular to the required route for the Project, to the north of Thorne and south of Crowle, as shown in **Figure 2-7** below.

Figure 2-7 – Location of 400kV Transmission Overhead Lines that may need to be Crossed by the Project

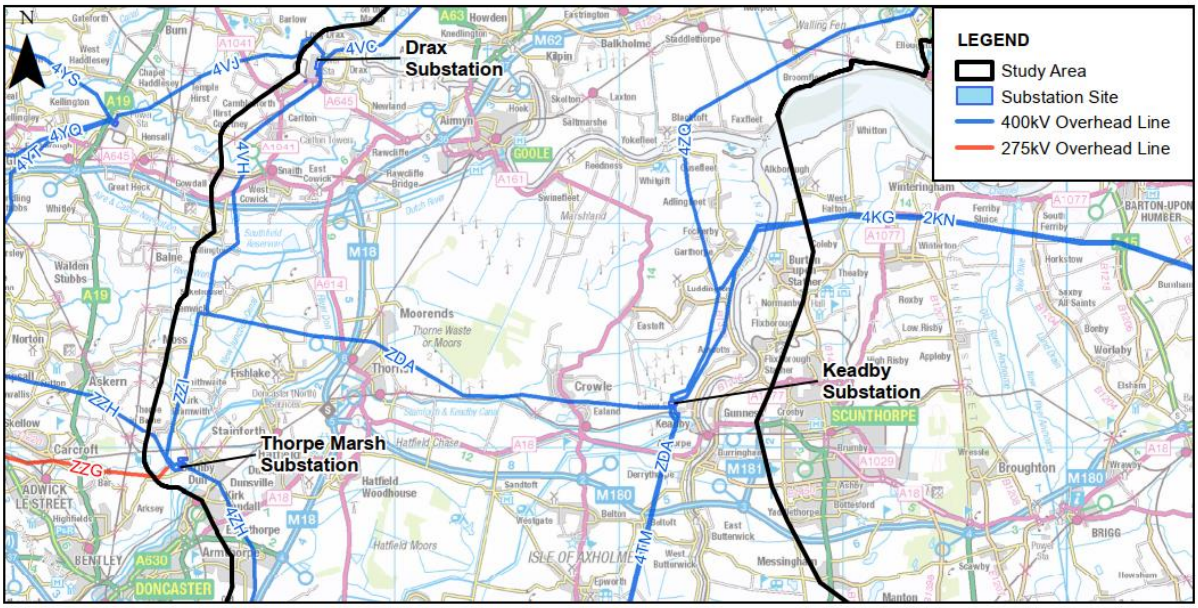


Figure 2-7 – Location of the Existing 400kV Overhead Lines which may need to be Crossed by the Project.

2.4.4 Due to the requirement to maintain the existing start and end points of the existing 400kV ZDA overhead line it will not be practicable to have a line swap over. Instead, the two routes will need to cross one above the other in order to maintain the existing route between Drax, Thorpe Marsh and Keadby Substations.

2.4.5 Whilst it is practicable to cross one overhead line with another, this results in significantly taller pylons on the higher line and introduces operational and safety concerns. As a result, it is typically considered more appropriate to replace the lower overhead line with a short section of underground cables. In this way operational and safety concerns are substantially reduced, and taller pylons which may have increased visual impacts can be avoided.

2.4.6 In the context of this Project, the 400kV ZDA overhead line is expected to transmit less power than the Project. Consequently, it is likely to be more cost effective to replace a short section of the 400kV ZDA overhead line with underground cables rather than undergrounding a section of the new route. The need to place a section underground and the associated costs and impacts of the cable installation have been considered as part of the identification and appraisal of corridors for the Project. Any works to cross the 400kV ZDA overhead line will form part of this Project. Further information on the 400kV ZDA overhead line in the context of this Project is provided in **Chapter 12**.

Local Improvements to Existing NGET Overhead Lines

2.4.7 The route and any line swap overs with the Project may result in interactions with other NGET overhead lines. For example, a line swap over is likely to mean that the new end-to-end connection is carried in part on existing pylons through existing conductor wires. If this is the case, subject to information from surveys and ongoing design studies, it may be necessary to replace these sections of existing conductor wire as part of the Project to align with the new overhead line.

2.4.8 The local improvements to existing NGET overhead lines will form part of this Project.

Local Improvements to Other Utility Companies' Overhead Lines

2.4.9 In addition to transmission lines, it will be necessary for the new overhead line to cross overhead lines of a relatively low voltage owned and operated by the local electricity distribution network operators. The transmission system and electricity distribution networks in the vicinity of the Project are operated by NPG and NGED.

2.4.10 When crossing lower voltage overhead lines, it may be cost effective, and have reduced environmental impacts, to permanently replace a length of the lower voltage line with underground cables. It is likely that the Project will need to cross the routes of existing 11kV, 33kV and 132kV overhead lines in multiple locations dependent upon the route.

2.4.11 NGET will work with the distribution network operators to design and undertake the replacement of any affected low voltage overhead lines with underground cables wherever this would be technically practicable and not prohibitively expensive.

2.4.12 The local improvements to existing NPG and NGED overhead lines will form part of this Project.

2.5 New Transmission Substations

New Creyke Beck Substation

Background

2.5.1 NGET's existing 400kV Creyke Beck Substation, to the north of Cottingham, was built in the late 1960's to supply electricity to the city of Hull and the surrounding area. The electricity is distributed to the city and area from the adjacent 132kV Substation via electricity distribution lines owned and operated by NPG.

2.5.2 The past 20 or so years have seen the connection of a variety of new power generation sources in the area, which connect to the wider transmission system via the existing

Creyke Beck Substation. These include gas-fired generation and offshore windfarms connected at Salt End and Hedon (to the east of Hull).

2.5.3 The location of the existing 400kV Creyke Beck Substation, adjacent 132 kV Substation and connecting overhead lines is shown in **Figure 2-8** below.

Figure 2-8 – Location of the Existing 400kV Creyke Beck Substation, Adjacent 132 kV Substation and Connecting Overhead Lines

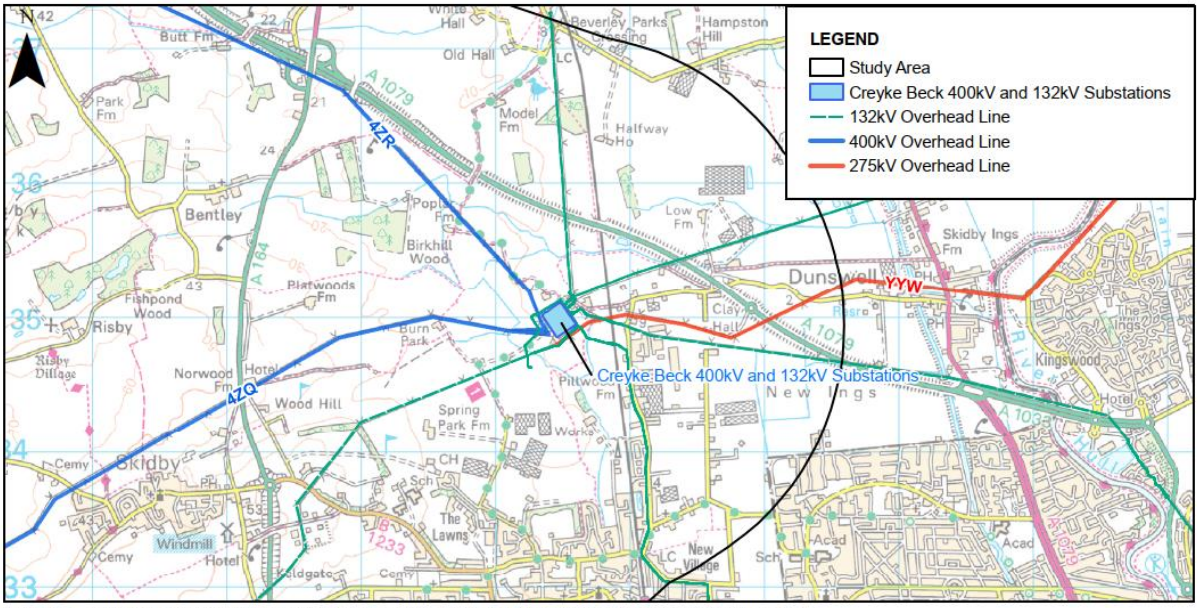


Figure 2-8 – Location of the Existing 400kV Creyke Beck Substation, Adjacent 132kV Substation and Connecting Overhead Lines

Future Connections in the Creyke Beck Area

2.5.4 Future projects potentially requiring connections into the Creyke Beck area include:

- Pillswood Battery Energy Storage Scheme – under construction[17];
- Dogger Bank Windfarm (Phases A and B) – under construction;
- Hornsea Project Four Offshore Wind Farm – development consent currently being sought, with a decision expected in July 2023. In order to accommodate this customer connection, the existing Creyke Beck substation will need to be extended. NGET already owns the area within which the extension is likely to be constructed, which is shown in **Figure 2-9** below. The substation extension would occupy only part of the landholding shown. NGET expects to apply for planning permission for the substation extension in 2023;
- Continental Link Multi-Purpose Interconnector – expected to submit an application for a Development Consent Order (DCO) in 2025;
- Atlantic Super Connection – for which a contract has been signed by for a connection;
- Solar/Battery Storage Scheme at Creyke Beck – for which a contract has been signed by for a connection in 2033; and

[17] Operational since November 2022 (under construction at the time of undertaking the CPRSS).

- HVDC Links – the ESO recommended, in 'The Pathway to 2030 Holistic Network Design'[18] that two further HVDC links should also connect into the Creyke Beck area. These would bring power ashore from large-scale offshore windfarms. These links may also serve to connect further offshore generation and help move power from Scotland.

Figure 2-9 – Area of NGET Owned Land within which the Existing 400kV Creyke Beck Substation Extension could be Located

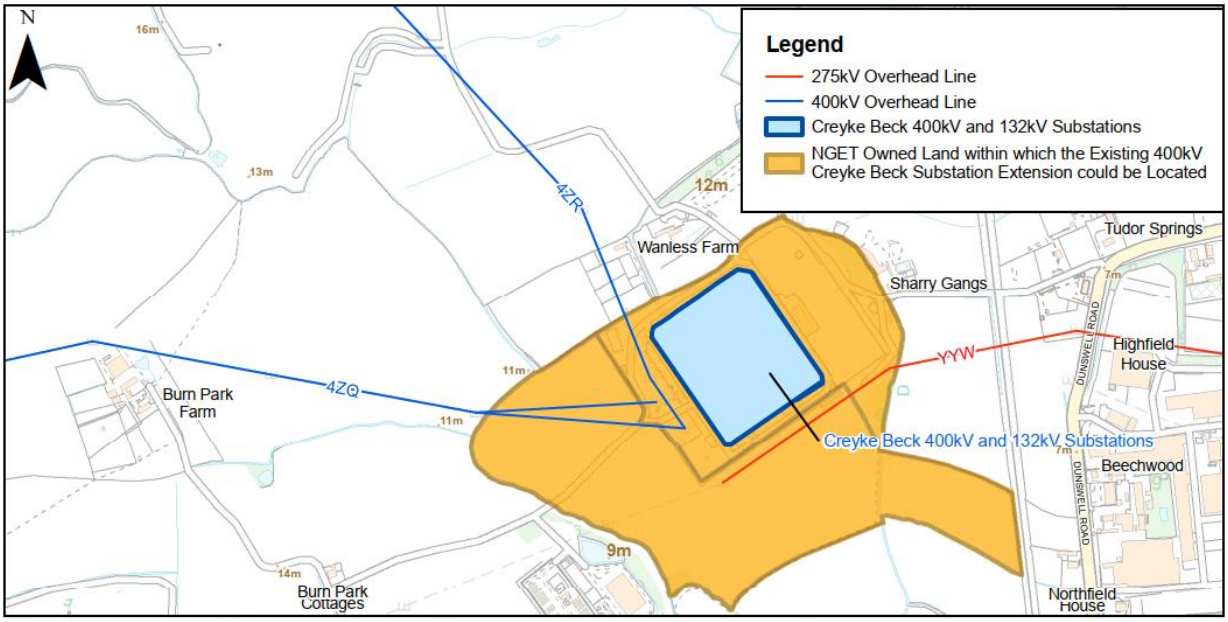


Figure 2-9 – Area of NGET Owned Land within which the Existing 400kV Creyke Beck Substation Extension could be Located

2.5.5 As can be seen from the above, the existing and extended Creyke Beck Substation together with the new substation in the vicinity of the existing Creyke Beck Substation will become increasingly important hubs for the connection of new sources of electricity generation. This in turn supports the transition to low carbon generation and helps secure Britain's long-term energy supply.

2.5.6 Whilst the Project is not dependent upon the development of any of these projects it will help to facilitate the connection of these, as well as others across the north of England and Scotland. These future projects, along with any other reasonably foreseeable projects, will not form part of this Project, but will be considered during the ongoing design studies and when assessing cumulative effects as part of the Environmental Impact Assessment (EIA) process.

New Creyke Beck Substation

2.5.7 A proposal for an additional Creyke Beck Substation is currently being developed by NGET to facilitate the connection of these future projects. This new Creyke Beck Substation will not form part of this Project. The new Creyke Beck Substation is in addition to the proposed substation extension. The new substation is likely to connect to the 400kV transmission line that runs westward from Creyke Beck towards Thornton. Minor diversions of the existing 400kV overhead line will be necessary in order to

[18] National Grid ESO, (2022), Pathway to 2030. Available at https://www.nationalgrideso.com/document/262676/download. Accessed 02 December 2022.

connect the line into the new Creyke Beck Substation. Temporary diversions of the route may also be required to maintain electricity supplies whilst the permanent works are undertaken.

2.5.8 The final design for the new Creyke Beck Substation has not yet been confirmed. Both outdoor; 'air insulated' and indoor; 'gas insulated' designs will be considered. It is anticipated that an outdoor substation could extend to approximately 480m by 140m dependent upon the number of connections required. Alternatively, an indoor substation could have a smaller footprint of around 150m by 100m but would require the construction of a large building to house equipment. Regardless of the technology chosen permanent access would be needed to the new Creyke Beck Substation, together with peripheral landscaping, drainage, and other related works.

2.5.9 To help inform initial public and stakeholder feedback on this Project the indicative location for the new Creyke Beck Substation is shown in **Figure 2-10** below, to which the proposed overhead line corridor connects.

2.5.10 NGET envisages that public consultation regarding the new Creyke Beck Substation will take place during 2023. It is anticipated that consent for the new Creyke Beck Substation will be sought by means of a local planning application to East Riding of Yorkshire Council.

2.5.11 The new Creyke Beck Substation will not form part of this Project, but will be considered during the ongoing design studies and when assessing cumulative effects as part of the EIA process.

Figure 2-10 – Indicative Area of Search Area for the New Creyke Beck Substation

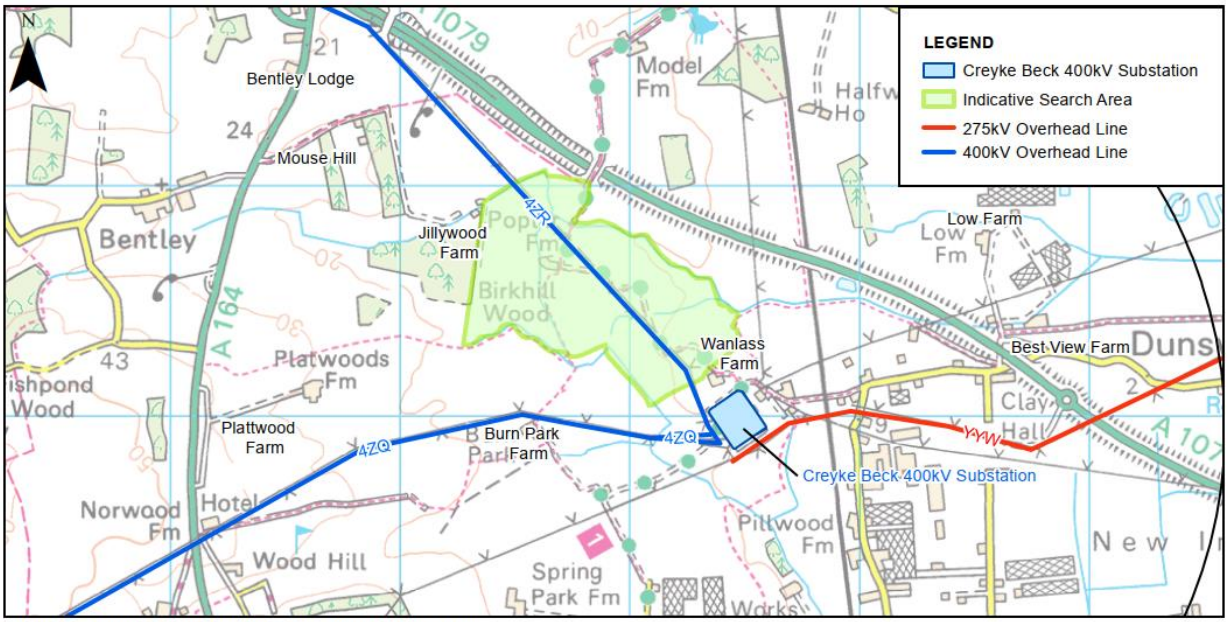


Figure 2-10 – Indicative Search Area for the New Creyke Beck Substation

New High Marnham Substation

Background

2.5.12 NGET's existing 275kV High Marnham Substation is located approximately 14km southeast of Retford in Nottinghamshire. The substation was built in the late 1950s to connect the High Marnham coal-fired power station to the transmission system. The Power Station was closed in 2003, with demolition of the power station completed approximately ten years later.

2.5.13 NGET added a smaller 400kV Substation at High Marnham in the 1960s, connected to the adjacent 275kV Substation with two supergrid electricity transformers. Both of these substations remain in operation, acting as a bussing point on the transmission network to direct power flows through a number of 400kV and 275kV overhead lines. These overhead lines transmit power from West Burton (at 400kV) and the Sheffield and Chesterfield areas (at 275kV). In addition, a small (30 MW) biomass power station also connects to the transmission network at High Marnham.

2.5.14 The location of the existing 275kV and 400kV High Marnham substations and connecting overhead lines is shown in **Figure 2-11** below.

Figure 2-11 – Location of the Existing 275kV and 400kV High Marnham Substations and Connecting Overhead Lines

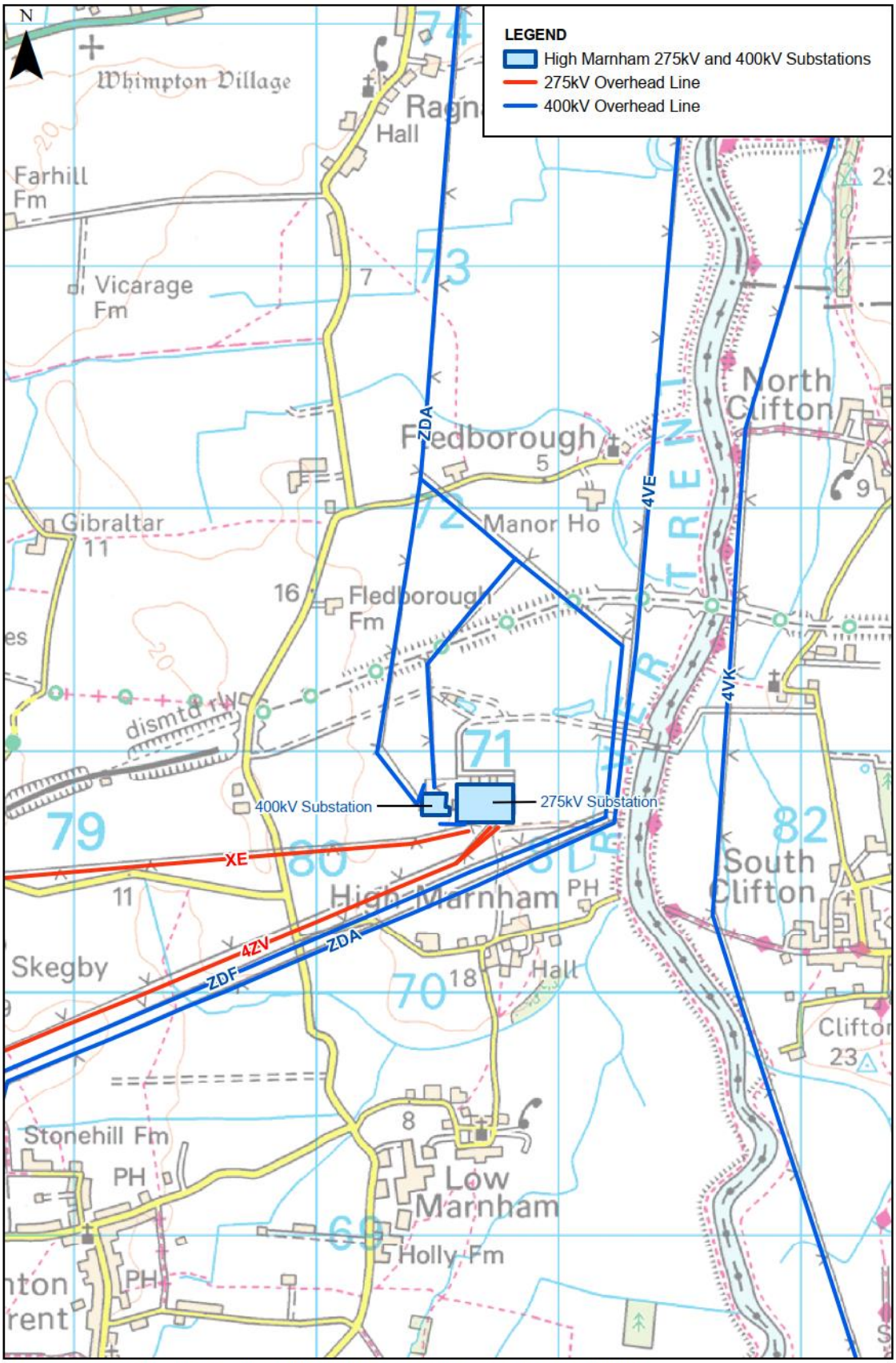


Figure 2-11 – Location of the Existing 275kV and 400kV High Marnham Substations and Connecting Overhead Lines

SCALE:1:25,000 0 0.5 1 km

Other Improvements at High Marnham to Reinforce the Transmission System

2.5.15 The existing 275kV overhead line that connects to High Marnham from Brinsworth (on the east side of Sheffield) via Chesterfield operates at a voltage of 275kV. However, the line, built in the mid-1960s, is capable of operating at the higher voltage of 400kV and has the necessary consents to do so. Uprating the operating voltage would allow more power to flow along this route. This would achieve greater power transfers between the north and the midlands using the existing overhead line. This should allow these benefits to be achieved earlier than can be achieved with the development of new overhead lines, such as this Project.

2.5.16 The ESO has considered the potential consumer benefits that uprating the existing overhead line would have. The ESO has consequently recommended that the uprating should proceed, with an optimal delivery date of 2028. This is explained in more detail in the ESO's 'Network Options Appraisal Refresh'[19] published in 2022, where the project is referenced by the code 'EDEU'.

Future Customer Connections in the High Marnham Area

2.5.17 At present four customers have contracts to connect generation projects to the transmission system at High Marnham. All of which are new Solar PV projects expected to connect in the mid to late 2020s, with a total capacity of 897 MW[20].

New High Marnham Substation

2.5.18 Whilst the uprating of the existing line to 400kV operation will involve only minor works to the overhead line, it will require the two circuits supported by the line to be disconnected from the existing 275kV substation at High Marnham. These circuits will instead need to be connected into a 400kV substation. However, the existing 400kV substation cannot easily be extended to accommodate the new overhead line. Therefore, NGET is proposing to develop a new 400kV substation in the vicinity of the former High Marnham Power Station site to connect the uprated circuits. This is likely to replace both existing substations, which would become redundant. All of the overhead transmission lines that connect to the existing substations would therefore also need permanently diverting into the new substation. Temporary diversions of the routes may also be required to maintain electricity supplies whilst the permanent works are undertaken. This new High Marnham Substation will not form part of this Project.

2.5.19 As well as the uprated and diverted lines the new substation would also form the end point for this Project.

2.5.20 A separate project is underway to determine the most appropriate location for the new substation within the indicative search area. To help inform initial public and stakeholder feedback on this Project the indicative search area for the new High Marnham Substation is shown in **Figure 2-12** below, together with a zone within which the initial section of the new 400kV overhead line for this Project could route.

---

19 National Grid ESO, (2022), Network Options Assessment 2021/22 Report. Available at https://www.nationalgrideso.com/document/262981/download. Accessed 02 December 2022.

20 As per the National Grid ESO Transmission Entry Capacity (TEC) Report 11 April 2023. Available at https://www.nationalgrideso.com/document/183631/download. Accessed 13 April 2022.

2.5.21 The new High Marnham Substation will not form part of this Project, but will be considered during the ongoing design studies and when assessing cumulative effects as part of the EIA process.

Figure 2-12 – Indicative Area of Search Area for the New High Marnham Substation

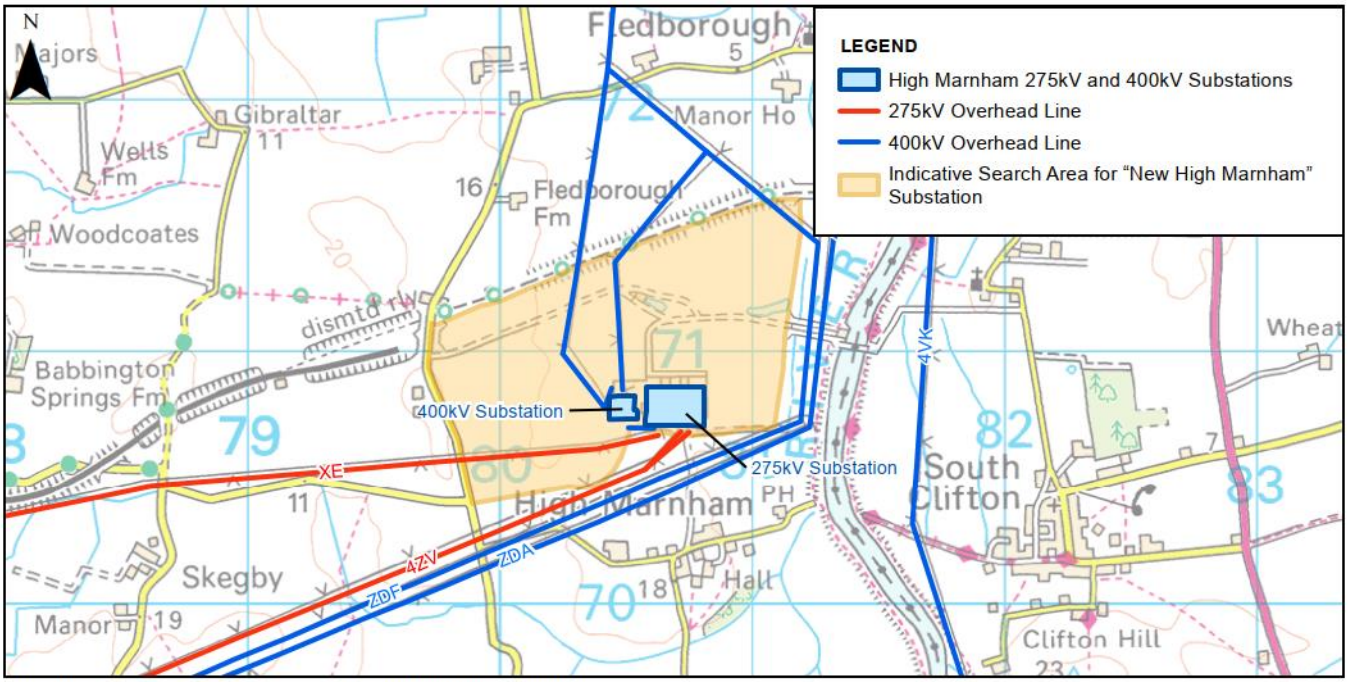


Figure 2-12 – Indicative Area of Search Area for the New High Marnham Substation

2.6 Other Unrelated NGET Works

2.6.1 In addition to the works required to deliver this Project and the development of the two new substations at Creyke Beck and High Marnham, NGET will also be undertaking various other works to upgrade the transmission network over the course of the coming decade within a similar geographical area. Whilst they are not required by, or associated with, this Project, where appropriate, they will be considered during the ongoing design studies and when assessing cumulative effects as part of the EIA process.

3. National Grid's Approach to Routeing and Siting

3. National Grid's Approach to Routeing and Siting

3.1 Overview

3.1.1 This chapter provides an overview of the key legislation, policy and guidance applicable to National Grid's routeing and siting (implemented by NGET), a summary of National Grid's approach to routeing and siting and the technology options considered for this Project.

3.2 NGET's Statutory Duties (Electricity Act 1989)

3.2.1 NGET has duties placed upon it by the Electricity Act 1989 ('the Electricity Act') and operates under the terms of its transmission licence. Those duties and terms of particular relevance to the Project are set out below. Where NGET develops new infrastructure, such as this Project, it is required to have regard to these following statutory duties under the Electricity Act:

- Section 9 (General duties of licence holders) of the Electricity Act states that:

  "It shall be the duty of the holder of a licence authorising him to participate in the transmission of electricity:

  (a) to develop and maintain an efficient, co-ordinated and economical system of electricity transmission;…"

- Electricity Act – Schedule 9 (preservation of amenity), which includes considering impacts upon communities, landscape, visual amenity, cultural heritage, and ecological resources; and

- Section 38 and Schedule 9 of the Electricity Act state that:

  "(1) In formulating any relevant proposals, a licence holder or a person authorised by exemption to generate, distribute, supply or participate in the transmission of electricity:

  (a) shall have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and

  (b) shall do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects."

3.2.2 NGET have had due regard to other relevant statutory obligations and requirements, where relevant, in the undertaking of Options Identification and Selection Stage (Stage 2).

3.3 British Energy Security Strategy (2022)

3.3.1 In response to concerns over the security, affordability, and sustainability of the UK's energy supply the UK Government published the British Energy Security Strategy in April 2022.

3.3.2 The British Energy Security Strategy proposes to accelerate the UK towards a low-carbon, energy independent future with a focus expanding domestic UK energy supply, accelerating the connecting network infrastructure to support an expansion in domestic UK energy supply and to work with international partners to maintain stable energy markets and prices.

3.3.3 The British Energy Security Strategy recognises that:

"Accelerating our domestic supply of clean and affordable electricity also requires accelerating the connecting network infrastructure to support it. Within this decade, our modern system will prioritise two key features: anticipating need because planning ahead minimises cost and public disruption; and hyper-flexibility in matching supply and demand so that minimal energy is wasted. This more efficient, locally-responsive system could bring down costs by up to £10 billion a year by 2050."

3.3.4 To support this the British Energy Security Strategy includes several aims including, to:

- Set out a *"blueprint for the whole system by the end of 2022 in the Holistic Network Design (HND) and Centralised Strategic Network Plan (CSNP). The HND will identify strategic infrastructure needed to deliver offshore wind by 2030";* and
- *"Dramatically reduce timelines for delivering strategic onshore transmission network infrastructure by around three years. We will work with Ofgem, network operators and the supply chain to find further savings, for example in the procurement, manufacture and construction stages. Overall, we aspire to halve the end-to-end process by the mid-2020s."*

3.3.5 When considering new electricity infrastructure, NGET have regard to the British Energy Security Strategy where appropriate.

3.4 National Policy Statements (NPS)

3.4.1 National Policy Statements EN-1 and EN-5 set the regulatory context within which the routeing and siting for electricity infrastructure networks is undertaken. Taken together these Statements provide the primary national policy context for decisions on applications for electricity transmission projects classified as Nationally Significant Infrastructure Projects.

3.4.2 The commentary provided below is based on the extant NPSs. Whilst draft revisions to the NPSs were consulted upon between the September and November 2021 and a further round of consultation is concluding on 25th May 2023 the extant versions remain the current policy guidance. It should be noted that the drafts of the updates to the NPSs included reference to both of the Holford and Horlock Rules (described below). NGET consistently follow the principles of the Holford and Horlock Rules and as such there is very little prospect that the identified changes to the NPSs will affect the policy appraisals undertaken to inform this Report. The emerging revised NPSs will be kept under review to ensure, if necessary, that any material changes are addressed.

Overarching National Policy Statement for Energy – EN-1 (2011)

3.4.3 EN-1 sets out the need for new nationally significant infrastructure which includes meeting energy security and carbon reduction strategies, the need for more electricity capacity to support increased supply from renewables and the need to meet future increases in electricity demand.

3.4.4 EN-1 sets out the impacts and means of mitigation that are anticipated to arise most frequently from energy projects. This CPRSS considers the following topics:

- Landscape (covering the 'landscape' impacts described in EN-1);
- Visual (as described in EN-1);
- Ecology (covering the 'biodiversity' impacts described in EN-1);
- Historic environment (as described in EN-1);
- Air quality (covering the 'air quality and emissions' and 'dust' impacts described in EN-1);
- Noise and vibration (as described in EN-1);
- Geology and soils (covering the 'geological conservation' impacts described in EN-1);
- Water (covering the 'flood risk' and 'Water quality and resources' impacts described in EN-1);
- Economic activity (covering the 'socio-economic' and 'land use including open space, green infrastructure and green belt' impacts described in EN-1);
- Aviation and defence (covering the 'civil military aviation and defence interests' impacts described in EN-1); and
- Traffic and transport (as described in EN-1).

3.4.5 Coastal change, odour, artificial light, smoke, steam, insect infestation and waste management impacts, as described in EN-1, would not have a significant impact on the determination of the emerging preferred routeing and siting for this Project. Where relevant, these topics will be considered as the Project development progresses into the Defined Proposal and Statutory Consultation Stage (Stage 3).

3.4.6 Electromagnetic fields will be considered as the Project development progresses into the Defined Proposal and Statutory Consultation Stage (Stage 3). However, NGET designs all infrastructure to be compliant with current regulations and guidance[21] on such matters.

3.4.7 EN-1 explains that in terms of:

- Biodiversity – applicants, such as NGET, should show how a given project has taken advantage of opportunities to conserve and enhance biodiversity interests;

[21] Energy Networks Association, (2017), Electric and Magnetic Fields: The Facts.

- Historic Environment – there is a desirability to sustaining and where appropriate enhancing the significance of heritage assets, their setting, and the positive contribution they can make to communities. EN-1 also makes clear that substantial harm to or loss of designated assets of the highest significance, including scheduled monuments; registered battlefields; grade I and II* listed buildings; grade I and II* registered parks and gardens; and world heritage sites, should be wholly exceptional;
- Landscape and visual – projects need to be designed carefully, taking account of the potential impact on the landscape and on sensitive visual receptors. The aim should be to minimise harm to the landscape and sensitive visual receptors, providing reasonable mitigation where possible and appropriate. EN-1 confirms that National Parks and Areas of Outstanding Natural Beauty (AONBs) have been confirmed by the Government as having the highest status of protection in relation to landscape and scenic beauty. It makes clear that development consent in these areas can be granted in exceptional circumstances. In such instances, the development should be demonstrated to be in the public interest and consideration of such applications should include an assessment of:
  - *"the need for the development, including in terms of national considerations, and the impact of consenting or not consenting 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, taking account of the policy on alternatives set out in Section 4.4 (of EN-1); and*
  - *Any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated."*
- Socio-economics – applicants for a given project should identify the impacts of new energy infrastructure and potential mitigation measures.

National Policy Statement for Electricity Networks Infrastructure EN-5 (2011)

3.4.8 EN-5 sets out the factors influencing routeing and siting selection and the impacts and other matters which are specific to electricity networks infrastructure. In summary, it states that:

- Biodiversity – particular consideration should be given to the impacts on large birds, including feeding and hunting grounds, migration corridors and breeding grounds.
- Landscape and Visual – Paragraph 2.8.2 of EN-5 states that *"The Government does not believe that development of overhead lines is generally incompatible in principle with developers' statutory duty under section 9 of the Electricity Act to have regard to amenity and to mitigate impacts. In practice new above ground electricity lines, whether supported by lattice steel towers/pylons or wooden poles, can give rise to adverse landscape and visual impacts, dependent upon their scale, siting, degree of screening and the nature of the landscape and local environment through which they are routed. For the most part these impacts can be mitigated, however at particularly sensitive locations the potential adverse landscape and visual impacts of an overhead line proposal may make it unacceptable in planning terms, taking account of the specific local environment and context. New substations, sealing end compounds and other above ground installations that form connection, switching and voltage transformation points on the electricity networks can also give rise to landscape and visual impacts".*

3.4.9 EN-5 also makes clear that the Holford Rules should be followed by developers when designing their proposals. Paragraph 2.8.8 states that *"Paragraph 3.7.10 of EN-1 sets out the need for new electricity lines of 132kV and above, including overhead lines. Although Government expects that fulfilling this* need *through the development of overhead lines will often be appropriate, it recognises that there will be cases where this is not so. Where there are serious concerns about the potential adverse landscape and visual effects of a proposed overhead line, the IPC will have to balance these against other relevant factors, including the need for the proposed infrastructure, the availability and cost of alternative sites and routes and methods of installation (including undergrounding)"*[22].

3.5 The Holford and Horlock Rules

3.5.1 NGET consistently employs two sets of rules/guidelines for the routeing and siting of new energy transmission infrastructure:

- Holford Rules – provide guidelines for the routeing of new high voltage overheard transmission lines[23]; and
- Horlock Rules – provide the approach to, and guidelines for, the design and siting of SECs (amongst substations and line entries)[24].

3.5.2 When considering new electricity infrastructure, NGET have regard to the degree to which routeing and siting options comply or deviate from these rules.

Holford Rules

3.5.3 Paragraph 2.8.7 of the existing NPS EN-5 makes clear *"that the Holford Rules, and any updates, form the basis for the approach to routeing new overhead lines"*. In summary, the Holford Rules state that routeing of high voltage overhead transmission lines should where practicable:

- Avoid areas of the highest amenity value;
- Choose the most direct line with no sharp changes in direction;
- Be positioned against tree and hill backgrounds as far as possible;
- Prefer moderately open valleys with woods;

---

22 The Draft National Policy Statement for EN-5 states that *"Although it is the government's position that overhead lines should be the strong starting presumption for electricity networks developments in general, this presumption is reversed when proposed developments will cross part of a nationally designated landscape (i.e. National Park, The Broads, or Area of Outstanding Natural Beauty). In these areas, and where harm to the landscape, visual amenity and natural beauty of these areas cannot feasibly be avoided by re-routing overhead lines, the strong starting presumption will be that the applicant should underground the relevant section of the line".*

23 The Draft National Policy Statement for Electricity Networks Infrastructure EN-5 in Paragraph 2.9.16 confirms that the Holford Rules *"should be embodied in the applicant's proposals for new overhead lines".*

24 The Draft National Policy Statement for Electricity Networks Infrastructure EN-5 has incorporated the Horlock Rules. At Paragraph 2.9.18 it states *"The Horlock Rules – guidelines for the design and siting of substations – were established by National Grid in 2009 in pursuance of its duties under Schedule 9 of the Electricity Act 1989. These principles should be embodied in applicants' proposals for the infrastructure associated with new overhead lines".*

- Be kept as far as possible from smaller lines, converging routes and other poles, masts, wires and cables to avoid a concentration or wirescape[25]; and
- Approach urban areas through industrial zones, where they exist; and when residential and recreational land intervenes between the approach line and the SECs, carefully compare costs of undergrounding, for lines other than those of the highest voltage.

3.5.4 Whilst the guidelines were initially developed in 1959, they have been reviewed on a number of occasions by NGET and by the other UK transmission licence holders. One of the reviews was against the Electricity Act 1989. The guidelines have stood the test of time and have become accepted industry best practice in overhead line routeing.

3.5.5 The general principles underlying the Holford Rules – the avoidance of adverse impacts by careful routeing – are to a degree also relevant to the routeing of underground cables, although the balance of impacts and constraints will often be different.

Horlock Rules

3.5.6 The Horlock Rules state that:

- In the development of system options consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements against the consequential environmental impacts, in order to avoid as far as possible adverse impacts;
- Siting should seek to avoid areas of the highest amenity, cultural or scientific value by the overall planning of the system connections;
- Areas of local amenity value, important existing habitats and landscape features should be protected as far as reasonably practicable;
- Siting should take advantage of the screening provided by landform and existing features and the potential use of site layout and levels;
- Proposals should keep visual, noise and other environmental impacts to a minimum;
- Land use impacts of the proposal should be considered when planning siting;
- Early consideration should be given to the options available for pylons and ancillary equipment appropriate to individual locations;
- Space should be used effectively to limit the area required for the Project consistent with appropriate mitigation measures and to minimise the adverse impacts on existing land use and rights of way, whilst also having regard to the potential for any future extension;
- For the design of access roads, perimeter fencing, earth shaping, planting and ancillary development should form an integral part of the site layout and design to fit in with the surroundings;
- In open landscape especially, high voltage line entries should be kept, as far as possible, visually separate from low voltage lines and other overhead lines so as to avoid a confusing appearance; and

[25] Caused by multiple overhead lines running in different angles or the proximity of multiple overhead lines.

- The inter-relationship between pylons, ancillary structures and background and foreground features should be studied to reduce the prominence of structures from main viewpoints. Where practicable the exposure of terminal pylons on prominent ridges should be minimised by siting pylons against a background of trees rather than open skylines.

3.5.7 The Horlock Rules predominately apply to the siting of substations and line approaches. The general principles underlying the Horlock Rules – the avoidance of areas of high amenity – apply equally to the siting of SECs, although the balance of impacts and constraints will often be different.

3.5.8 As detailed above, the Draft National Policy Statement for Electricity Networks Infrastructure (EN-5) (2023) in paragraph 2.9.18 confirms that the Horlock Rules "*should be embodied in applicants' proposals for the infrastructure associated with new overhead lines"*.

3.6 National Planning Policy Framework (NPPF) (2021)

3.6.1 Paragraph 5 of NPPF states that the:

"Framework does not contain specific policies for nationally significant infrastructure projects. These are determined in accordance with the decision making framework in the Planning Act 2008 (as amended) and relevant national policy statements for major infrastructure, as well as any other matters that are relevant (which may include the National Planning Policy Framework). National policy statements form part of the overall framework of national planning policy, and may be a material consideration in preparing plans and making decisions on planning applications."

3.6.2 When considering new electricity infrastructure, NGET have due regard to the NPPF, where appropriate.

3.7 National Grid's Approach to Consenting

3.7.1 National Grid's Approach to Consenting[26] outlines the development process for major infrastructure projects, from initial inception to consent and construction. National Grid's Approach to Consenting is divided into six stages:

- Stage 1: Strategic Proposal;
- Stage 2: Options Identification and Selection;
- Stage 3: Defined Proposal and Statutory Consultation;
- Stage 4: Assessment and Land Rights;
- Stage 5: Application; and
- Stage 6: Examination, Decision and Construction.

[26] National Grid, (2022), Network and Infrastructure. Available at https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure. Accessed 08 June 2022.

3.7.2 A staged approach has been adopted to identify potential routeing and siting options for the Project. This considered the potential impacts on the environment, the local community, relevant planning policy, other existing and proposed developments as well as technical and engineering design information.

3.7.3 The aim of the approach is to balance consideration of these factors and identify an emerging preferred corridor within which the overhead lines, underground cables and upgrade works to existing transmission and distribution infrastructure could be routed, and locations where SECs could be sited (as appropriate).

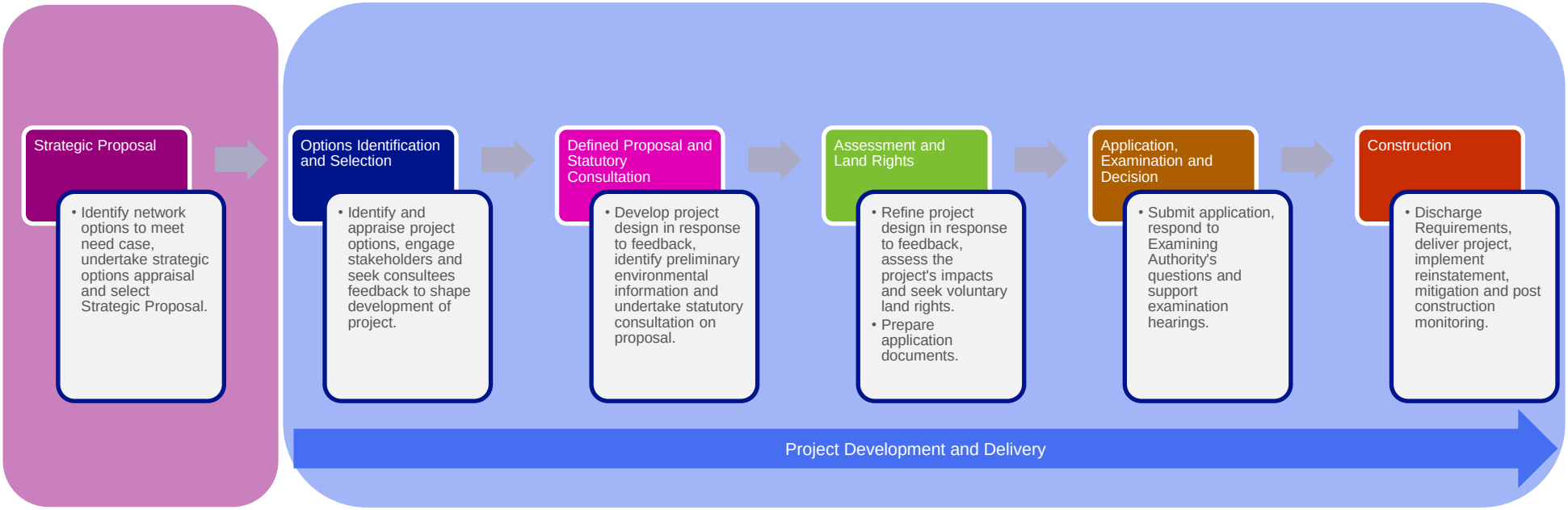
3.7.4 **Figure 3-1** presents an overview of National Grid's Approach to Consenting; a summary of the main objectives of this stage of the consenting process can be seen below each stage. The Project is at the Options Identification and Selection Stage (Stage 2).

3.7.5 This CPRSS has been undertaken as part of the Stage 2. For the Project, the activities identified in National Grid's Approach to Consenting as being required at Stage 2 were broken down into the following nine steps (as detailed in **Chapter 4**):

- Step 1 – Definition of the study area/s and data gathering;
- Step 2 – Scoping of environmental topics and baseline data-gathering;
- Step 3 – Weight, agree and heat map features;
- Step 4 – Identifying and defining corridors;
- Step 5 – Agree end-to-end corridors for appraisal;
- Step 6 – Undertake site visits and refinement of corridors;
- Step 7 – Options appraisal of corridors;
- Step 8 – Confirm emerging preferred corridor and develop graduated swathe for consultation; and
- Step 9 – Undertake non-statutory consultation.

3.7.6 This CPRSS sets out the findings of the first eight steps of Stage 2 for the Project. This CPRSS will inform subsequent non-statutory consultation, Step 9.

Figure 3-1 – NGET's Approach to Project Development and Delivery



4. Options Identification and Selection Process (Stage 2)

4. Options Identification and Selection Process (Stage 2)

4.1.1 The Strategic Proposal (Stage 1) was completed in 2021/22 and a Preferred Strategic Proposal selected, as described in **Section 1.2**. This CPRSS presents the findings of the Options Identification and Selection Stage (Stage 2) and seeks to find the corridor emerging as preferred for the Project. The findings of this CPRSS will be used as part of the non-statutory consultation with stakeholders, including landowners. The feedback received on Project during non-statutory consultation will be used to inform the design and alignment of the Project. Following the non-statutory consultation, the Project will progress into the Defined Proposal and Statutory Consultation Stage (Stage 3).

4.1.2 The methodologies employed for the nine steps, as defined for this Project, of the Options Identification and Selection Stage (Stage 2) are summarised in **Figure 4-1** and described below.

4.1.3 The following key terms are used throughout this CRPSS:

- Study Area – the broad areas within which infrastructure required for the Project may be located and within which detailed environmental and socio-economic data is gathered to inform Stage 2.
- Corridor – a broad preliminary area, within which new transmission infrastructure (overhead lines, SEC, underground cables (as appropriate)) could be routed.
- Emerging Preferred Corridor – a broad area within which the infrastructure for the Project may be located, based on the findings of Stage 2.
- Graduated Swathe – shaded areas within the emerging preferred corridor within which Project infrastructure is considered more or less likely to be located, shown by the varying levels of shading. Darker shaded areas represent where infrastructure at this stage is likely to be better located, in NGET's emerging view, within the corridor.
- Non-statutory consultation – an engagement process which will be undertaken to capture public, stakeholder and landowner feedback on the emerging preferred corridor and the graduated swathe. The feedback received will inform the onward development of the Project.

Figure 4-1 – CPRSS Methodology

4.2 Step 1: Define the Study Area

4.2.1 The Study Area is the area within which the transmission infrastructure required for the Project will be located. The Study Area is also the area within which detailed environmental and socio-economic data will be gathered to inform Stage 2.

4.2.2 The Study Area developed was informed by:

- The connection points (start / end points) identified in the Strategic Proposal Stage (Stage 1);
- The distribution of extensive areas of the highest amenity value or environmental constraint (for example, internationally designated sites);
- The nature of the physical and human geography. The presence of major geographical features such as estuaries or hills, or major settlements may represent a natural boundary to the Study Area or dictate a need for the area to extend to support routes around such features;
- Consideration of the likely balance of environmental impacts between direct and indirect routes; and
- Consideration of the Holford Rules (for routeing of an overhead line) and Horlock Rules (for siting of SECs).

4.2.3 Based on these factors, the Study Area should encompass the maximum extent within which a Project design which satisfies the statutory duties and obligations of NGET and meets the Project objectives is likely to be located.

4.2.4 A broad indicative corridor was defined as part of the Strategic Proposal Stage (Stage 1) undertaken in 2021/22. The broad indicative corridor informed the Study Area developed at this Stage (Stage 2).

4.2.5 The Study Area developed encompassed the area within which preliminary corridors may be identified but excluded areas where these are unlikely to be feasible. It was defined in part by Holford Rule 1 and allows for the application of the principles of the Holford and Horlock Rules as described in **Chapter 3**. The Study Area, described in **Chapter 5**, therefore encompassed an area within which the identification and assessment of preliminary corridors could be completed.

4.2.6 The Study Area and factors that influenced its definition are described in **Chapter 5.**

4.3 Step 2: Scope Environmental Topics and Baseline Data-gathering

Scoping of Environmental Topics

4.3.1 National Grid's approach to the appraisal of design options considers the following topics and sub-topics:

- **Environmental:** Landscape and Visual Amenity; Ecology; Historic Environment; Air Quality; Noise and Vibration; Soils and Geology; Water; Greenhouse Gas Emissions;
- **Socio-economic:** Economic Activity; Traffic and Transport; Aviation and Defence;
- **Technical:** Technical Complexity; Construction / Delivery issues; Technology issues (which includes sustainability issues); Capacity issues; Network efficiency / benefits (which includes energy efficiency); and
- **Cost:** Capital cost; Lifetime cost; and Constraint costs (where applicable).

4.3.2 The environment and socio-economic topics are aligned with applicable requirements of Section 5 of EN-1 and Section 2 of EN-5.

4.3.3 National Grid acknowledges that sub-topics (and potentially whole topics) may be scoped-out if it is likely that there would be no material impact as a result of any of the options (because of the nature of the Project).

4.3.4 To identify the data-gathering required to contribute to the effective evaluation of options, and ultimately help inform decision-making, a review of the environmental topics and their constituent sub-topics was undertaken. The review considered the presence of receptors for a particular topic or sub-topic within the Study Area, and whether the Project could have a material impact on the receptors. If there were either no receptors, or no risk of a material impact, the topic or sub-topic was scoped-out of the appraisal process. This ensured that the CPRSS and appraisal process only addressed those sub-topics that are potentially material to the decision-making process.

4.3.5 It should be noted that scoping out a sub-topic simply reflected the fact that either: (i) there are no receptors for that sub-topic in the vicinity of the Study Area or option that could be impacted; or (ii) the different options could not be distinguished on the basis of that sub-topic. It does not mean that the topic or sub-topic is not important, nor does it mean that it would necessarily be scoped-out during subsequent stages.

4.3.6 At this early development stage of the Project coastal change, odour, artificial light, smoke, steam, insect infestation and waste management impacts were scoped out on the basis that with the other topics applied, these topics would not be determining factors in the identification and selection of corridors. Furthermore, NGET designs all of its infrastructure to be compliant with current regulations and guidance on electromagnetic fields and therefore this was scoped out.

4.3.7 The environmental and socio-economic topics scoped into this Project at Stage 2 include air quality and emissions, dust, landscape and visual amenity, ecology, historic environment, noise and vibration, soils and geology, water, economic activity, traffic and transport, and aviation and defence.

4.3.8 At this stage of the Project, air quality and emissions and noise and vibration are considered accounted for by considering proximity to settlements, residential and other sensitive receptors. Waste management and electric and magnetic fields are not considered material to the decision-making process at this stage, and will be considered as the Project development progresses into the Defined Proposal and Statutory Consultation Stage (Stage 3).

Data Gathering

4.3.9 To identify corridor options which best satisfy NGET's statutory duties and obligations and meet the need case for the Project, it is necessary to understand the presence and distribution of environmental, socio-economic, and technical constraints and opportunities within the Study Area. As part of this process, geographical information system (GIS)[27] web mapping was developed comprising available environmental, socio-economic, and technical data within the Study Area.

4.3.10 Data for each topic was gathered through a desk-based review of information on potentially international, national, regional and locally important receptors. This included the following:

- Identification of designated sites and other constraints from British Geological Survey, Civil Aviation Authority, Environment Agency, Forestry Commission, Joint Nature Conservation Committee, Marine Management Organisation, Department for Levelling Up, Housing and Communities, Natural England, Office for National Statistics, Ordnance Survey, SUSTRANS, The Royal Society for the Protection of Birds (RSPB) and relevant local authorities;
- Identification of archaeological designations and other recorded sites, using GIS datasets available from Historic England;
- Review of the Local Development Plans for Hull City Council, East Riding of Yorkshire Council, Selby District Council, North Lincolnshire Council, Doncaster Council, West Lindsey District Council, Bassetlaw District Council and Newark and Sherwood District Council to identify further environmental constraints and opportunities, such as county and regional level designations or other locations important to the public;
- Review of Landscape Character Assessments of relevance to the Study Area;
- Review of Ordnance Survey (OS) mapping (1:50,000 mapping and terrain data) and aerial photography to identify other potential constraints such as settlements, properties, walking routes, cycling routes etc.;
- Extrapolation of OS OpenData to identify further environmental constraints including locations of watercourses and waterbodies; and
- Review of other local information through online and published media such as tourism sites and walking routes.

[27] GIS is a system that enables the creation, management, analysis and mapping of all types of data.

4.4 Step 3: Weight, Agree and Heat Map Features

4.4.1 To allow the identification of corridors the various elements within the scoped-in sub-topics which may constrain routeing and siting and for which data was gathered were mapped.

4.4.2 Once mapped, the data sets were assigned a classification or 'sensitivity weighting' based on their sensitivity to the technology likely to be required for the Project. This classification was determined using professional judgement, whilst having regard to relevant environmental legislation, policy and best practice. A six-point scale was used to determine the 'sensitivity weighting', as shown in **Table 4-1**.

Table 4-1 – Description Associated with Sensitivity Weighting

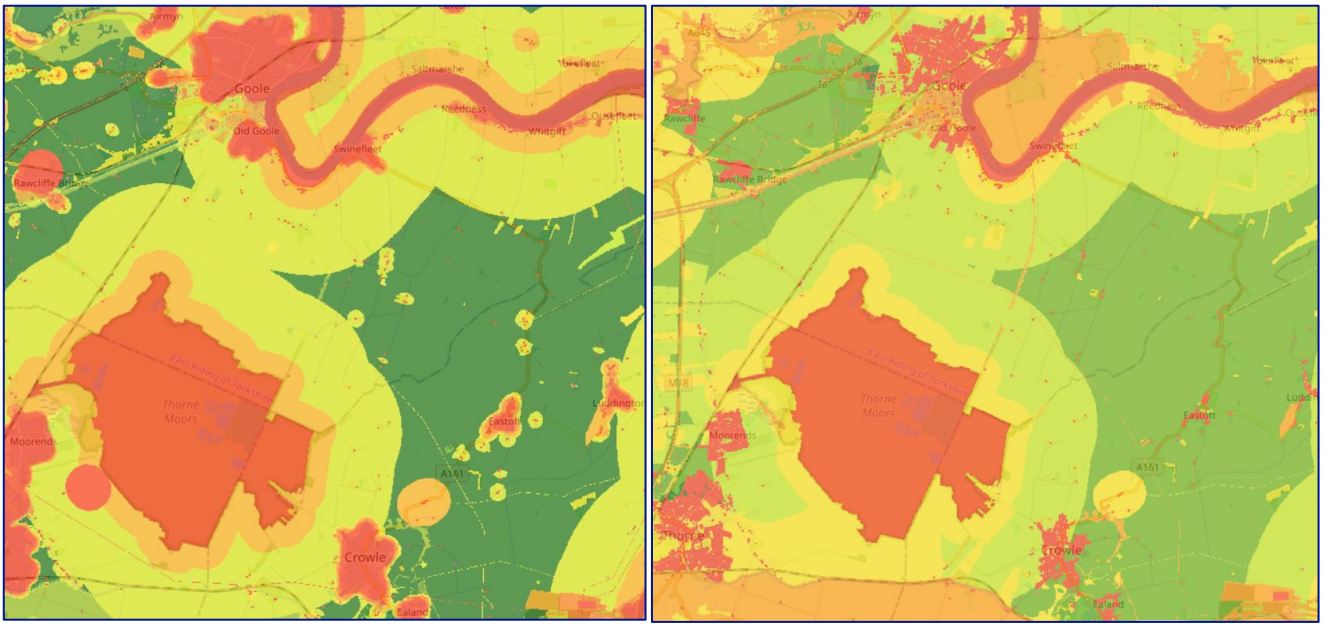
Classification Value	Classification Value Description
0	Areas with no identified constraint.
1	Very low potential to constrain the Project.
2	Low potential to constrain the Project.
3	Intermediate potential to constrain the Project.
4	High potential to constrain the Project.
5	Very High potential for the Project to be constrained.

4.4.3 The weighting of the different constraints varies between the potential technologies of the Project (overhead lines and underground cables), as these would not all have the same impacts on different features. For example, areas containing Priority Habitats and areas of Traditional Orchard Habitats are weighted intermediate for underground cables due to the increased risk to terrestrial species and orchard habitats that would be caused by the cable excavation works but very low or low for overhead lines as excavation works would be limited to the area required for the pylons.

4.4.4 The sensitivity weighting effectively formed a robust scoping exercise to ensure a focus on features that materially inform decision making. This gave the highest weight to receptors of national or international value, whilst not excluding receptors of more local importance.

4.4.5 Sensitivity weightings associated with these features were agreed with NGET and the Front-end engineering design (FEED) Contractor and were then combined to produce separate composite 'heat maps'[28] showing the highest 'weight' for each cell[29] of the map. Examples of the heat maps produced for overhead line and underground cable are shown in **Figure 4-2**. These composite heat maps reflect the relative importance of different receptors and help to visualise the constraints to developing infrastructure for the Project and, when combined with professional judgement, informed the identification of corridors, as described in **Chapter 5**.

Figure 4-2 – Example Sections of Heat Mapping for Overhead Line (left) and Underground Cable (right)



4.4.6 For composite heat maps, and to enable GIS analysis of the information within the heat maps, the Study Area was broken down into 10m square 'cells' based on the Ordnance Survey (OS) grid. Within each of these cells the sensitivity weighting of a feature is added to a 'baseline' score of one[30]. The heat map therefore shows numerical weightings of one to six.

4.4.7 To avoid the risk of double-counting the composite heat map shows the highest individual 'weight' identified in each cell, not the combined total of different weights identified. For example if a cell has a baseline of one, contains a listed building with a weight of five and is located in a conservation area with a weight of three, then the cell would have a weight of six (baseline of one, plus listed building, five). This process is shown in **Figure 4-3**.

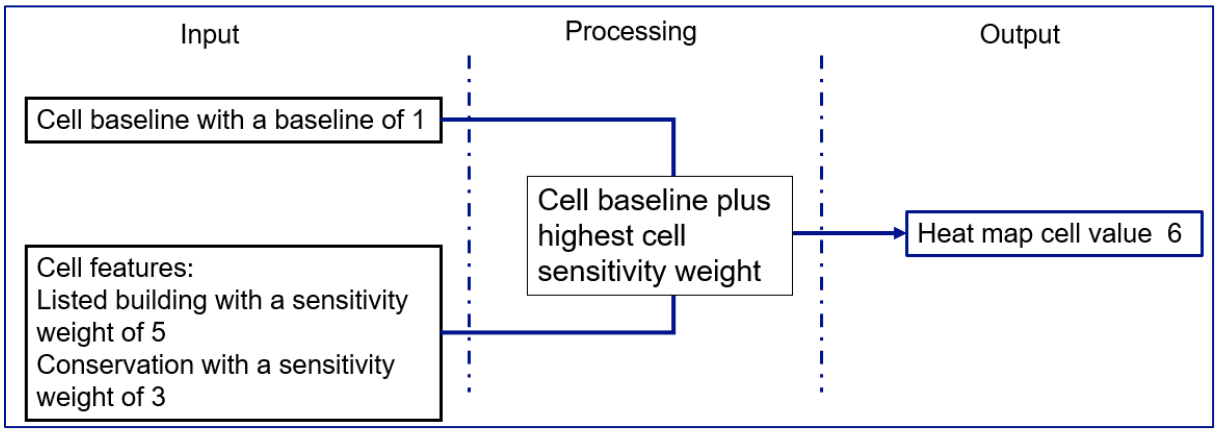
---

28 A heat map is a graphical representation of data where values are depicted by colour. In the context of the Project the data is the environmental features which are weighted, and the colour will be determined by the sensitivity weighting allocated to each feature.

29 The map was divided into 10m-by-10m square cells based on the Ordnance Survey National Grid.

30 The entire study area starts with an even 'weight' of one, so that the lowest cost across a 'level playing field' is a straight line - the shortest line.

Figure 4-3 – Example of how Sensitivity Weighting is Incorporated into Heat Mapping



4.4.8 The sensitivity weighting enabled the exercise to focus on receptors that materially inform decision making. This gave the highest weight to receptors of national or international value, whilst not excluding receptors of more local value. Receptors of the highest weight primarily informed the development of corridors whilst the lower weighted receptors (and small areas of high weight) informed the development of the corridors, once the larger areas of higher weight had been avoided where practicable.

4.4.9 The sensitivity weightings were reviewed prior to the development of indicative corridors, particularly to allow the refinement of buffer zones and to test the weighting assumptions. An example of this is for the setting of heritage assets. For the development of an indicative corridor, an appropriate buffer all-round the asset was weighted. However, prior to the development of the indicative corridors, the assets within a corridor were preliminarily reviewed to identify any 'directionality' in setting. For example, a listed building with a designed outlook would have a more extensive setting along the line of that outlook than in other directions. This review would be backchecked and verified by site visits as the Project progresses.

4.4.10 These heat maps reflected the relative importance of different features and helped to visualise the constraints to developing infrastructure for the Project and informed the identification of corridors, as described in **Chapter 5**.

4.5 Step 4: Identifying and Defining Corridors

4.5.1 At this stage of the Project, identification of preliminary routeing and siting options involves little detailed engineering design. It is led by landscape and environmental specialists who have due regard to the environmental and socio-economic considerations alongside the required technical parameters. The aim of identifying early corridors is balancing high-level mitigation with engineering requirement; routeing and siting to avoid designated sites and other large-scale constraints, to minimise impacts on the environment and local population as far as practicable, whilst ensuring options identified meet the Project engineering requirements.

4.5.2 To start, the heat maps produced in Step 3 were used to undertake a GIS 'corridor analysis'. This is a GIS tool that takes the weight applied to each cell as the 'cost' of crossing it and calculates the total cost of every possible path between the start and end points. From this it is possible to identify potential corridors that minimise the environmental 'cost', where the environmental 'cost' is determined by the combination of distance and the sensitivity weighting applied by the heat map.

4.5.3 The GIS tool helps identify potential corridors with the likely least potential for adverse impacts on those aspects of the environment that can be mapped, by finding routes across the heat map surface to connect the start and end points of the Project which have the least environmental 'cost' – the least interaction with environmental constraints. It is run separately for overhead lines and underground cables, identifying potential corridors for each. This approach ensures that potential corridors prioritise key issues, including mapped technical constraints, whilst retaining all data to be considered so that further analysis can be undertaken to address pinch-points and later for developing the graduated swathe.

4.5.4 The corridors generated through the GIS analysis provided a starting point for the Project Team landscape and environmental specialists, working with the wider Project Team as appropriate, and employing professional judgement and their understanding of routeing considerations to identify technically feasible preliminary corridors. Preliminary corridors included aspects which cannot be mapped but are no less important considerations to the routeing of a transmission connection. For the overhead line options this included for example, avoiding the use of too many angle pylons (Holford Rule 3), finding the best 'landscape fit' i.e. how an overhead line would sit in the landscape (Holford Rules 4 and 5) and how it would affect visual amenity (Holford Rule 6).

4.5.5 The options identified were then subject to review by the FEED Contractor and the Project Team, who used their professional judgement to recommend amendments (i.e., to park, refine or expand) to the corridors. These recommendations were reviewed and implemented by the landscape and environmental specialists to ensure that changes were made in a manner consistent with landscape and environmental considerations.

4.5.6 As part of this exercise, the distribution and density of constraints (environmental, technical and socio-economic) was examined to identify areas where it might be particularly challenging to identify a technically feasible and / or environmentally acceptable overhead line connection (subject to further analysis). The starting assumption (in accordance with National Grid's guidance and national planning policy) is that transmission connections are as overhead lines, except in nationally designated landscapes. Consideration was given to the use of underground cables throughout, including through the Yorkshire Wolds on the assumption that the area could be designated as an AONB. Underground cable options were considered across the Yorkshire Wolds because the initial 'Area of Search' for the AONB covered the entirety of the Wolds within the Study Area. When the provisional 'Candidate Area' for the proposed AONB was announced, indicating that designation within the Study Area was unlikely, it was considered likely that a policy compliant overhead line could be developed within the Study Area through the Yorkshire Wolds.

4.5.7 **Chapter 2** describes underground cable technologies, and the associated SECs.

4.5.8 To enable a clear comparative analysis and understanding of the early corridors, the complex network of corridors was structured into a number of corridors, divided into 'sections', with a series of connection links and loops. This exercise was undertaken so that an emerging preference can be identified using a series of sections of one corridor then via a link to a series of sections of another corridor, in order to bypass an area of greater constraint. The corridors, links and loops are described in **Chapter 5**.

4.5.9 The outcome of Step 4 is a set of early corridors, links and loops to be subject to further analysis and informed by field observations at Steps 5 and 6. This approach allowed for the continued appraisal of multiple and interrelated options.

4.6 Step 5: Agree Corridors for Appraisal

4.6.1 The corridors, links and loops were then further reviewed by NGET and the FEED Contractor to confirm the technical feasibility and ensure that key issues, and the interaction of constraints, had been fully considered.

4.6.2 At this point the corridors were also reviewed to ensure that all corridors, links and loops had the potential to form end-to-end solutions.

4.6.3 Prior to progressing to Step 6, the corridors, links and loops were agreed by the Project Team.

4.7 Step 6: Site Visits and Refinement of Corridors

4.7.1 Following the identification of the corridors, links and loops (Steps 4 and 5), site visits were undertaken by landscape, heritage and ecology specialists, the FEED Contractor and NGET. The purpose of these visits was to ground truth the key landscape, environment, community and technical features, to allow closer consideration of areas identified as particularly constrained ('pinch points') during the desk studies, and to identify further construction and design hazards that might mean corridors, links and loops would not be feasible.

4.7.2 Following the site visits further review was undertaken of the corridors, links and loops by the Project Team to identify any options which should be parked, new options identified or amendments to existing options where applicable.

4.7.3 Following the site visits some further refinement of the corridors, links and loops was undertaken before progressing to Options Appraisal (Step 7).

4.8 Step 7: Options Appraisal of Corridors

4.8.1 In Step 7, the corridors, links and loops agreed at Step 6 are subject to Options Appraisal in accordance with National Grid's Approach to Consenting. National Grid's guidance provides a thorough and consistent framework to inform the appraisal of project options and decision making. Its aim is to ensure that decisions regarding the location or technology of a given project are based on a full understanding of the technical, socio-economic, environmental, and cost implications of identified options. It also enables NGET to document in a transparent manner the information on which judgements have been based.

4.8.2 National Grid's Approach to Consenting notes that the Options Identification and Selection Stage (Stage 2) should be largely desk based. However, as described in Step 6, the Options Appraisal for this Project has also been informed by observations from site visits undertaken by the Project Team. These observations have provided additional information to inform the Options Appraisal, which, in conjunction with that drawn from the desk-based studies, provided an evidence-base appropriate to inform this stage of the Project. As the Project progresses to subsequent stage of more detailed design and assessment, additional surveys and analysis will add further information to the evidence base, which will be used to back-check the findings of this study.

4.8.3 The overall objective throughout the Options Appraisal was to take full consideration of all known environmental factors to minimise the risk of significant adverse impacts on the environment and communities whilst taking into account engineering and economic considerations.

4.8.4 For each relevant environmental and socio-economic sub-topics (outlined in Step 2) the appraisal considers the potential impacts on relevant receptors, and whether such impacts could be avoided or mitigated through careful routeing or siting. Where impacts cannot be avoided or mitigated by careful routeing other forms of mitigation were considered in accordance with NGET's mitigation hierarchy, including:

- Different lattice pylon design / conductor configuration;
- Alternative pylon design (such as low height pylon);
- Reduction of wirescape through distribution network rationalisation or undergrounding;
- Reduction of wirescape through transmission network rationalisation; and
- Alternative transmission technology (such as undergrounding).

4.8.5 Once such mitigation measures were considered, a judgement was made as to the potential for residual impacts. The residual impacts considered in the Options Appraisal do not take account Project-specific environmental, socio-economic or technical mitigation measures which are likely to be included as part of the EIA process undertaken at the Defined Proposal and Statutory Consultation Stage (Stage 3). The findings of the Options Appraisal for the relevant sub-topics are detailed within **Chapter 6** to **Chapter 9** (one chapter for each of the four corridors identified).

4.8.6 The Options Appraisals also took cognisance of the requirements of the Environment Act (2021) regarding biodiversity net gain (BNG) and climate resilience and greenhouse gas emissions. The Act introduces new environmental targets across waste and resource efficiency, air quality, water, nature, and biodiversity. The most notable of these is the mandatory 10% BNG for developments. The mandatory 10% BNG will be implemented by amends to the Town and Country Planning Act 1990 (TCPA) and, of relevance to this Project, the Planning Act 2008. The Options Appraisal noted where land may be available and or suitable to support with BNG requirements (subject to collaboration with landowners and Local Nature Partnerships). The consideration of BNG will form part of the later stages of the Project.

4.8.7 The Project itself is designed to enable renewable energy generation thus contributing to combating climate change. At the subsequent stages the Project will need to assess climate change both in terms of greenhouse gas emissions and climate resilience. However, both components of climate change have been inherently considered at a high-level in the Options Appraisals i.e., consideration of presence of peaty soils, Flood Zones and overhead line / underground cable lengths. At this stage a of the Project high-level carbon cost exercise was undertaken and further information on this is provided in **Chapter 10**.

4.8.8 The process of comparison and selection of options is described under Step 8.

4.9 Step 8: Confirm Emerging Preferred Corridor and Develop Graduated Swathe For Consultation

4.9.1 Following completion of Step 7, a challenge and review workshop was held and attended by NGET, the FEED Contractor and the landscape and environmental specialists. The purpose of the workshop was to review environmental preferences and, in accordance with EN-1 and EN-5, balance these against technical and cost inputs to reach a conclusion on the emerging preferred corridor that provides the optimum balance of efficiency and economy, whilst having appropriate regard to environmental and socio-economic impacts.

4.9.2 Further to this a back-check and review to confirm the outcome of the options appraisals of the corridors, links and loops, agree the emerging preferred corridor and to develop a graduated swathe within the emerging preferred corridor for non-statutory consultation.

4.9.3 Following identification of the emerging preferred corridor, the likely areas within which the infrastructure for the Project may be located were identified by the FEED Contractor. Identified preliminary areas were then sifted taking into consideration the initial heat mapping and Holford Rules, with particular regard of rules 1, 2 and 3 to avoid areas of amenity value and while taking this into consideration selecting a direct route. A workshop attended by the Project Team was then undertaken to discuss the outputs of the siting and to review the technical requirements for creating a graduated swathe.

4.10 Step 9: Undertake Non-Statutory Consultation

4.10.1 The final step in the CPRSS was to report the entire process for non-statutory consultation. The CPRSS process and outcomes are captured in this Report. This Report is intended to support public consultation to engage stakeholders, statutory consultees and interested parties, including the public.

5. Study Area and Corridor Definition

5. Study Area and Corridor Definition

5.1 Defining the Study Area (Step 1)

5.1.1 The Study Area was defined through a five-phase process which is outlined below and shown in **Figure 5-1**.

5.1.2 The approach to developing the Study Area for the Project was based on balancing NGET's duty to develop an economical system of transmission (Section 9 of the Electricity Act 1989), with Holford Rule 1 which is to *"avoid altogether, if possible, the major areas of highest amenity value, by so planning the general route of the first line in the first place, even if the total mileage is somewhat increased in consequence".*

Phase I: Connection Points

5.1.3 The first step involved joining the two connection points, Creyke Beck in the north and High Marnham in the south, in the most economic manner: a straight line between the two connection points. All other things being equal, a straight line would be the shortest route and therefore both the least cost and the least amount of new development potentially giving rise to environmental impacts.

Phase II: High-level Constraints Review

5.1.4 A high-level desk-based review was then undertaken of the features representing major potential constraints between the two connection points: the areas of highest amenity value, main centres of population and major technical constraints. Major areas of highest amenity value included the Humber Estuary Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar sites and Thorne and Hatfield Moors SAC and SPA sites. It was also noted that the Yorkshire Wolds were being considered for designation as an AONB. The main centres of population identified included Hull and Scunthorpe. The major technical constraint identified was the crossing of the Humber Estuary.

5.1.5 The straight line was then amended to avoid the major areas of highest amenity value that had been identified. The following amendments were made at this stage:

- The straight line was deviated to cross the River Ouse upstream of the confluence with the River Trent to minimise the width of the crossing of the Humber Estuary SAC, SPA and Ramsar sites, also thereby avoiding the main populations in Hull and Scunthorpe; and
- The straight line from this first deviation was itself deviated slightly in the Trent valley to avoid re-crossing the Humber Estuary SAC and Ramsar sites.

5.1.6 It was acknowledged that this amended line does not altogether avoid the Humber Estuary SAC, SPA and Ramsar sites; it crosses adjacent to the existing 400kV crossing.

5.1.7 The Yorkshire Wolds (currently an Important Landscape Area (ILA)) could not be avoided as it forms an arc from the Humber to the east coast. It was acknowledged that part of the Yorkshire Wolds were being considered for designation at the time of identifying the Study Area. The extent of the designation was unknown at the point of identifying the Study Area for the Project.

Phase III: Initial Search Area

5.1.8 A search area was then introduced around the line established following Step 2, to allow for the development of a reasonable range of early corridor options. A search area of 20km wide was considered sufficient to enable the development of early corridor options that avoid the major constraints.

Phase IV: Refinement of Search Area

5.1.9 The 20km wide search area was then reviewed and refined to exclude the major areas of highest amenity value, the main centres of population and major technical constraints identified in Phase II.

5.1.10 At this stage, the search area was refined around Creyke Beck to avoid the populated area of Hull; around the Humber Estuary to minimise the width of the crossing of the Humber Estuary SAC, SPA and Ramsar sites, avoid the populated area of Goole; and to the west of Scunthorpe to avoid the populated area.

Phase V: Expansion of Search Area

5.1.11 A high-level desk review of the unconstrained areas within the likely Study Area identified in Phase IV was then undertaken to identify where the likely Study Area could be expanded to avoid constraints and provide opportunities to reduce environmental impacts.

5.1.12 Two areas were identified for expansion. The first was to the north of Doncaster as the area was relatively unconstrained and would provide options to avoid major areas of highest amenity (including the possibility of altogether avoiding the Humber Estuary SAC, SPA and Ramsar sites) centres of population and technical constraints. The existing overhead lines to the west formed a natural limit to the expansion.

5.1.13 The second expansion was related to the opportunity to close parallel the existing overhead lines and was focused to the north-east of Doncaster.

5.1.14 The Study Area as presented in **Figure 5-2** begins to the north-west of Hull in the Creyke Beck area which is the northern connection point for the Project, as shown by the red pin in **Figure 5-2**. The Study Area extends to High Marnham in the south, which is the southern connection point for the Project, and is shown by the blue pin in **Figure 5-2**.

Figure 5-1 – Process of Defining the Study Area

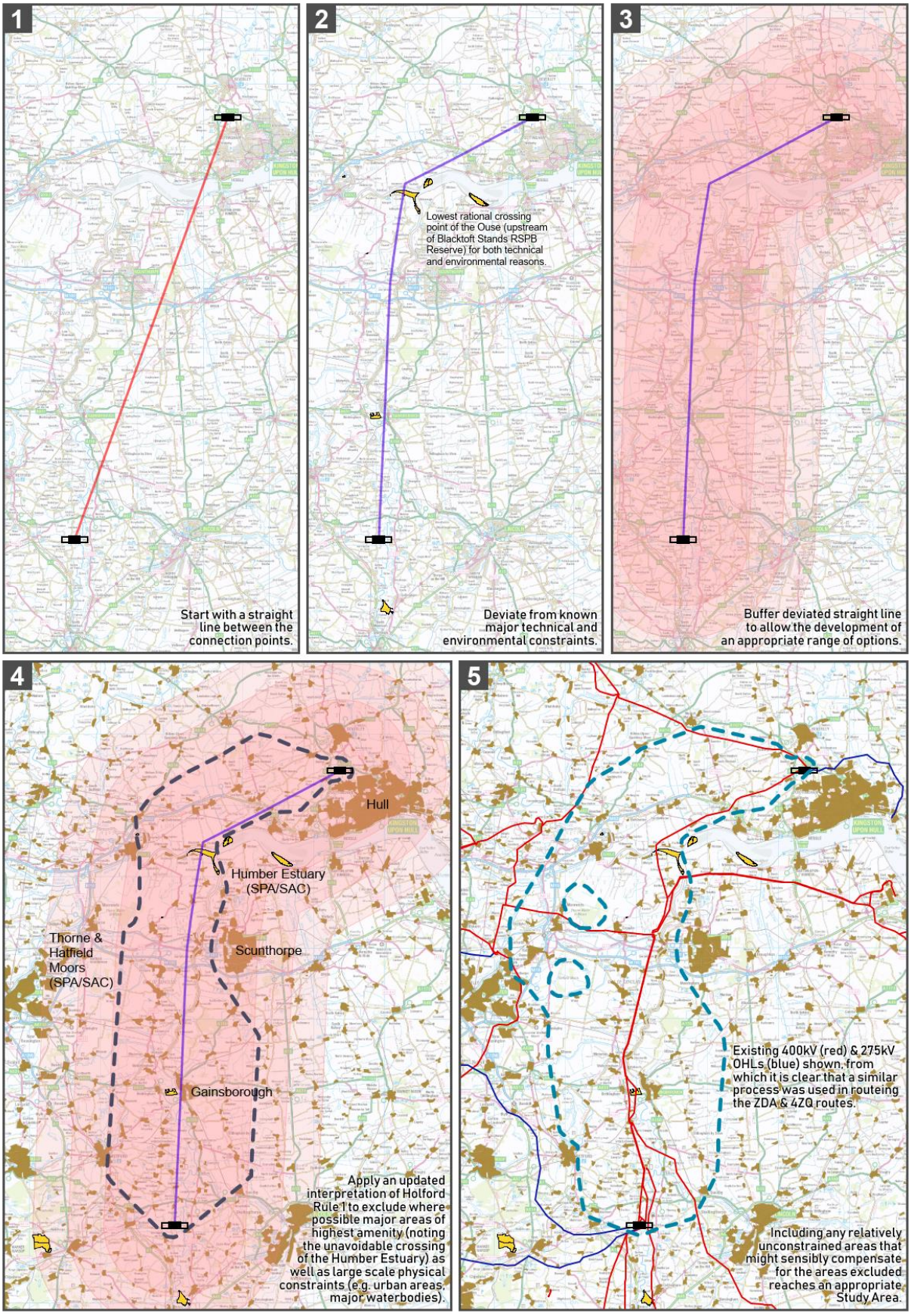


Figure 5-2 – The Study Area

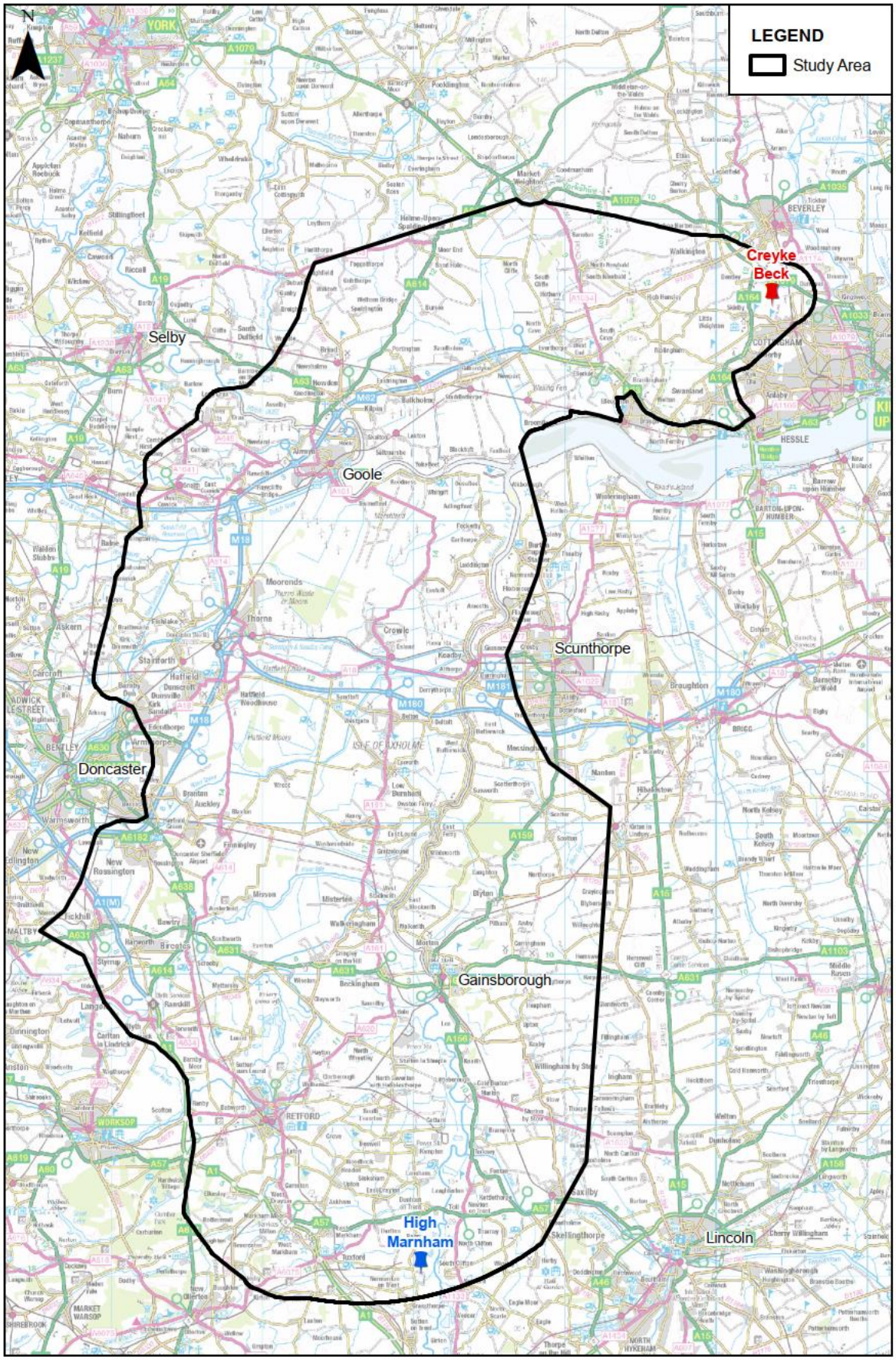


Figure 5-2 – The Study Area

5.1.15 The Study Area in the northern Humber area extends north-west towards Market Weighton and south to the Humber. The boundaries of the Study Area were defined within this area to follow existing 400kV transmission overhead lines, shown as the blue lines in **Figure 5-3**. This includes the 4ZR 400kV overhead line which routes north-west out of Creyke Beck to the south of Market Weighton, the 4ZQ 400kV overhead line which routes south-west out of Creyke Beck to the River Ouse, and the 4VC 400kV overhead line which routes south from the A163 to the River Ouse. The inclusion of these existing overhead lines allows opportunities for close parallel routeing.

Figure 5-3 – The Study Area – Existing Overhead Lines North of the Humber and the River Ouse

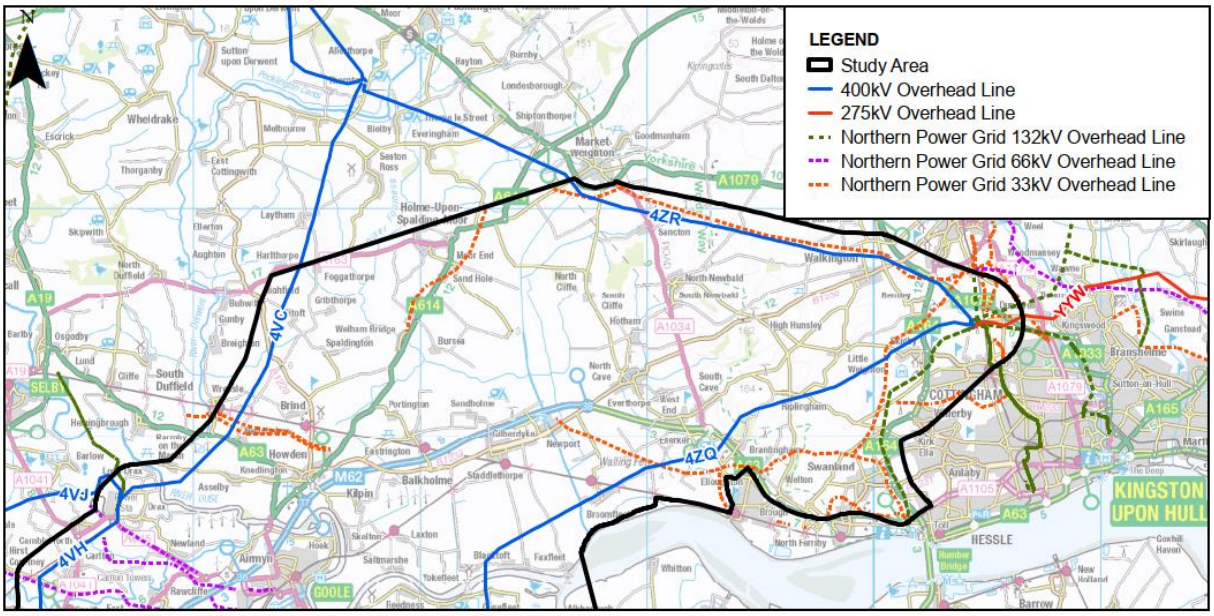


Figure 5-3 – The Study Area – Existing Overhead Lines North of the Humber and the River Ouse

5.1.16 The boundary of the Study Area was drawn between Market Weighton and the A163 to allow a connection to be established between the 4ZQ and 4VC 400kV overhead lines and which would adhere locally to the principles of Holford Rule 3 to choose the most direct line.

5.1.17 In a similar approach to the area north of the Humber and River Ouse, the western boundary of the Study Area to the south of the River Ouse follows the existing transmission overhead lines. This includes the 4VH 400kV from the River Ouse which then connects into the ZZI and 4ZH 400kV overhead lines, which are shown as the blue lines in **Figure 5-4** and the XE 275kV overhead line shown as the red line in **Figure 5-4** routeing between Tickhill to High Marnham.

5.1.18 The Study Area was drawn to avoid the Humber Estuary due to ecological concerns related to the designated sites and technical considerations of crossing the Humber Estuary. The eastern boundary of the Study Area has been drawn to follow the River Trent, a short distance to the east of the river, from the Humber Estuary to just south of Scunthorpe. The Study Area avoids Scunthorpe before extending out to the east. This allows the opportunity to route to both west and east of the River Trent.

Figure 5-4 – The Study Area – Existing Overhead Lines south of the River Ouse

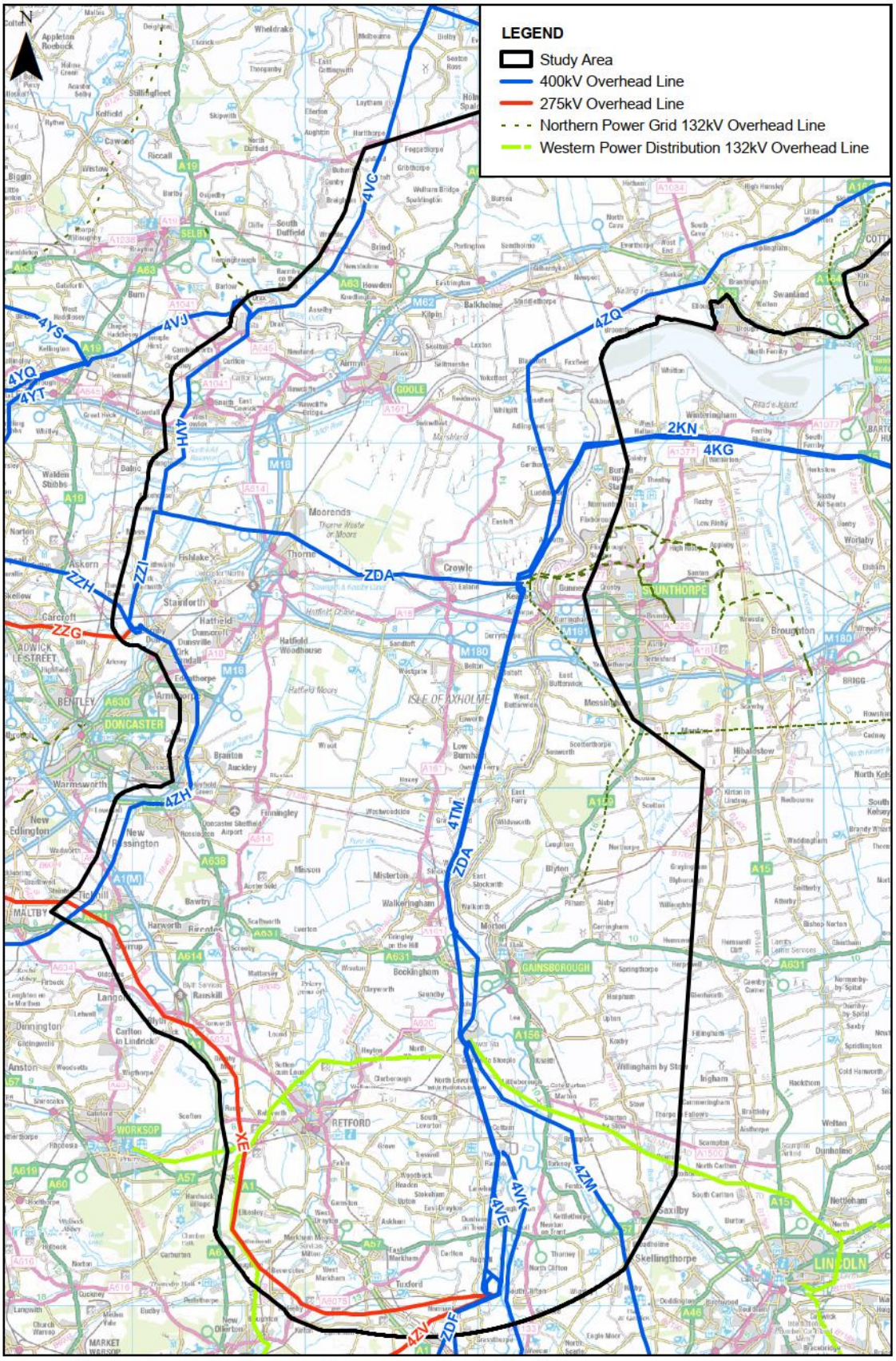


Figure 5-4 – The Study Area – The Study Area – Existing Overhead Lines south of the River Ouse

SCALE:1:350,000 0 2.5 5 7.5 10 km

5.2 Description of the Study Area

5.2.1 The northern extent of the Study Area is located between Hull in the east to Drax in the west, bounded by the River Ouse to the south and Beverley and Market Weighton to the north. This section of the Study Area is located within East Riding of Yorkshire and primarily comprises the open flat landscape of the Humberhead Levels National Character Area (NCA) in the west and the elevated landscape of the Yorkshire Wolds NCA in the east. The location of the NCAs is shown in **Figure 5-5**. The primary land use comprises arable farmland bounded by field drains, and scattered settlements including South Cave, Gilberdyke and Howden.

5.2.2 The River Ouse runs through the Study Area from Drax in the west to the south-west of Blacktoft in the east where it joins with the River Trent to form the Humber. The Humber Estuary SAC, SPA and Ramsar sites extend from east to west across the Study Area along the River Ouse to the north of Airmyn, bounded by the A614. The sites also extend south along the River Trent, where the Humber Estuary SPA ends to the east of Adlingfleet, and the Humber Estuary SAC and Ramsar sites continue south to Althorpe, bounded by Keadby Bridge. This area is within the Humberhead Levels NCA and is an open flat landscape comprising arable farmland in the east to the increasingly industrial landscape around Goole and Drax in the west.

5.2.3 To the south of the River Ouse in the central section of the Study Area, the Humberhead Levels NCA dominates the Study Area to Retford in the south and Laughton in the east. The landform is flat and open in this area, and the eastern section of the Study Area is covered by the Isle of Axholme which comprises settlements including Garthorpe, Crowle and Epworth. The land use within this area is predominantly arable farmland with infrastructure including Keadby Power Station, Keadby Windfarm and the existing electricity transmission network. The road network comprises major routes including the M62, M18 and M180 which connect the large settlements of Goole, Thorne, Stainforth and Hatfield. The Thorne and Hatfield Moors SPA, SAC, Site of Special Scientific Interest (SSSI) and National Nature Reserve are located within the central section of the Study Area. To the south of these sites lies Doncaster Sheffield Airport in the western extent of the Study Area.

5.2.4 To the south of the Humberhead Levels lies the Trent and Belvoir Vales NCA which begins in the Gainsborough area and covers the south-eastern extent of the Study Area. The landform in this area is undulating with a broad gently rolling ridge running north-south, separating the Trent and Idle valleys. Retford (Gamston) Airport lies within the western extent of the Study Area. The land use within this area is predominantly arable farmland which is intersected by the meandering River Trent.

Figure 5-5 – The Study Area – National Character Areas

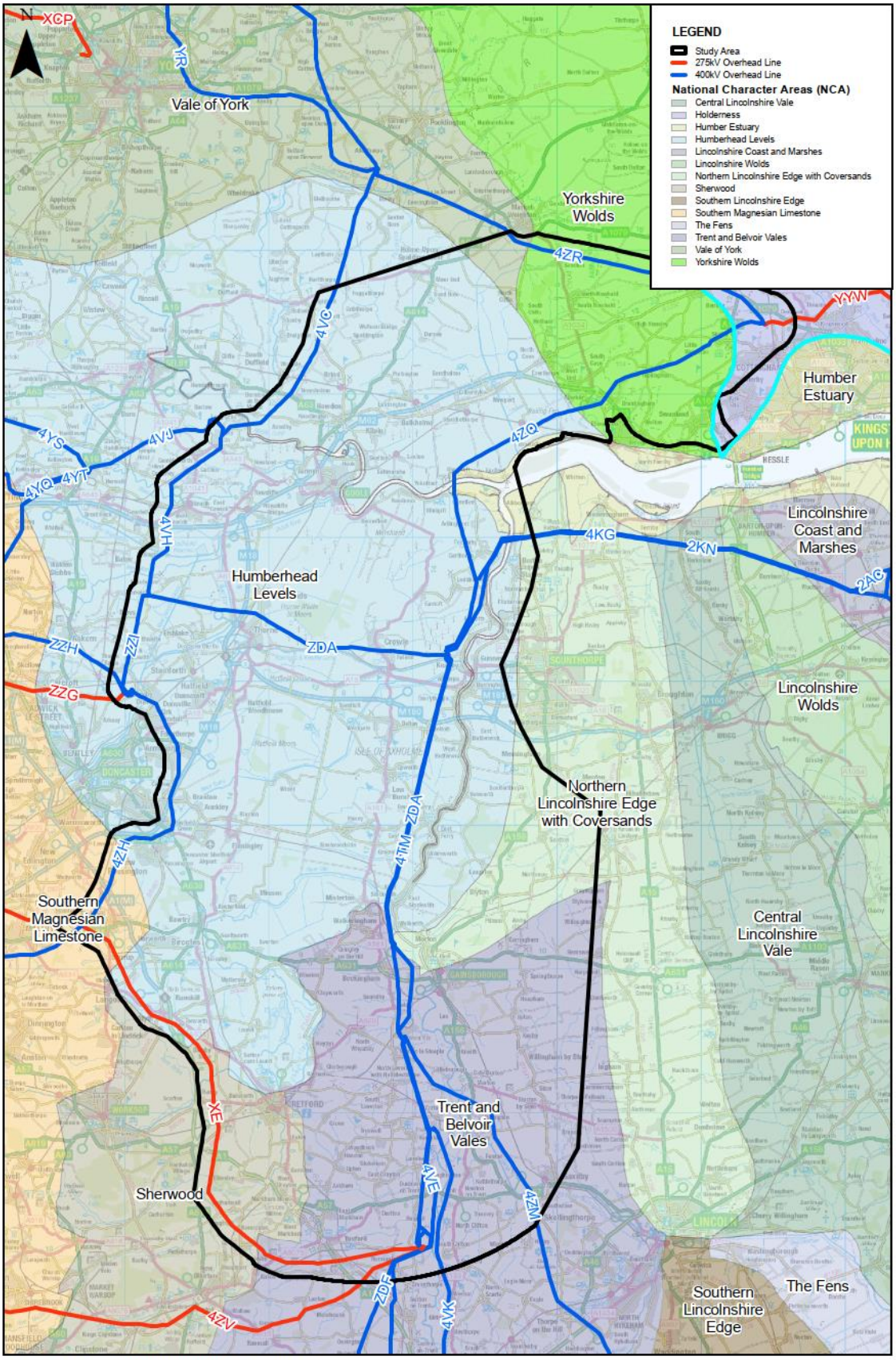


Figure 5-5 – The Study Area – National Character Areas

SCALE:1:420,000 0 2.5 5 7.5 10 km

5.3 Data Gathering (Step 2)

5.3.1 To identify connection options which best satisfy NGET's statutory duties and obligations and meet the Project objectives identified in the Strategic Proposal Stage (Stage 1), it is necessary to understand the distribution of environmental and technical constraints (push factors) and opportunities (pull factors) within the Study Area. Data to inform this was gathered for the Study Area, as well as for the immediately surrounding areas for those topic areas where it was considered that there was the potential for adverse impacts on a feature within the Study Area boundary (for example, impacts on migrating wildfowl from a designated site). The extent of the data gathering was based on the professional judgement of the Project environmental and engineering specialists, considering relevant environmental legislation, policy, and best practice.

5.3.2 Features representing potential constraints to development were categorised as either 'seek to avoid' or 'seek to minimise' in order to, respectively, either avoid or minimise impacts whilst achieving the Project objectives for each of the technology options (overhead lines and undergrounding). Features were categorised based on the level of constraint that the relevant environmental specialist considered them to represent on the basis of professional judgement and relevant environmental legislation, policy and best practice. The sensitivity of particular sites and features relevant to the Project will be continually reviewed as the Project progresses in response to consultation feedback and further site-based assessment.

5.3.3 A list of the data obtained, to inform the onward steps, is listed in **Table 5-1** for overhead lines and **Table 5-2** for undergrounding.

5.3.4 Buffers were also included for some features representing constraints, where it was considered that potentially significant indirect impacts could occur from beyond the asset itself, for example impacts on the setting of a listed building, in order to avoid or minimise that impact. The extent of the buffers was based upon the professional judgement of the relevant Project Team subject matter expert against relevant legislation, policy and best practice. The buffers were not intended to be areas where transmission development must be avoided. The buffers are shown in **Table 5-1** for overhead lines and **Table 5-2** for undergrounding.

5.3.5 As well as potential constraints to the Project, the mapping exercise also identified features that might offer potential opportunities and therefore promote the inclusion of certain areas within preliminary corridors. The principal opportunities were associated with the potential to route parallel in close proximity (referred to as 'close parallel') to existing 400kV overhead lines, and thus restrict the geographic extent of environmental impacts associated with such infrastructure. Further discussion of the close parallel opportunity is provided in **Section 5.8**.

Table 5-1 – Data Gathering Features (Overhead Line)

Sub-topic	Feature Name	Buffer
Air Quality	Residential Properties	25m
	Education Establishments (such as schools and colleges)	
	Buildings (other than residential properties e.g., retail, industrial estates)	
	Air Quality Management Areas (AQMA)	
Aviation and Defence	Radar, Radio Navigation Beacon or Radio Sites	
	Ministry of Defence Low Flying Zone (only high priority and regular)	
	Licensed Airfields	500m (runway)
	Unlicensed Airfields with Buildings	
	Unlicensed Airstrips	
	Ministry of Defence Properties	500m (runway)
	Civil Aviation Authority Airports	4km (runway)
	Civil Aviation Authority Aerodromes	500m (runway)
	Military Airfield / Passenger Airport	4km (runway)
Ecology	Ancient Woodland (AW)	50m
	National Nature Reserves	
	Ramsar	500m and 2km
	Special Area of Conservation (SAC)	500m
	Special Protection Area (SPA)	500m and 2km
	Site of Special Scientific Interest (SSSI)	500m
	Local Nature Reserves (LNR)	
	National Forest Inventory Woodland	
	Important Bird Area	500m and 2km
	Priority Habitat Inventory	
	RSPB Reserves	250m
Economic Activity	Buildings (other than residential properties e.g., retail, industrial estates)	
	Aggregate and Mineral Resource Areas	

Sub-topic	Feature Name	Buffer
	Woodland / Forestry Operations	
	National Trust Inalienable Land	
	Wind Farms and Solar Farms	
	Planning Applications/Consents (only for NSIPs registered with the Planning Inspectorate)	
	Local Plan Allocations	
Geology and Soils	Geological Sites of Special Scientific Interest	
	Local Geodiversity Sites	
	Peaty Soils	
	Landfill Sites (historic and authorised)	
	Mines	25m
Historic Environment	Scheduled Monuments	250m
	Listed Buildings (Grade I, II and II*)	250m
	Registered Parks and Gardens	250m
	Conservation Areas	
	National Trust Inalienable Land	
Landscape and Visual	Area of Outstanding Natural Beauty (AONB)	2km
	Important Landscape Area (ILA)	
	Residential Properties	25m
	National Trails	
	National Cycle Network	
	National Trails	
	European Long-Distance Paths	
	Viewpoints	
	Recreational areas (e.g., country parks, Countryside and Rights of Way (CROW) access land)	
	Outdoor Recreational Facilities (e.g., canals, caravan parks, mountain bike centres)	
Noise and Vibration	Residential Properties	25m
	Education Establishments (e.g., Schools and Colleges)	
	Buildings (other than residential properties e.g., retail, industrial estates)	
Traffic and Transport	National Cycle Network	
	National Trails	
	European Long-Distance Paths	

Sub-topic	Feature Name	Buffer
	Rail Network (including Railway Stations)	
	Trunk Road Network	
Water	Statutory Main Rivers	
	Water Framework Directive (WFD) Surface Waters	
	Floodplains (including storage areas)	
	Groundwater Dependent Terrestrial Ecosystems	
	Groundwater Source Protection Zones – Inner/Zone 1	

Table 5-2 – Data Gathering Features (Undergrounding)

Sub-topic	Feature Name	Buffer
Air Quality	Residential Properties	25m
	Education Establishments (such as schools and colleges)	
	Buildings (other than residential properties e.g., retail, industrial estates)	
	Air Quality Management Areas (AQMA)	
Aviation and Defence	Radar, Radio Navigation Beacon or Radio Sites	
	Licensed Airfields	500m (runway)
	Unlicensed Airfields with Buildings	
	Unlicensed Airstrips	
	Ministry of Defence Properties	500m (runway)
	Civil Aviation Authority Airports	4km (runway)
	Civil Aviation Authority Aerodromes	500m (runway)
	Military Airfield / Passenger Airport	4km (runway)
Ecology	Ancient Woodland (AW)	50m
	National Nature Reserves	
	Ramsar	500m
	Special Area of Conservation (SAC)	500m
	Special Protection Area (SPA)	500m
	Site of Special Scientific Interest (SSSI)	500m
	Local Nature Reserves (LNR)	
	National Forest Inventory Woodland	
	Important Bird Area	500m
	Priority Habitat Inventory	
	RSPB Reserves	250m
Economic Activity	Buildings (other than residential properties e.g., retail, industrial estates)	
	Aggregate and Mineral Resource Areas	
	Woodland / Forestry Operations	
	National Trust Inalienable Land	
	Wind Farms and Solar Farms	
	Planning Applications/Consents (only for NSIPs registered with the Planning Inspectorate)	
	Local Plan Allocations	

Sub-topic	Feature Name	Buffer
Geology and Soils	Geological Sites of Special Scientific Interest	
	Local Geodiversity Sites	
	Peaty Soils	
	Landfill Sites (historic and authorised)	
	Mines	25m
Historic Environment	Scheduled Monuments	250m
	Listed Buildings (Grade I and II*)	250m
	Listed Buildings (Grade II)	
	Registered Parks and Gardens	
	Conservation Areas	
	National Trust Inalienable Land	
Landscape and Visual	Area of Outstanding Natural Beauty (AONB)	
	Important Landscape Area (ILA)	
	Residential Properties	25m
	Recreational areas (e.g., country parks, Countryside and Rights of Way (CROW) access land)	
	Outdoor Recreational Facilities (e.g., canals, caravan parks, mountain bike centres)	

Sub-topic	Feature Name	Buffer
Noise and Vibration	Residential properties	25m
	Education Establishments (e.g., Schools and Colleges)	
	Buildings (other than residential properties e.g., retail, industrial estates)	
Traffic and Transport	Rail Network (including Railway Stations)	
	Trunk Road Network	
Water	Statutory Main Rivers	
	Water Framework Directive (WFD) Surface Waters	
	Floodplains (including storage areas)	
	Groundwater Dependent Terrestrial Ecosystems	
	Groundwater Source Protection Zones – Inner/Zone 1	

5.4 Weight, Agree and Heat Map Features (Step 3)

5.4.1 Data gathered for features representing potential constraints to development was attributed a sensitivity weighting as described in **Chapter 4**. Sensitivity weightings were attributed by the relevant landscape and environmental specialist on the basis of professional judgement, considering relevant environmental legislation, policy and best practice. The data thus classified was then mapped onto 'heat maps' showing the relative importance of the different constraints and receptors. This assisted in providing a visual representation of the relevant constraints for the Project and informed the identification of early corridors.

5.4.2 The heat maps were then reviewed by the Project Team to ensure that the sensitivity weightings applied were appropriate in terms of their relative importance in decision-making for the type of development proposed, and to check whether there were features that were so extensive that they would affect all corridors and thus not help in distinguishing between options. Following this review a number of amendments were made for example removing Best Most Versatile[31] Agricultural Land from the heat maps as the entirety of the Study Area was covered by this feature and therefore it would not be a differentiating factor in the identification and appraisal of corridors.

5.4.3 The review also identified the need for a number of additional datasets for which data was collated into the GIS and added to the heat mapping. This included:

- Residential density, derived from OS AddressBase residential property data;
- Planning policy land allocations, set out in relevant development plans and digitised by GIS specialists; and
- Local airfields, data derived from OpenStreetMap and checked against aerial imagery.

5.4.4 The heat maps were reviewed again following these changes and approved for the identification of early corridors for both overhead lines and undergrounding. The heatmaps for each technology type for the Project are shown in **Figure 5-6** and **Figure 5-7**.

[31] 'Best Most Versatile' land, which is defined as Agricultural Land Classification (ALC) Grades 1, 2 and 3a agricultural land and is recognised as the most productive and versatile land. The ALC system for grading agricultural land quality is provided in England & Wales (MAFF 1988) – see Appendix 1.

Figure 5-6 – Heat Map (Overhead Lines)

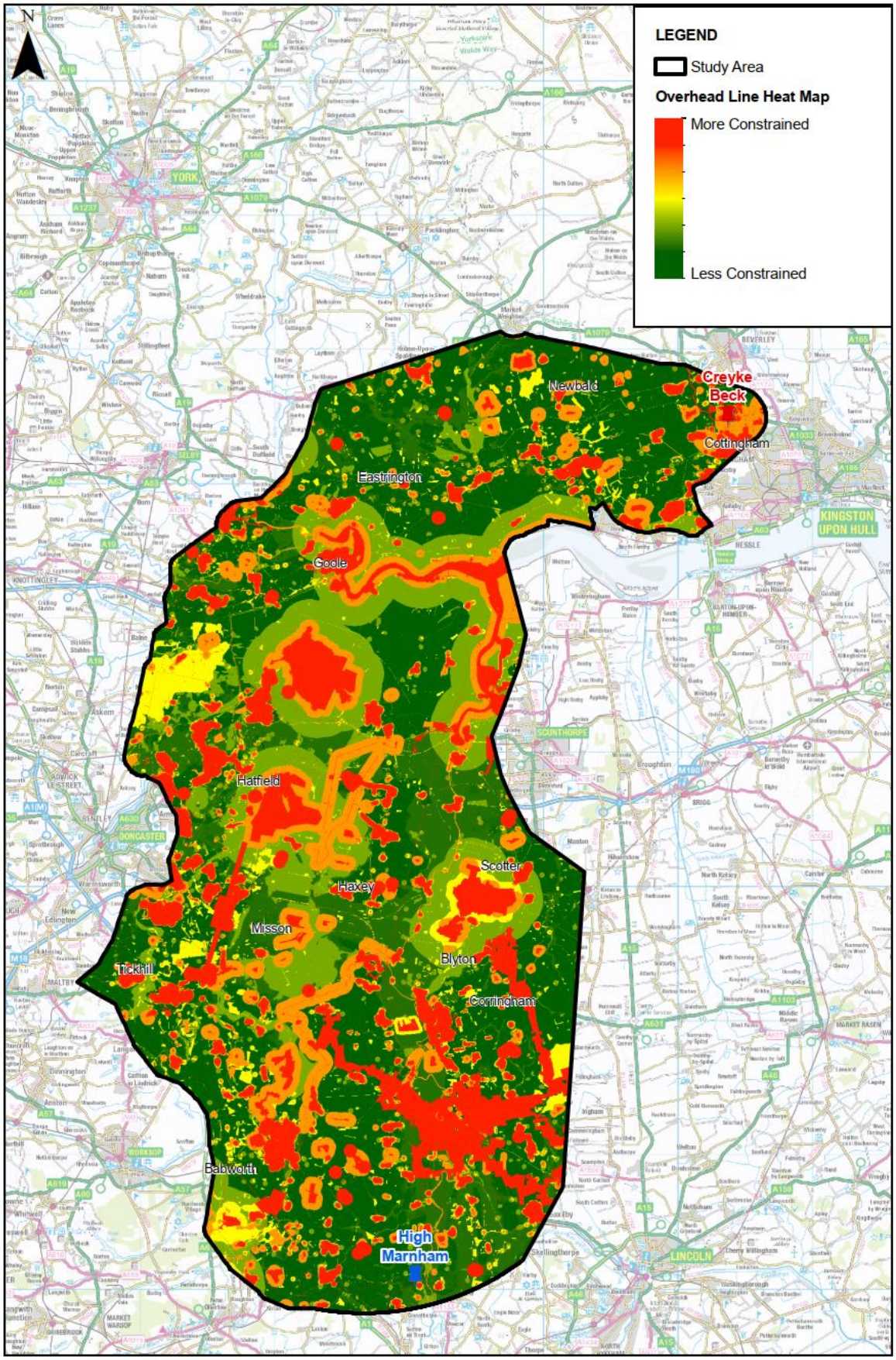


Figure 5-6 – Heat Map (Overhead Line)

SCALE:1:450,000 0 2.5 5 7.5 10 km

Figure 5-7 – Heat Map (Directly Buried Underground Cable)

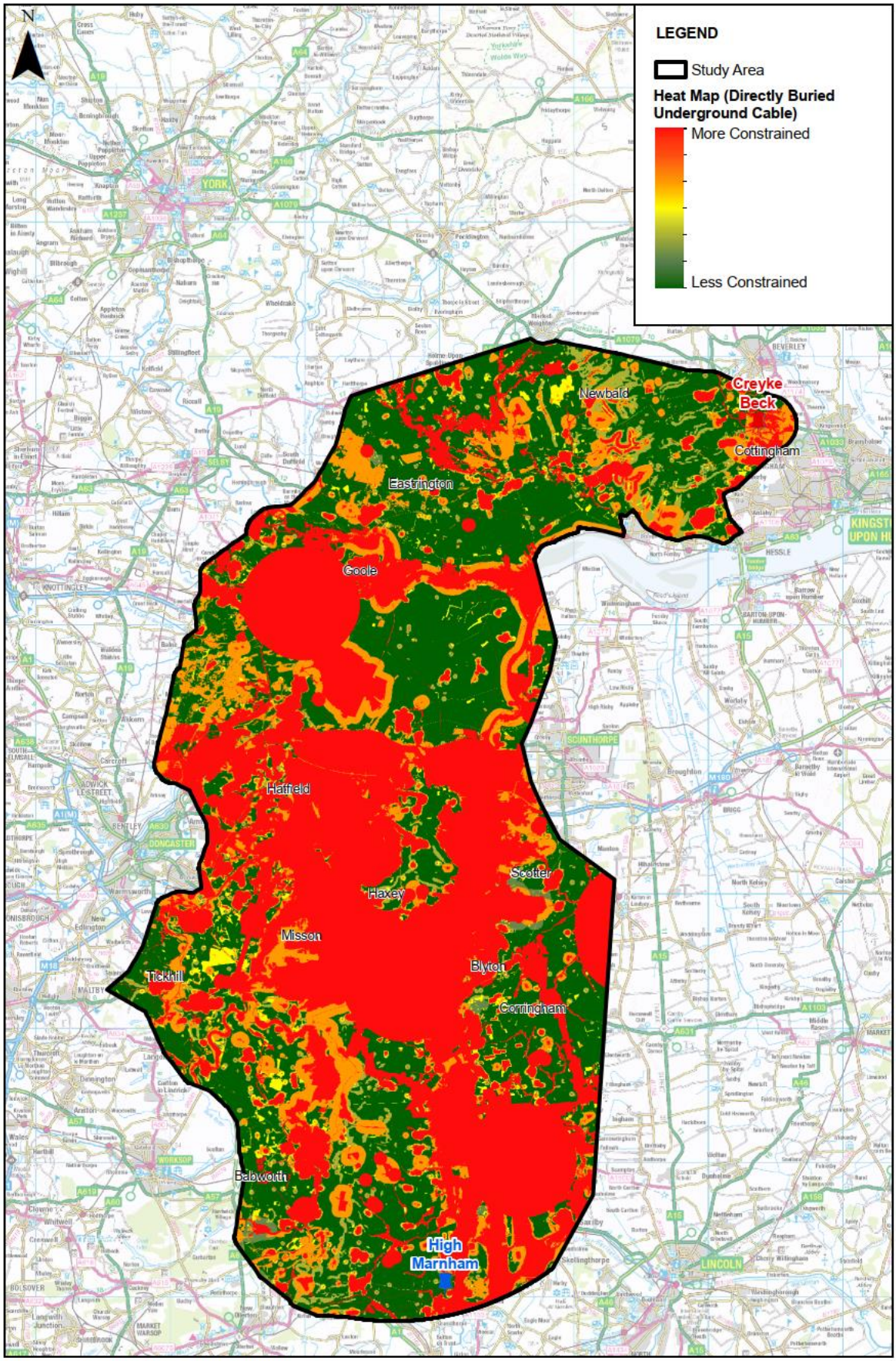


Figure 5-7 – Heat Map (Directly Buried Underground Cable)

5.5 Identifying and Defining Corridors (Steps 4 to 6)

5.5.1 Following the development of heat maps at Step 3, early corridors were developed between the potential start/end points by landscape specialists working with others as appropriate. The early corridors were identified by applying professional judgement, their knowledge of routeing considerations, in particular the Holford Rules. This was to ensure that the corridors identified were technically feasible whilst minimising the potential for adverse impacts on the environment, including elements and nuances that cannot be digitised (e.g. Holford Rules 3 to 7, see below).

5.5.2 The consideration of the Holford Rules in the development of the early corridors was led by landscape specialists because the underlying aim of the rules is, in effect, to guide the design of overhead lines to have the least possible landscape and visual impacts whilst avoiding important constraints. Rules 1 and 2 address the areas of high amenity (i.e. environmental constraints). Rule 1 applies at a broader scale, primarily in setting the overhead line Study Area. Rule 2 considers amenity areas at a smaller scale and therefore was the main driver in developing the heat maps and the GIS analysis, and critical in developing corridors. Rule 3 considers the impact of angle pylons and the visual impacts that may be caused by an overhead line with frequent changes of direction. Rules 4 and 5 consider ways to 'best fit' an overhead line in the landscape to reduce the degree to which it may be visible. Rule 6 considers wirescape and Rule 7 the approaches to urban areas.

5.5.3 As well as potential constraints to development, the mapping exercise also identified opportunities to promote the inclusion of certain areas within the corridors. The principal opportunities were associated with the potential to route parallel with and close to existing 400kV overhead lines (referred to as 'close parallel'), and thus restrict the geographic extent of environmental and socio-economic impacts associated with such infrastructure.

5.5.4 The GIS analysis using heat maps was used as a starting point to identify corridors that aimed to:

- Entirely avoid the largest areas of highest amenity and largest settlements;
- Avoid smaller areas of higher amenity and smaller clusters of houses as far as possible;
- Avoid smaller areas of technical constraint as far as possible;
- Allow for enough space to accommodate reasonable lengths of straight alignment at later stages of the Project, in accordance with Holford Rule 3;
- Be broad enough to allow for smaller areas of high amenity and residential properties within the corridor to be avoided at detail design stage;
- Likewise, be broad enough for constraints not apparent at this stage (i.e. information arising from non-statutory consultation, not currently known to NGET) to be avoided at detail design stage; and
- Provide options to connect from one corridor to another so that constrained sections of an otherwise suitable corridor can be bypassed.

5.5.5 The identified corridors were then subject to a back-check review and further analysis and review by the project team.

5.5.6 The review considered information gathered from the environment and technical site visits (ground-truthing key issues and pinch points identified during the desk studies) and further design and construction issues identified by the technical teams as part of this. Suggested amendments to the corridors were implemented where they were consistent with environmental considerations. One of the changes implemented was to cut out sections of corridors where there were clusters of residential properties. In addition, an exercise was undertaken to check the extent of potential constraints on both larger scale mapping and aerial photography. This led to a number of minor corridor boundary changes.

5.5.7 Four overhead line corridors were identified, as shown in **Figure 5-8**.

Figure 5-8 – Overhead Line Corridors

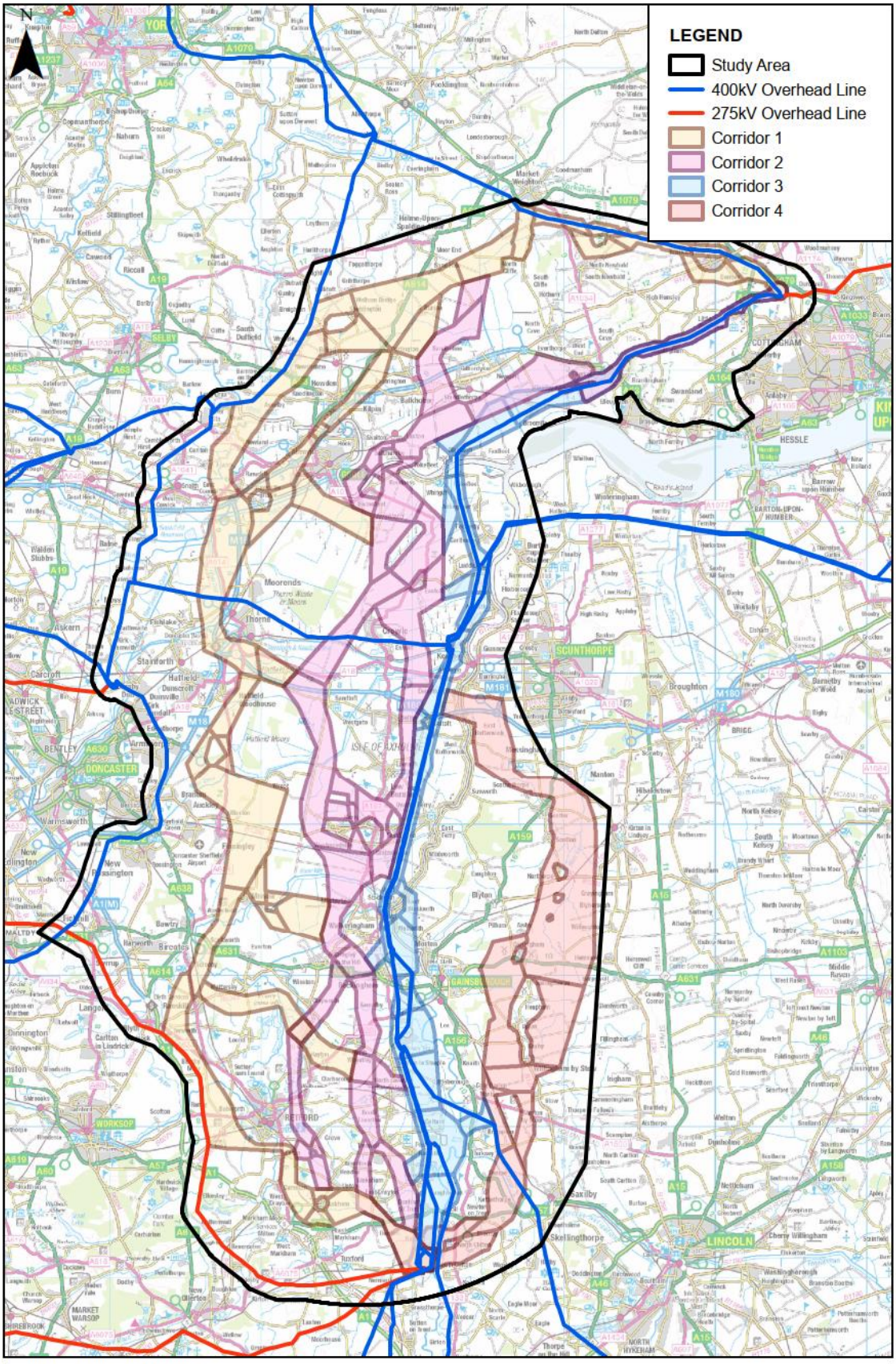


Figure 5-8 – Overhead Line Corridors

SCALE: 1:400,000

0 2.5 5 7.5 10 km

5.6 Mitigation of Impacts Through Avoidance

5.6.1 The Study Area and corridors are effectively the first two stages of an iterative process looking at features which represent constraints at a steadily smaller scale and finer grain. They were designed to comply with Holford Rules 1 and 2, avoiding the major areas of highest amenity value altogether, where practicable, and allowing room within the corridors to avoid smaller areas of high amenity value by local deviation. This approach seeks to minimise environmental impacts from the outset. The main constraints which influenced the formation of the corridors, and whether they have been avoided by this process, are listed in **Table 5-3**.

Table 5-3 – Major Features Representing Constraints within the Study Area

Topic	Name of Constraint	Avoided by Corridors?
Aviation and Defence	Sandtoft Airfield	Avoided
	Doncaster Sheffield Airport	Avoided
	Retford (Gamston) Airport	Avoided
Ecology	Sites of Special Scientific Interest (42 in total)	Avoided (33) Within one or more corridor – partially (9)
	Humber Estuary Ramsar site, SAC and SPA	Within one or more corridor – partially
	Thorne Moor SAC	Avoided
	Hatfield Moor SAC	Avoided
	Thorne and Hatfield Moors SPA	Avoided
Economic Activity	Wind Farms (9 in total)	Avoided (8) Within one or more corridor – partially (1 – Sober Hill Wind Farm)
	Drax Power Station	Avoided
	Goole Port	Avoided
	Solar Farms (14)	Avoided (10) Within one or more corridor – partially (4)
	Golf Courses (15)	Avoided (11) Within one or more corridor – partially (4)
	Nationally Significant Infrastructure Project (8)	Avoided (2) Within one or more corridor – partially (6)

Topic	Name of Constraint	Avoided by Corridors?
Historic Environment	Risby Hall Registered Park and Garden	Avoided
	Houghton Hall Registered Park and Garden	Avoided
	Babworth Hall Registered Park and Garden	Avoided
Landscape and Visual	Yorkshire Wolds ILA	Within one or more Corridor
	Major urban areas including Hull, Goole, Gainsborough and Retford	Avoided
Water	River Ouse	Within one or more Corridor
	River Trent	Within one or more Corridor
	River Humber	Avoided

5.6.2 For example, of the 42 SSSIs in the Study Area, 33 are avoided altogether by the corridors, whilst nine smaller ones are included where the size of the corridor will allow for them to be avoided in detailed design. Likewise, most areas of Ancient Woodland are avoided altogether, with smaller parcels only included where there is room for them to be avoided. The Thorne and Hatfield Moors designated sites are avoided altogether. The only exception the Humber Estuary designated sites, where one corridor was identified to entirely avoid them, whilst the others acknowledge that its geographical extent makes it difficult to avoid altogether. From a historical environment perspective, the majority of listed buildings and scheduled monuments were also avoided, and all Registered Parks and Gardens were avoided when defining the corridors. Each feature was considered on its own merits through the process of defining the corridors, including looking at the reasons for its designation and sensitivity to change, the wider context and value around the given site.

5.6.3 The landscape of the Study Area, with the exception of the Yorkshire Wolds ILA, is predominantly low-lying flat lands, under intensive agriculture, with smaller areas of gentle relief, meaning that landscape, and thus Holford Rules 4 and 5 (the consideration of tree and hill backdrops and seeking to follow moderately open valleys) have generally been less of a driver than is usually the case in overhead line routeing. In the Yorkshire Wolds ILA, the two overhead line corridors that cross the entire area provide close parallel opportunities following the existing 400kV overhead lines.

5.6.4 Major settlements such as Goole, Gainsborough and Retford, and smaller settlements such as Gilberdyke, Crowle and Haxey within the Study Area were avoided through the process of defining the corridors, either by routeing the corridor away from a settlement entirely or reducing the extent of the corridor, or where this is not possible, by cutting out a section of the corridor to exclude the settlements. A similar approach was taken for residential properties and recreational sites. This was primarily to mitigate potential visual impacts resulting from the Project.

5.6.5 Airports including Sandtoft Airfield, Doncaster Sheffield Airport and Retford (Gamston) Airport, were avoided when defining the corridors to mitigate against potential aviation

impacts associated with routeing in close proximity. Smaller airfields and aerodromes were also avoided where practicable.

5.7 Introduction to the Cost and Programme Model

NGET's Cost Estimates

5.7.1 Costs have been developed by NGET's cost estimating team using consistent assumptions such that route lengths are based on a route produced from a desktop exercise that is representative of the likely constraints to routeing. The costs of applying normal industry 'best practice' mitigation measures during construction and operation are inherent within the cost base used. Costs can therefore be compared on a consistent basis noting that they could be higher or lower, but consistent in relative terms. The scope of work for the new substations at Creyke Beck and High Marnham is identical for all corridor options and does not form part of the Project. The costs of this work has therefore not been included and is not a differentiator between options.

5.7.2 The costs included were estimated based on prices from the financial year 2020/21 and as such would need adjustment for inflation with time however provide a consistent cost point for comparison of options at this stage. Lifecyle costs of assets have been calculated and represent a cost for operation and maintenance and fault restoration over a 60-year lifecycle but do not account for electrical losses.

NGET's Programme Estimates

5.7.3 A logic linked activity schedule was built for each discipline based on a generic build process for overhead lines using assumptions such as pylon type, span length and pylon foundation type to standardise any unknown parameters, offering consistency across the corridors. Any variables determined by the corridors, such as construction discipline and corridor length were inputted to the schedule, producing estimates of construction duration and provision of an earliest operational date for each corridor.

5.8 Appraising 'Close Parallel' Opportunities

The Opportunity of a Close Parallel Alignment

5.8.1 In general terms, a close parallel route may have the potential to reduce the overall extent of environmental impacts arising from the Project by intensifying the degree of impact on receptors already affected by existing overhead lines, rather that spreading impacts to areas not currently affected.

5.8.2 Whilst the efficacy of close paralleling in reducing environmental impacts would be strongly influenced by local factors (e.g. topography, settlement pattern, woodland cover etc.), the optimum level of benefit is likely to result from lines that, as stated in Holford Rule 6, are planned with pylon types, spans and conductors forming a coherent appearance. In most circumstances, this is likely to be more achievable the closer the overhead lines are to each other, as local conditions would be likely to be similar for both overhead lines.

5.8.3 The minimum distance between lines is determined by technical and safety constraints and would typically be 80m. The maximum distance at which the benefits of close paralleling might be achieved depends on local factors which are described in more

detail below. Whilst this maximum cannot be precisely defined, it is considered to be unlikely to be more than approximately 200m in most circumstances.

Challenges with a Close Parallel Alignment

5.8.4 As mentioned above, the benefit of a close parallel alignment is realised when the pylon types, spans and conductors form a coherent appearance. This is difficult to achieve, as the appearance of the infrastructure can change depending on the direction and level it is being viewed from. It is not always feasible to site pylons adjacent to each other if there are constraints present alongside the existing pylon, and this can also result in an inconsistent span length and clearance level for the overhead line.

5.8.5 There are technical challenges associated with construction of a close parallel alignment, including difficulties with achieving the required offset from the existing overhead line and access where the existing overhead line is already within a constrained working area. In some locations, there will be a need to cross the existing overhead line where routeing is not continually viable on one side. In these circumstances, a line swap over, or cable duck-under would be required and it can be challenging to accommodate these within the existing infrastructure. For instance, existing overhead lines may need to be re-routed or require temporary diversions to accommodate a line swap over.

5.8.6 There are locations within the Study Area where there are already two lines running close parallel. In these locations, the separation between a new line and the existing would have to be greater than when running alongside a single line (to allow for maintenance access to the central line). This greater separation makes it more difficult to ensure that the arrangement of pylons, conductors and spans achieves a coherent appearance, and increases the risk of creating a wirescape.

Defining Close Parallel Alignment Opportunities

5.8.7 Close parallel alignment opportunities were defined through a five-phase process which is outlined below. The process is more detailed than, and differs from, that used to define the corridors because it required the identification of potential alignments to better understand the technical complexity, costs, viable areas and in-combination impacts.

Close Parallel Phase I

5.8.8 Existing overhead lines within the Study Area which would be suitable for close parallel were identified. These are 400kV overhead lines with pylons of a height and spacing that can likely be matched by the Project.

Close Parallel Phase II

5.8.9 300m by 300m squares were drawn along each suitable single overhead line, narrowed to 215m wide along pairs of overhead lines already in close parallel. An appraisal of each square was undertaken from an environmental and engineering perspective, appraising each square individually on its own merits.

5.8.10 The environmental and socio-economic considerations are shown in **Table 5-4** and the technical considerations shown in **Table 5-5**. These tables only include those constraints considered material in defining close parallel opportunities. Constraints present within the square were recorded and each square was allocated a red, amber

or green (RAG) rating dependent on the number, value or significance of constraints present, whether there was sufficient space for an overhead line considering the constraints present and whether an overhead line within the square would be policy compliant and adhere to the principles of the Holford Rules.

Table 5-4 – Close Parallel Alignment Opportunities – Environmental and Socio-economic Appraisal

Topic	Feature for Consideration
General	Residential (including individual properties) Commercial Recreational Receptors
	Humber Low Carbon Pipelines (HLCP) Project Preferred Route Corridor
	Existing and New Creyke Beck Substation
	Existing and New High Marnham Substation
Landscape and Visual	World Heritage Site
	Biosphere reserve
	National Trail
	National Park
	Important Landscape Area
Ecology	Special Area of Conservation
	Special Protection Area
	Site of Special Scientific Interest
	Ramsar
	National Nature Reserve
	Ancient Woodland
	Important Bird Areas
	RSPB Reserves
	Local Nature Reserve
Historic Environment	Scheduled Monument
	Conservation Area
	Listed Buildings
	Registered Parks and Gardens
	National Trust Properties

Topic	Feature for Consideration
	Registered Battlefields
Socio-economic	Wind Turbines
	Ministry of Defence Properties
	Airports
	Aerodromes
	Country Park
Geology and Soils	Historic Landfill Site
	Permitted Waste Sites
Water	Statutory Main River
	Groundwater Dependent Terrestrial Ecosystems

Table 5-5 – Close Parallel Alignment Opportunities – Technical Appraisal

Feature for Consideration
Available room for routeing (0 to 150m).
Major and complex crossings (e.g., railway lines, motorways, A-roads and large watercourses)
Existing Transmission Infrastructure: • The National Grid 275kV and 400kV overhead lines • The DNO 33kV, 66kV and 132kV overhead lines • Wind turbines
Encirclement of features (e.g., residential properties and work sites)
Environmental designations, planning allocations and new developments
Land Use (e.g., historic landfill site, active / disused power station sites)

Close Parallel Phase III

5.8.11 The RAG ratings from both an environmental and engineering perspective for each square were collated and reviewed through a series of workshops and an overall RAG rating was allocated to each square.

Close Parallel Phase IV

5.8.12 The red RAG rated squares were then removed from consideration of a potential close parallel alignment. The green and amber RAG rated squares were taken forward and used to define potential close parallel alignments. These were developed by both

environmental and engineering specialists to ensure that environmental and technical constraints, such as crossings of existing overhead line, were considered.

Close Parallel Phase V

5.8.13 Following the production of the potential close parallel alignments, these were reviewed from an environmental and engineering perspective, identifying similarities and differences between the two. They were then used to define the extent of a corridor which formed a continual close parallel alignment opportunity corridor following the existing 4ZQ, 4TM, ZDA and 4VE[32] 400kV overhead lines from Creyke Beck to High Marnham.

5.9 Next Step – Options Appraisal (Step 7)

5.9.1 As explained in **Chapter 4**, Options Appraisal (Step 7) is a structured process by which the environmental, socio-economic, technical, cost and programme implications are identified, reported and compared. It is tool to aid objective and justified decision making and it enables NGET to document in a transparent manner the information on which judgements have been based. Options Appraisal is therefore focussed on those sub-topics which assist in distinguishing between options.

5.9.2 For the environmental, socio-economic and technical issues the appraisal considers the potential impacts on relevant receptors, and whether such effects could be avoided or mitigated through careful routeing or siting. Where impacts cannot be avoided or mitigated by careful routeing other forms of mitigation have been considered in accordance with NGET's mitigation hierarchy as detailed in **Section 4.8**. The residual impacts considered in the Options Appraisal do not take account of project-specific environmental, socio-economic or technical mitigation measures which are likely to be included as part of the EIA process undertaken at the Defined Proposal and Statutory Consultation Stage (Stage 3).

5.9.3 The environmental, socio-economic and technical appraisals for the overhead line corridors are described in **Chapter 6** to **Chapter 9**, one chapter for each of the four corridors, with the cost and programme implications outlined in **Chapter 10**.

[32] The 4ZQ 400kV overhead line routes between Creyke Beck and Keadby; the 4TM and ZDA 400kV overhead lines route between Keadby and West Burton. The ZDA and 4VE 400kV overhead lines then continue on to High Marnham from Keadby, via Cottam.

6. Options Appraisal – Corridor 1

6. Options Appraisal – Corridor 1

6.1 Introduction

6.1.1 Corridor 1 begins to the north of Cottingham in the area around the existing Creyke Beck Substation and then routes in a north-westerly direction to the south of Market Weighton. From here, it routes in a south-easterly direction towards Barmby on the Marsh where it crosses the River Ouse. From the River Ouse, the corridor continues south passing the towns of Thorne, Bawtry and Retford before ending at the area around the existing High Marnham Power Station. The extent of the corridor is shown on **Figure 6-1**.

6.1.2 Corridor 1 is located furthest west and is the longest corridor of the options appraised. Constraints to note for this corridor include the Yorkshire Wolds Important Landscape Area (ILA); River Ouse crossing; Thorne and Hatfield Moors designated sites; Local Plan Allocations and proximity to Doncaster Sheffield Airport and Retford (Gamston) Airport. These constraints are shown on **Figure 6-2**.

6.1.3 The corridor was progressed primarily due to it providing an option to avoid crossing the sections of the River Ouse that are internationally designated for their bird interest (Humber Estuary designated sites). It was also recognised as potentially providing opportunities to close parallel existing overhead lines. The corridor provides three close parallel opportunities. The first is between Creyke Beck and Market Weighton alongside the existing 4ZR 400kV overhead line for approximately 17.5km, the second is between Spaldington and Barmby on the Marsh alongside the existing 4VC 400kV overhead line for approximately 8.5km, and the third is between Blyth and Retford alongside the existing XE 275kV overhead line for approximately 8km.

Figure 6-1 – Corridor 1

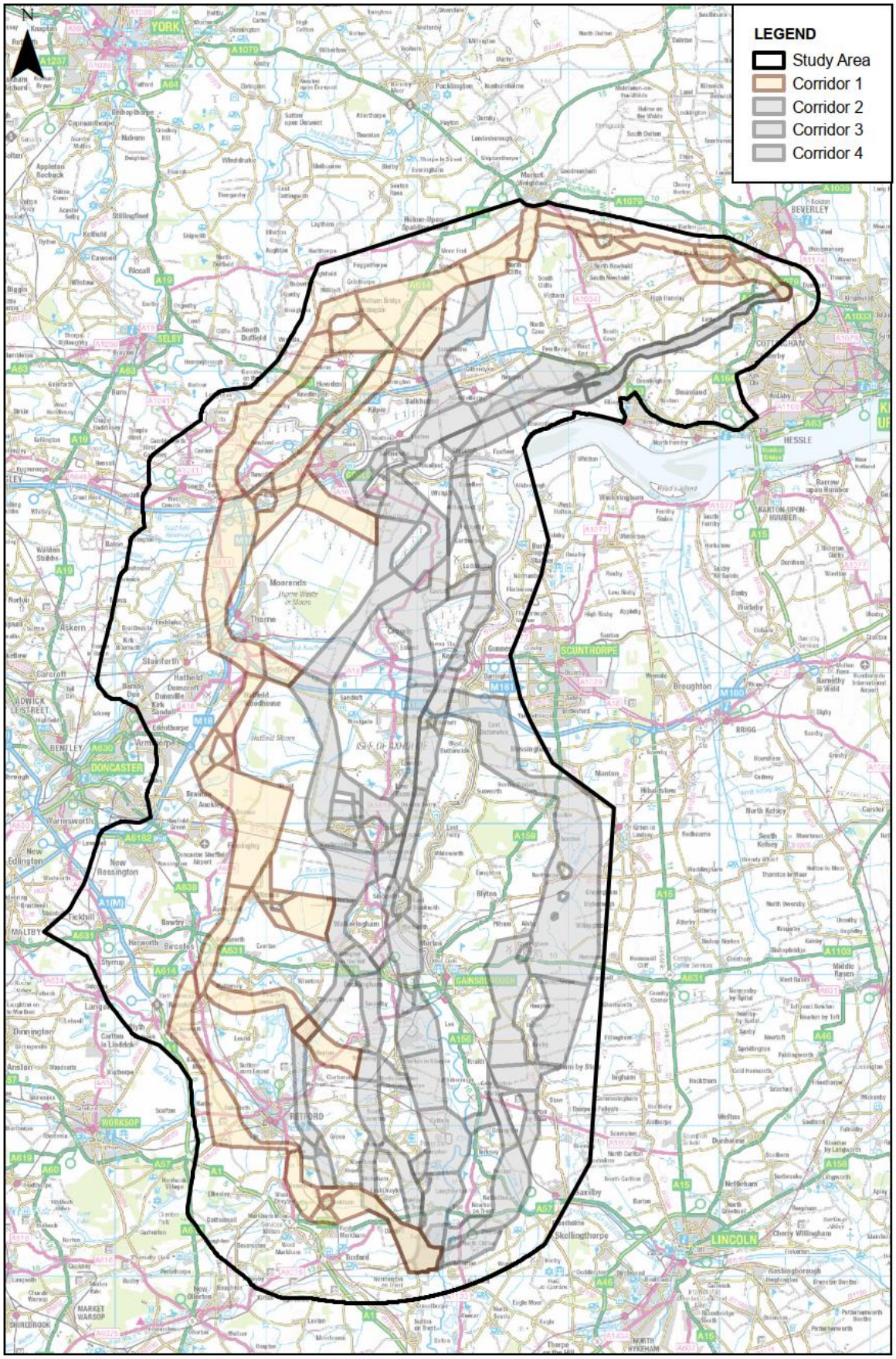


Figure 6-1 - Corridor 1

Figure 6-2 – Corridor 1 – Key Constraints

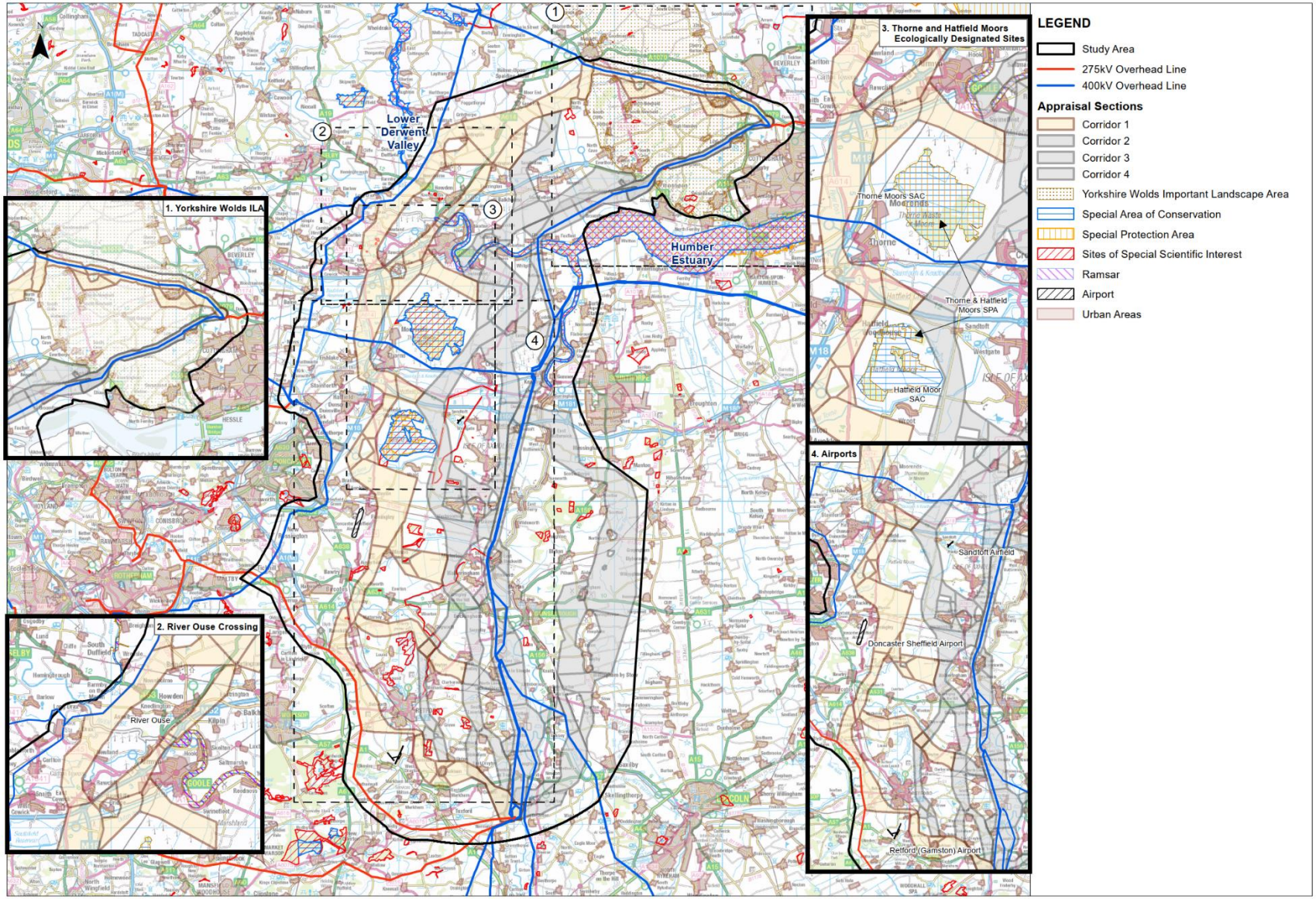


Figure 6-2 – Corridor 1 – Constraints

6.1.4 The majority of Corridor 1 comprises one complete corridor, however there are five locations where the corridor splits into two and routes either side of a cut-out to avoid a receptor and/or constraint. The five splits are:

- To the north and south of Walkington, to avoid the village (see WC1b(n) and (s), **Figure 6-1**);
- To avoid Sancton and Sober Hill Wind Farms (see WC1d(n) and (s), **Figure 6-3**);
- To the north and south of Spaldington, to avoid the village, linear woodland and Boothferry Golf Club (see C1c(n) and (s), **Figure 6-3**);
- To avoid Woodward Lakes and Lodges, Yorkshire Motor and Aqua Park, Yorkshire Aggregates and an area of ancient woodland (see C1g(w) and (e), **Figure 6-4**); and
- To the north and south of Askham, to avoid the village (see C1l(n) and (s), **Figure 6-4**).

6.1.5 In addition to the corridor itself, a Loop (C1-C1-Loop) has also been included leaving Corridor 1 to the west of Eastrington and routeing south to cross the River Ouse before joining back with Corridor 1 at Rawcliffe Bridge, as shown in **Figure 6-3** and **Figure 6-4**. This Loop was included to provide an alternative route along the M62 corridor, away from the ongoing development in the Drax Power Station area, the opportunity to close parallel the M62 crossing of the River Ouse and to provide an eastern connection point to Corridor 2 (described in **Chapter 7**).

6.1.6 The corridor also has six links which were included to provide flexibility in the routeing process and are as follows:

- Link 1 (C1-C2-Link1), which connections to Corridor 2 and is located to the west of North Cliffe;
- Link 2 (C1-C2-Link2), which connects to Corridor 2 and is located to the north of Eastrington;
- Link 3 (C1-C2-Link3), which connects the Loop to Corridor 2 and is located to the south of Goole;
- Link 4 (C1-C2-Link4), which connects to Corridor 2 and is located to the south-east of Thorne;
- Link 5 (C1-C2-Link5_a – c), which connects to Corridor 2 and is located to the north and east of Misson; and
- Link 6 (C1-C2-Link6_a – c), which connects to Corridor 2 and is located to the north of Ranskill, Lound and Clarborough.

6.1.7 The option of crossing the River Ouse with underground cables was considered and the likely environmental, technical and cost implications of this are summarised in **Appendix A**. The preliminary conclusions relating to the use of underground cables across the River Ouse are presented in **Section 11.4**.

6.2 Environmental Factors

6.2.1 All descriptions are given moving from north to south along the corridor (including the Loop and Links).

6.2.2 To aid the reader, this report separates the Options Appraisal for Corridor 1 into two geographical sections:

- Creyke Beck to the River Ouse, including the River Ouse crossing (see **Figure 6-3**); and
- South of the River Ouse to High Marnham (see **Figure 6-4**).

Figure 6-3 – Corridor 1 between Creyke Beck and the River Ouse

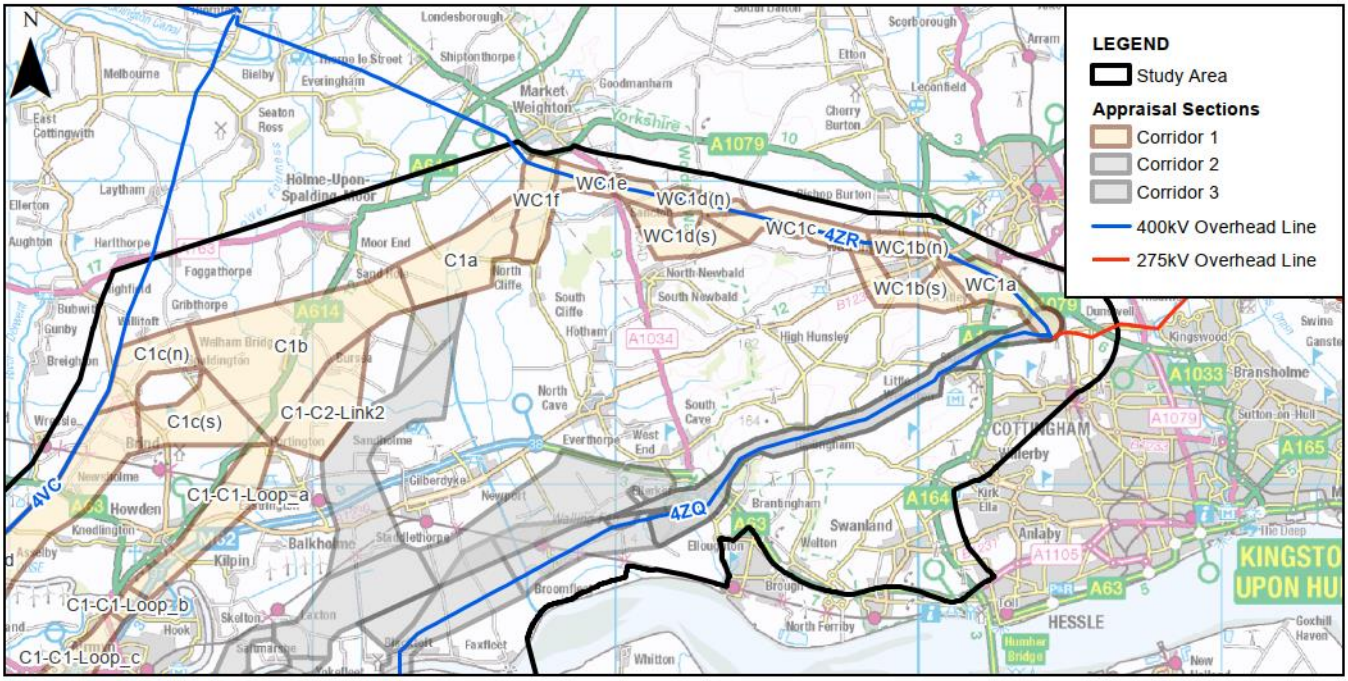


Figure 6-3 – Corridor 1 between Creyke Beck and the River Ouse

Figure 6-4 – Corridor 1 between the River Ouse and High Marnham

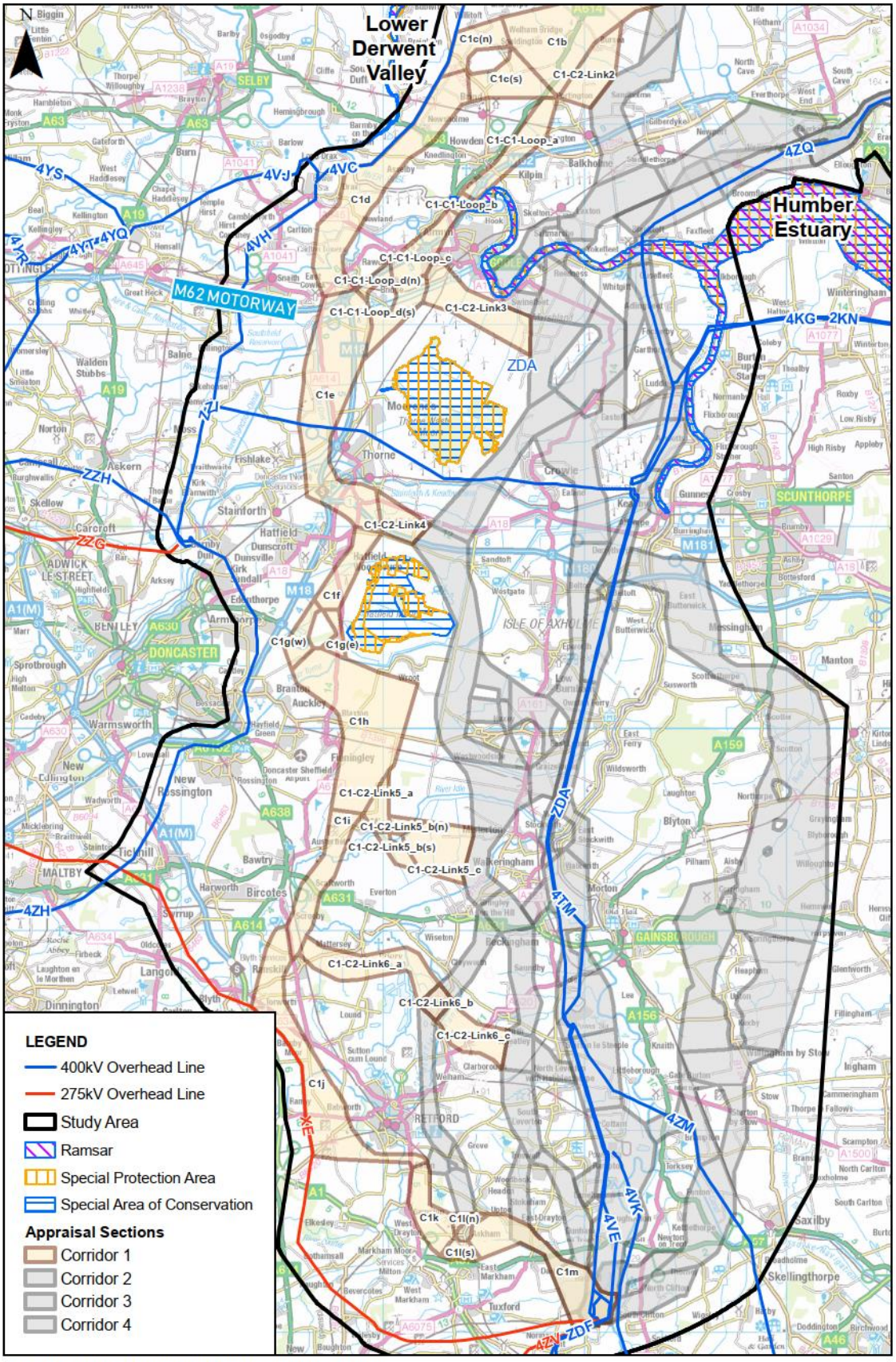


Figure 6-4 - Corridor 1 between the River Ouse and High Marnham

Creyke Beck to the River Ouse

6.2.3 The corridor follows the existing 4ZR 400kV overhead line north-west from Creyke Beck. Running close parallel to the existing overhead line, this would intensify existing adverse impacts on the landscape and on visual amenity. The A1079 to the north-west of Creyke Beck limits opportunities for routeing over the first few kilometres but also reduces sensitivity of the local landscape to receiving new infrastructure.

6.2.4 To the north-west of Creyke Beck, the A1079 meets the A164 which forms the eastern boundary of the Yorkshire Wolds ILA ('the Wolds'). The Wolds designation covers the corridor between the A164 in the east to the south of Market Weighton in the west and signifies that the landscape is valued at a regional level. The introduction of a new overhead line could be incongruous in the context of this valued landscape, however this potential is reduced due to the presence of the existing 400kV overhead line.

6.2.5 To the west of the A164, around Walkington, there is the potential for a new overhead line to affect views from the settlements of Walkington and Bentley, and from the edge of Beverley. Moving further west, the landscape becomes slightly more rolling with blocks of woodland. These woodland blocks may limit flexibility at Walkington Park and Risby Park, south of Walkington. Further west, a linear belt of woodland at Burton Rakes lies across most of the corridor. There are two windfarms on the crest of the Wolds, on Sancton and Newbald Wolds (Sober Hill and Sancton Wind Farms, respectively). A new overhead line is likely to give rise to landscape and visual impacts, when considered in combination with the wind farms and existing infrastructure. The Yorkshire Wolds Way, a national trail, crosses the corridor to the east of the windfarms and there is the potential for adverse impacts on views from the trail.

6.2.6 Between the windfarms and the village of Sancton and the A1034, the scarp slope is a more complex and sensitive landscape. This area, along with some of the southern part of the corridor west of Sancton (around Houghton Hall) is recognised in the Local Plan as being the area of highest landscape quality within the Wolds ILA designation. Blocks of woodland associated with Mask Hall limit flexibility for routeing to the west of the A1034. In the western part of the corridor there is the potential for adverse impacts on views from the settlement of Sancton and on views to and from the sensitive western scarp of the Wolds.

6.2.7 Beyond the Wolds, the corridor moves briefly through the Vale of York NCA into the Humberhead Levels NCA, characterised by flat, low-lying open landscape with long views. Moving south-westerly through the corridor, blocks of woodland are present which could be avoided through routeing and there is the potential for adverse impacts on views from scattered residential properties. The presence of Holme Industrial Estate and A614 which crosses the corridor reduces sensitivity of the local landscape to receiving new infrastructure in this area. The A614 continues into the Corridor 1 Loop where it connects with the M62. The sensitivity of the local landscape is reduced due to the presence of the M62, however there is the potential for adverse impacts on easterly views from Howden.

6.2.8 Further west lie the villages of Spaldington and Brind, and Boothferry Golf Club. There is the potential for adverse impacts on views experienced from these locations as well as from scattered residential properties. Linear strips of woodland south of Spaldington would be difficult to avoid. Spaldington Airfield Wind Farm is located to the west of Spaldington and a new overhead line could give rise to landscape and visual adverse impacts when considered in combination with the wind farm. The existing 4VC 400kV overhead line routes to the west of Spaldington and running close parallel to this would also likely intensify existing adverse impacts on the landscape and on visual amenity.

6.2.9 Continuing in a south-westerly direction from Spaldington to the River Ouse, the corridor follows the existing 4VC 400kV overhead line offering a close parallel opportunity. A new overhead line would likely intensify existing adverse impacts on the landscape and on visual amenity, including potentially on the Lower Derwent Valley and Pocklington Canal ILA, located approximately 700m to the west of the corridor at its closest point. There is also the potential for adverse impacts on views experienced by recreational receptors including users of the National Cycle Network (NCN), Trans Pennine Trail and the River Ouse.

River Ouse Crossing

6.2.10 The crossing of the River Ouse was identified as having potentially adverse impacts on landscape due to the potential requirement for tall river crossing pylons. The Loop which crosses the River Ouse to the east of Corridor 1 would also result in potential adverse landscape and visual impacts due to the anticipated presence of tall river crossing pylons. The latter crossing point would be more visible from residential properties in Howden, Booth, Airmyn and Goole.

South of the River Ouse to High Marnham

6.2.11 South of the River Ouse, Rusholme Wind Farm is located to the east of Drax and Corridor 1 and a new overhead line with tall river crossing pylons could give rise to adverse landscape and visual impacts, particularly when considered in combination with the wind farm. Rusholme Wind Farm is located to the west of the Loop but the presence of the M62, Rawcliffe Road Industrial Estate and commercial premises within the Loop reduces sensitivity of the local landscape to receiving new infrastructure in this area. However, there is the potential for adverse impacts on views experienced from Airmyn, Goole, Rawcliffe and Rawcliffe Bridge. Link 3 which connects to the Loop would also cause adverse impacts on residential properties (Old Goole) and users of nearby recreational routes.

6.2.12 South of Rawcliffe and the River Aire, the corridor continues through a largely open landscape. Within this landscape there is the potential for adverse impacts on landscape character, due to the distinctive field pattern with tree-lined boundaries which would be hard to avoid. To the west of Thorne, the corridor becomes more constrained reducing the flexibility for routeing and increasing the likelihood of visual impacts on residential settlements, isolated residential properties, and users of recreational sites including the Stainforth and Keadby Canal, Thorne Community Wood and Thorne Golf Club.

6.2.13 South of Thorne, there is the potential for adverse visual impacts on views from the village of Hatfield Woodhouse, and from recreational sites including Woodward Lakes and Lodges, the Yorkshire Motor and Aqua Park, and on visitors to the Humberhead Peatlands National Nature Reserve to the east of Armthorpe. These potential impacts are considered unavoidable given the limited flexibility for routeing within this section of Corridor 1.

6.2.14 To the north-east of Blaxton, Blaxton Common woodland covers a large swathe of the corridor and, together with the surrounding blocks of woodland would be difficult to avoid without the need for additional angle pylons. Moving south towards Bawtry, there is the potential for adverse impacts on views across the Idle Valley from scattered residential properties and from the settlements of Misson, Bawtry, Scaftworth and Scrooby.

6.2.15 To the north of Ranskill, Link 6 splits off from the corridor and the landscape begins to transition to higher ground and has potential to result in adverse visual impacts on residential settlements on lower ground, such as Hayton. Link 6 routes across the Chesterfield Canal and has the potential to have adverse impacts on recreational users.

6.2.16 Moving south from Ranskill, the corridor crosses the gently undulating landscape between the Ryton and Idle valleys, with the potential for adverse landscape impacts. There may also be visual impacts on views from scattered residential properties, settlements and recreational receptors, particularly between Blyth and Retford. The existing XE 275kV overhead line forms the western boundary of Corridor 1 between Blyth and Retford. Running close parallel to this would likely intensify existing impacts on the landscape and on visual amenity.

6.2.17 In the southern-most section of this corridor, the likely potential adverse landscape and visual impacts are concentrated to the west and south of Retford and to the north of the village of High Marnham. The landscape is slightly elevated to the west of Retford and there is extensive woodland within the corridor around the A620 which would be hard to avoid. To the south, the corridor crosses the Idle Valley between Retford and Eaton, with the potential for adverse landscape and visual impacts in this area. Beyond the Idle Valley, Corridor 1 would cut across an elevated ridge, near the village of Askham which would result in some unavoidable visual impacts on this settlement. Corridor 1 approaches High Marnham from a north-westerly direction, and the potential for adverse impacts has been identified in relation to the presence of a new overhead line in-combination with the six existing overhead lines routeing into High Marnham (two from the north and four from the south). This could intensify the presence of a wirescape in and around High Marnham.

Ecology

Creyke Beck to the River Ouse

6.2.18 There are no notable ecological constraints within Corridor 1 as it routes west from Creyke Beck. However, there are considerations to note including the two parcels of ancient woodland to the east and west of the A164, one of which is within the corridor (unnamed) and the other adjacent to the south (Birkhill Wood). Moving further west through the corridor, Little Wood ancient woodland is located approximately 510m to the south of the corridor and Newbald Becksies Site of Special Scientific Interest (SSSI) is located approximately 300m to the south. There is the potential for hydrological connectivity and direct and indirect adverse impacts on these sites if routeing within the southern extent of the corridor.

6.2.19 South Cliffe Common SSSI is located adjacent to the corridor to the west of North Cliffe and there is the potential for habitat connectivity with the corridor. Assuming careful routeing and siting of pylons, no adverse impacts are anticipated on this designated site.

6.2.20 Between Spaldington and Barmby on the Marsh, the corridor is located approximately 750m east of the River Derwent SAC and SSSI but is hydrologically linked to the corridor via the River Ouse. The qualifying features of the SAC include its populations of river lamprey, bullhead fish and otter. The corridor is also located approximately 1.5km east of the Lower Derwent Valley SAC, SPA and Ramsar site and Breighton Meadows SSSI at its closest point. The qualifying features of the SAC include the presence of lowland hay meadows, alluvial forests and otter. The qualifying features for the SPA include bewick's swan, Eurasian wigeon, Eurasian teal, Northern shoveler, European golden plover, ruff and waterbirds. The Ramsar site is designated due to the site's importance for several species of breeding waders, and nationally important numbers of breeding and wintering ducks and swans. There is the potential that the habitats present within the corridor support qualifying species of the designated sites and may be adversely impacted by the Project.

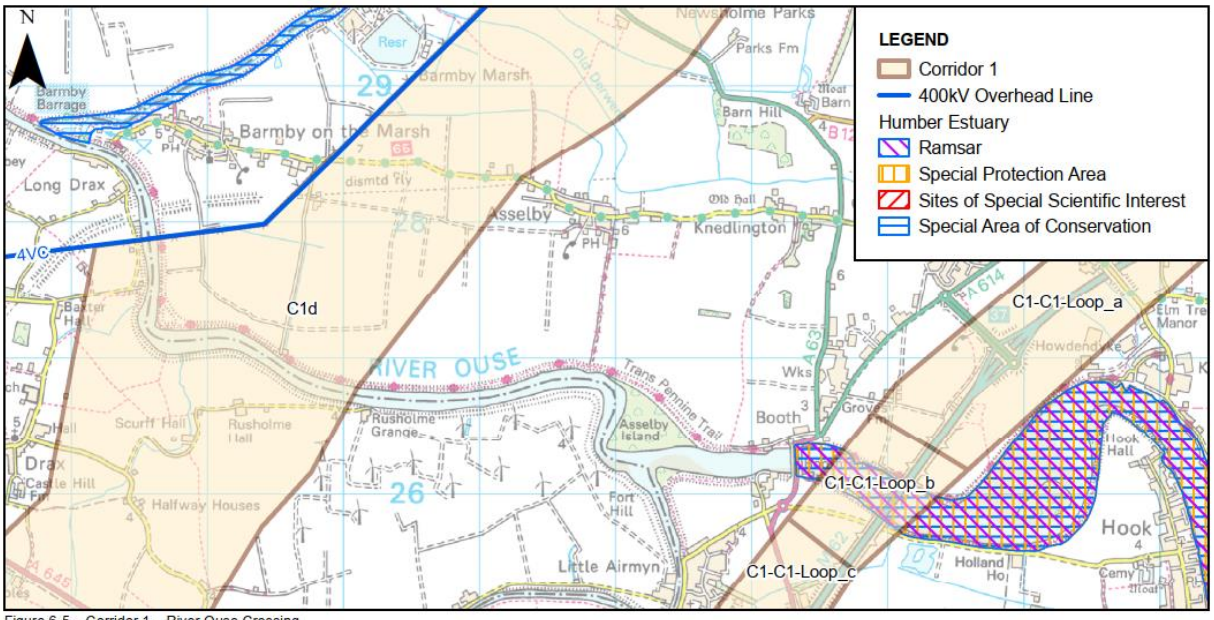
River Ouse Crossing

6.2.21 The most notable ecological constraint for Corridor 1 is the River Ouse, which is crossed by the corridor and the Loop, as shown on **Figure 6-5**.

6.2.22 Corridor 1 crosses the River Ouse to the north-east of Drax and the crossing is located outside of the Humber Estuary SAC, SPA, Ramsar and SSSI sites ('Humber Estuary designated sites') but is still hydrologically connected to them. An opportunity was identified to close parallel the existing 4VC 400kV overhead line through the corridor where practicable and across the River Ouse, thereby avoiding the introduction of a new overhead line into a stretch of river where an overhead line does not current exist. There are advantages associated with a close parallel option, including the grouping, rather than separation of infrastructure which may reduce the potential for adverse impacts on birds as their flightpaths would likely already avoid the existing infrastructure.

6.2.23 The Loop crosses the River Ouse further east than Corridor 1 at a wider point, to the north of Goole. The crossing is within the Humber Estuary designated sites, and to the west of the Blacktoft Sands RSPB Nature Reserve. The Humber Estuary designated sites are identified for their extensive wetland and coastal habitats and support migratory and wintering waterbirds in addition to breeding populations of bittern, marsh harrier, avocet and little tern. Blacktoft Sands supports similar bird species. The importance of the Humber Estuary designated sites poses a significant challenge to routeing and river bankside habitats would require assessment to determine whether they support qualifying species. There is also an opportunity to close parallel the M62 crossing of the River Ouse through the Loop, which would group infrastructure together and may reduce the potential for adverse impacts on birds as their flightpaths would likely already avoid the existing infrastructure.

Figure 6-5 – Corridor 1 – River Ouse Crossing



South of the River Ouse to High Marnham

6.2.24 As the Loop continues south of the River Ouse, the Humber Estuary designated sites remain a consideration due to the potential for habitats present within the Loop to support qualifying species of the designated sites and the hydrological connectivity between the Loop and the River Ouse. There is the potential for these species to experience indirect impacts through noise, light and vehicular disturbance during construction. In the southern extent of the Loop, there is also the potential for habitats present to support qualifying species of the Thorne and Hatfield Moors designated sites and NNR which is located approximately 1.5km south-east at its closest point.

6.2.25 Returning to Corridor 1, Eskamhorn Meadows SSSI is located within and adjacent to the corridor, to the east of Carlton. This site can be directly avoided through careful routeing but there is the potential for adverse impacts should the siting of pylons and construction access routes take place close to the SSSI. As the corridor continues south towards Thorne, it routes closer to the Thorne and Hatfield Moors SAC, SPA, SSSI ('designated sites') and NNR. The Thorne and Hatfield Moors SPA is primarily designated as an important habitat for supporting Nightjar populations of European Importance and the Thorne Moor SAC due to its significance as England's largest area of raised bog and Hatfield Moors SAC as England's second largest area of raised bog. The sites are also covered by the Humberhead Peatlands National Nature Reserve. The closest designation to the corridor is the Hatfield Moors SSSI which is adjacent to the central section of Corridor 1. There are also extensive areas of coastal and floodplain grazing marsh, deciduous woodland, mudflats and reedbeds priority habitat within and adjacent to the corridor within this area. There is the potential for direct and indirect impacts on this priority habitat as a result of pylon siting and construction access routes.

6.2.26 For the remainder of the corridor between Thorne and High Marnham, there are several ecological features which overlap, or are within, the corridor. This includes Buntings Wood Local Nature Reserve (LNR) which intersects the corridor to the west of Thorne, either side of the M18; two parcels of ancient woodland within the corridor to the north-

east of Branton; the River Idle Washlands SSSI intersects the corridor to the east of Bawtry and is hydrologically connected to the corridor; and Scooby Top Quarry is located within the corridor to the north of Ranskill. Chesterfield Canal SSSI also passes through Link 6 to the north of Hayton. Several ecological features including ancient woodland and SSSIs are also located adjacent to the corridor, Loop and Links 5 and 6 between Thorne and High Marnham. There is the potential for adverse impacts on these sites within, and adjacent to, the corridor, Loop and Links which could be minimised through careful siting of pylons and construction access routes.

Historic Environment

Creyke Beck to the River Ouse

6.2.27 Routeing east to west from Creyke Beck, the first notable considerations are Grade II Risby Hall Registered Park and Garden and Walkington Conservation Area, and their associated listed buildings and scheduled monuments. Views from these assets towards the corridor would need to be considered during routeing.

6.2.28 Moving further west from Walkington, there are no historic environment constraints within the corridor, but there is a cluster of scheduled monuments comprising prehistoric burial sites which lie adjacent to the north and south of the corridor. Given the prevalence of these within this area, there is a high potential for previously unrecorded buried remains relating to these assets to be found within this area. Further investigation would be required to confirm this.

6.2.29 To the west of Sancton lies Grade II Houghton Hall Registered Park and Garden, the northern and western tip of which lies within the corridor. Views from this site to the north towards the corridor would need to be considered during routeing.

6.2.30 Between North Cliffe and the River Ouse, there are a number of listed buildings within and adjacent to the corridor and Loop. It is anticipated that direct impacts on these historic assets can be avoided through careful routeing, due to their scattered nature.

South of the River Ouse to High Marnham

6.2.31 Scurff Hall Moated Site scheduled monument and a number of listed buildings are located within the corridor and Links between the River Ouse and High Marnham. It is anticipated that direct impacts on these historic assets can be avoided through careful routeing, due to their scattered nature.

6.2.32 A number of listed buildings, scheduled monuments, conservation areas and registered parks and gardens are also located adjacent to the corridor and Links, predominantly concentrated in and around residential settlements including Hatfield, Bawtry and Retford. Potential impacts on setting are likely to arise should the overhead line be developed where the corridor is closest to these settlements.

Socio-economics

Creyke Beck to the River Ouse

6.2.33 The A164 and A1079 route through the corridor to the north-west of Creyke Beck and a crossing of the A164 would be required. Crossings would also be required of the Yorkshire Wolds Way which routes north to south through the corridor to the north-east

of North Newbald and the A1034 to the north of Sancton. There may be potential adverse impacts relating to disruption during construction.

6.2.34 The predominant land use within the corridor and Loop is agricultural and the Project may result in the permanent loss of agricultural land, classed as high-quality. However, due to the substantial amount of agricultural land within the corridor, the potential land take required would be a small percentage of the overall area of agricultural land and is not considered a differentiating factor for routeing and siting of infrastructure.

6.2.35 A large number of applications for DCOs and planning applications occupy the land surrounding the existing Creyke Beck Substation including: the Hornsea P4 DCO Boundary, the Albanwise and Creyke Beck Solar Farms, the Dogger Bank Offshore Wind Farm Scheme, potential sites for the Continental Link Converter Station and the new Creyke Beck Substation. Within the remainder of the corridor there is also the proposed Hornsea P4 boundary, the proposed Eastern Green Link 2 (EGL2) development and the A164 Jock's Lodge Road Widening Scheme. Discussion and coordination with the developers may be necessary to ensure the new overhead line can be facilitated in combination with these proposed developments.

6.2.36 There are two wind turbines present within the corridor to the north-west of Creyke Beck and to the east of Sancton which may need to be removed as part of the Project. The wind turbines associated with Sancton and Sober Hill Wind Farms are also present to the north of North Newbald and would be avoided through careful routeing.

6.2.37 Two solar farms are located within the centre of the corridor, north and south of Welham Bridge, near Chapel Farm and Welham Bridge Farm. These would be avoided where practicable, through careful routeing and siting of pylons. A single wind turbine is also located to the north-west of Welham Bridge Farm which may need to be removed as part of the Project.

6.2.38 Continuing further south through the corridor, Holme Industrial Estate is partially within the corridor, Winfield Lakes fisheries is within the central section of the corridor and Boothferry Golf Course covers a large swathe of the corridor. There may be potential adverse impacts relating to disruption during construction. Where practicable, the overhead line and pylons would be routed and sited to avoid these sites, however land take from Boothferry Golf Course may be required. This is likely to be a small percentage of the overall site but may have potential adverse socio-economic impacts for users of the golf course.

6.2.39 The M62 intersects the Loop to the east of Howden and follows the Loop south to the west of Goole across the River Ouse. The M62 is centrally located for much of the Loop, limiting flexibility for routeing. For instance, to the south of Howden the M62 curves northwards towards the eastern boundary of the Loop and reduces the space available for constructing an overhead line. It is considered at least one crossing of the M62 would be required if an alignment using this Loop was selected. However, the M62 also presents a close parallel opportunity in places, particularly across the River Ouse as identified in the sections above. The A614 and railway line (Hull Line) would require a crossing. Routeing in proximity to these transport routes, is likely to result in temporary disruption to users and services during construction, however, this would not be the case during operation. Suitable clearance levels would be established for crossings of roads and the onward design of railway crossings would seek to avoid sections where there is a raised embankment present.

South of the River Ouse to High Marnham

6.2.40 To the south of the River Ouse, the motorway network remains a constraint as the M62 joins the M18 which then further south joins the M180. The corridor becomes particularly constrained to the west of Rawcliffe Bridge at the M62/M18 Langham Interchange and to the south of Thorne around the M18/M180 Junction. There are two large residential allocations designated as part of the Doncaster Local Plan[33] to the north and west of Thorne which partially intersect the corridor. The first (EMP04) is an employment site allocation to the north of Thorne and the second (MIX03) is a large-scale mixed-use development to the east of Stainforth. Kingswood Golf Centre and Thorne Golf Club are also present in this area and in combination with the motorway network and the two local plan allocations becomes a significantly constrained area of the corridor.

6.2.41 To the south of Hatfield Woodhouse lies Woodhouse Grange Fishery and Sunnybank Garden Centre which cover a large swathe of the corridor and constrain routeing within this area. Similarly, to the east of Armthorpe lies Yorkshire Aggregates, Yorkshire Motor and Aqua Park and Woodward Lakes and Lodges which cover a large swathe of the western portion of the corridor in this area and would limit routeing opportunities.

6.2.42 Several crossings of A-roads and railway lines are required throughout the corridor and Links. The majority of railway lines are not electrified; however, the electrified East Coast Main Line (ECML) crosses the corridor to the south-east of Scrooby and would require a crossing. These crossings may result in potential adverse impacts relating to disruption during construction.

6.2.43 The corridor then travels further south to the east of Doncaster before routeing east towards Blaxton. Doncaster Sheffield Airport is located to the west of the corridor, there is the potential for adverse impacts due to the distance (approximately 1.4km at its closest point) of the corridor boundary to the runway and the runways north-facing direction, towards the corridor. The corridor curves around Doncaster Sheffield Airport to the north and east. Routeing is also limited to the east of Blaxton due to Blaxton Common, Blaxton Aggregates and two fisheries which cover a large swathe of the corridor. Further south to the west of Misson, Misson Solar Farm, Tunnel Tech and the Idle Washlands cover a large swathe of the corridor and constrain routeing.

6.2.44 Moving further south down the corridor, a large housing allocation (HS13 – Ordsall South), designated in the Bassetlaw Local Plan[34] can be found to the south of Ordsall and covers the entire width of the corridor within this area. The presence of the large housing allocation would substantially limit opportunities for routeing within this area of Corridor 1, as shown on **Figure 6-6**. Retford (Gamston) Airport is also present to the south of Ordsall and there is the potential for adverse impacts due to the distance (approximately 900m at its closest point) of the corridor boundary to the north and east of the runway and the north-facing direction of the runway, towards part of the corridor.

6.2.45 The corridor also intersects with a number of proposed developments, including EGL2, the HLCP Project Preferred Route Corridor and the Drax Re-Power Project. Discussion and coordination with the developers may be necessary to ensure the new overhead line can be facilitated in combination with these proposed developments.

---

33 Doncaster Council (2021). Doncaster Local Plan 2015-2035 (Adopted September 2021).

34 Bassetlaw District Council (August 2021). Bassetlaw Local Plan 2020 – 2037.

Figure 6-6 – Corridor 1 – Ordsall South HS13 Local Plan Housing Allocation and Retford (Gamston) Airport

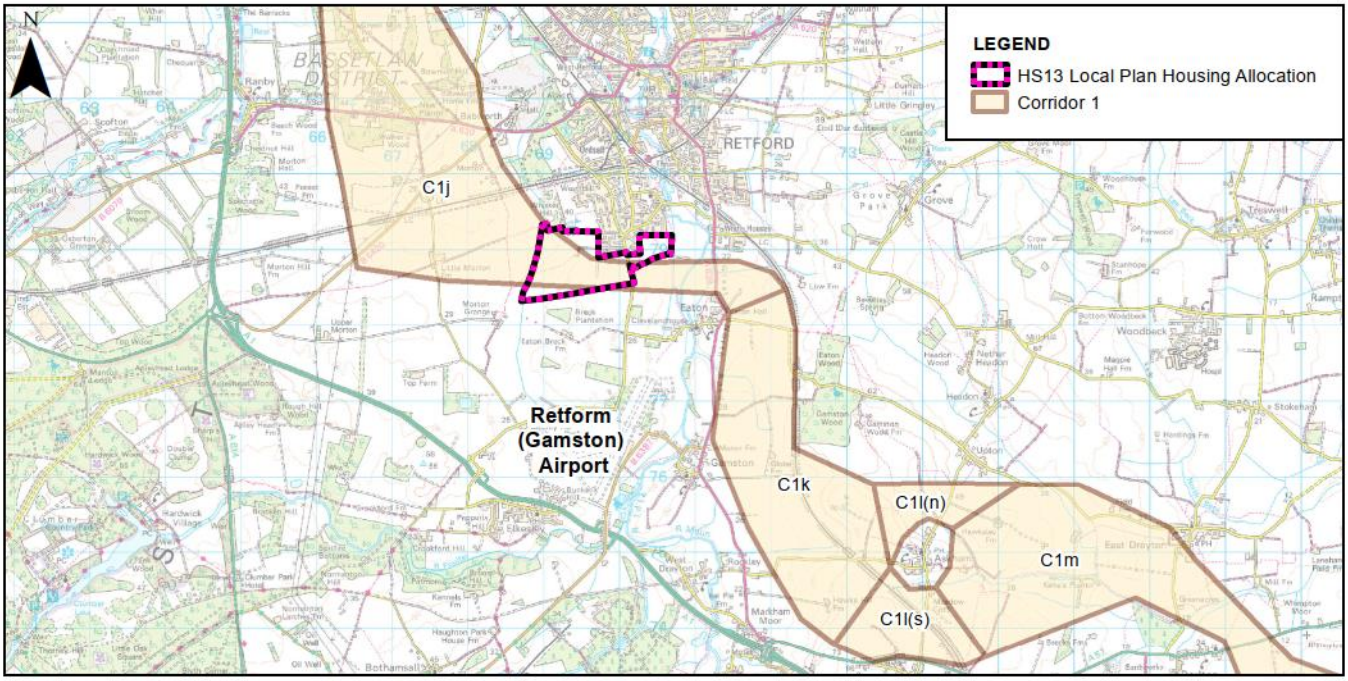


Figure 6-6 – Corridor 1 – Ordsall South HS13 Local Plan Housing Allocation and Retford (Gamston) Airport

SCALE: 1:100,000

Other Considerations

6.2.46 Other environmental topics were also considered as part of the options appraisal and include air quality, geology and soils, noise and water. These are summarised below for the entirety of Corridor 1 and associated Loop and Links.

6.2.47 There are scattered, sparsely distributed residential, commercial and agricultural properties throughout the corridor and there is a potential risk of temporary impacts limited to localised changes in air quality and noise and vibration during construction. There may also be localised changes in air quality and noise and vibration on settlements adjacent to the corridor during construction. No potential adverse air quality or noise and vibration impacts are anticipated during operation.

6.2.48 There are several historic landfill sites and permitted waste sites throughout the corridor which cover a small area and are considered avoidable due to their localised nature.

6.2.49 Peaty soils (within the topic of geology and soils) could potentially be adversely impacted, particularly within Links 5 and 6, where areas of peaty soils are unavoidable when siting pylons.

6.2.50 There are constraints associated with water, primarily due to the presence of the River Ouse and smaller watercourses, in combination with Flood Zone 2 and 3[35] which are present across the majority of the corridor. However, there are no constraints which are considered to have potential adverse impacts to the extent which they would prevent routeing.

[35] Flood Zone 2 is land with a high probability of flooding from rivers and/or the sea. Flood Zone 3 is land with a high probability of flooding from rivers and/or the sea.

6.3 Engineering and System Factors

Creyke Beck to the River Ouse

6.3.1 Overall, there are several constraints located throughout the corridor which are considered likely to reduce routeing flexibility and/or increase technical complexity of the corridor, which would also have associated construction and delivery impacts and potential network and capacity issues. Multiple DNO overhead line assets are also present throughout the corridor and may require mitigation.

6.3.2 Routeing west out of Creyke Beck, the initial section of Corridor 1 was deemed to be technically complex due to the large number of potential constraints within the corridor. The potential opportunity to route in parallel to the existing 4ZR 400kV overhead line was identified to the south and to the north of the existing overhead line in places. However, a large number of planning applications occupy the land surrounding the existing Creyke Beck Substation, as detailed above. Discussion and coordination with the developers may be necessary to ensure that routeing in parallel would be feasible, noting likely limitations to the positioning of infrastructure. Should routeing in parallel to the existing 4ZR 400kV overhead line be feasible, depending on the location of the new Creyke Beck Substation, a line swap over[36] may be required to facilitate a crossing of the existing overhead line to enable parallel routeing to the north or the south. This would carry significant technical risk through the introduction of possible construction and delivery issues as well as the potential for network and capacity issues. A graphic representation of a line swap over is shown in **Figure 2-4**.

6.3.3 From the new Creyke Beck Substation, routeing in parallel to the south of the existing 4ZR 400kV overhead line may require the removal of a wind turbine – subject to confirmation of the technical parameters of the turbine and the detailed design. Without removal of the turbine there is unlikely to be room within the corridor for routeing with sufficient stand-off. The A164 (including the Jocks Lodge Road Widening Scheme) would also have to be crossed and potentially a new raised roundabout above the A1079 may need to be navigated. Immediately prior to this road crossing, a high pressure gas pipeline would also need to be crossed which could increase the technical complexity. To the west of the A164, deviations away from close parallel to avoid the Butt Farm Caravan / Camp Site would require additional angle pylons which may increase the volume of construction materials required and increase the volume of construction traffic.

6.3.4 Routeing in parallel to the north of the existing 4ZR 400kV overhead line out of the new Creyke Beck Substation would also require a crossing of the A164 (including the Jocks Lodge Road Widening Scheme) and the high pressure gas pipeline. A crossing of the A1079 would also be necessary to facilitate parallel routeing to the north of the dual carriageway as there would be insufficient room for construction and maintenance if routeing to the south of the A1079 but remaining north of the existing 4ZR 400kV overhead line. A perpendicular crossing would require additional angle pylons potentially increasing the volume of construction materials required and increasing the volume of construction traffic. To the west of the A164, there is some technical risk associated with routeing through a pinch point between residential properties along Victoria Road whereby there may be limited space for routeing and construction. To the

[36] Consisting of the periodic swapping of positions of the conductors of a transmission line to improve transmission.

north-west of Victoria Road, the corridor does not extend to the north beyond the existing overhead lines position and as such an additional crossing of the A1079 would be required to remain within this corridor with a potential alignment.

6.3.5 At Broadgate (road) residential properties and the existing 4ZR 400kV overhead line significantly constrain the corridor. Routeing in parallel, with sufficient stand-off, to either the north or the south of the existing 4ZR 400kV overhead line is unlikely to be feasible through this pinch point. A realignment of the existing 4ZR 400kV overhead line between Victoria Road to the east and Mill Lane to the west would likely be required to increase the space available within the corridor for routeing and construction. This realignment would increase the technical complexity and carry additional cost and programme risk. Depending on whether routeing to the north or the south of the existing overhead line is preferred on the eastern and the western side of the pinch point, line swap overs may also be required to facilitate a crossing of the existing 4ZR 400kV overhead line. Infrastructure may be required within the Hornsea P4 DCO Boundary and there could be technical challenges with the reutilisation of existing structures, foundations, fittings and conductors as well as a potential requirement for additional outages. Should line swap overs be required, it would be necessary to have an even number of swap overs to ensure that the correct circuit and overhead line is terminated into the relevant substations. Alternatively, to navigate the pinch point and to facilitate a crossing of the existing 4ZR 400kV overhead line (if routeing to the northern side of the existing overhead line to the southeast of Broadgate) underground cabling with SECs could be utilised. This would significantly increase the technical complexity and risks associated with possible construction and delivery issues and the potential for network and capacity issues.

6.3.6 To the west of Broadgate and north of Walkington, continuation of routeing in parallel to either the north or the south of the existing 4ZR 400kV overhead line should be feasible, noting the possible requirement for additional angle pylons to deviate around localised residential properties on the southern side.

6.3.7 Corridor 1 also provides an alternative non-parallel routeing option around Walkington to the south whereby very few technical constraints were identified other than a crossing of the Hornsea P4 DCO Boundary and the potential need for routeing in parallel to the high pressure gas pipeline. Having routed around Walkington, a parallel alignment could be resumed to the south or to the north of the existing 4ZR 400kV overhead line however the latter would require a line swap over or underground cabling with SECs to cross the existing 4ZR 400kV overhead line.

6.3.8 To the north-west of Stoneknowle Hill, two wind farms occupy a significant proportion of the corridor both north and south of the existing 4ZR 400kV overhead line. Consequently, without the removal of at least one wind turbine, routeing close parallel to the existing overhead line is unlikely to be feasible. As part of Corridor 1, a southern split with very few technical constraints provides an opportunity for non-parallel routeing around the wind farms to the south. Should routeing have been in parallel to the north of the existing 4ZM 400kV overhead line prior to this point, then an underground cabling with SECs would be necessary to facilitate routeing into the southern split via a crossing of the existing 4ZM 400kV overhead line. This would further increase technical complexity as well as cost and programme risk.

6.3.9 To the north-west of Beverley Lane, again there is an opportunity to route in parallel to either the north or the south of the existing 4ZR 400kV overhead line. Routeing to the north may require line swap overs or two sets of underground cabling and SECs – one to cross the existing overhead line from the southern side should routeing around the

windfarms to the south be necessary, and another one to cross the existing overhead line from the northern side to enable continual routeing through Corridor 1. The resultant increase in technical risk and complexity associated with underground cabling and SECs could be avoided if routeing in parallel to the south as the existing overhead line would not need to be crossed. Irrespective of which side of the existing 4ZR 400kV overhead line the proposed new overhead line was to be routed, a crossing of the A1034 would be unavoidable, as would routeing through land associated with the proposed EGL2 development. This may limit the positioning of infrastructure. Additional angle pylons may be necessary to deviate away from close parallel around localised constraints (particularly on the southern side of the existing overhead line) which may result in increased volumes of construction materials required and increased volumes of construction traffic.

6.3.10 As aforementioned, Flood Zone 2 and 3 are present across the majority of the corridor, with approximately 50% of Corridor 1 lying within Flood Zone 3. This poses a risk to construction, delivery and maintenance of the overhead line, namely through potential waterlogging and possible access restrictions. Foundations would need to be designed to suit, as would temporary and permanent drainage mitigation and access provision.

6.3.11 North of the River Ouse towards Spaldington, the majority of Corridor 1 was deemed to be relatively unconstrained from a technical perspective. The proposed EGL2 development boundary traverses this section from north-west to south-east as does the A614. Crossings of the A614 and this proposed development boundary may be necessary. Two wind turbines situated north and north-east of Spaldington as well as Spaldington Golf Course located to the south are all likely to be avoidable through routeing. If routeing to the north of Spaldington, an oil pipeline crosses through the corridor which may limit the positioning of pylons.

6.3.12 South-east of Spaldington, two links (Link 1 and Link 2) with minimal technical constraints provide opportunity for routeing from Corridor 1 into Corridor 2. Crossing of an existing high pressure gas pipeline and the proposed EGL2 development may be necessary should Link 2 be utilised.

6.3.13 South-west of Spaldington towards the River Ouse, Corridor 1 becomes highly constrained and more technically complex, which presents potential for construction and delivery concerns. Throughout this section of the corridor, crossings of several major and minor roads, one railway line, existing high pressure gas pipelines and overhead DNO assets would be necessary which may limit the positioning of pylons and increase the volume of construction materials required and increase the volume of construction traffic.

6.3.14 Crossing of the River Ouse is likely to be technically complex due to the number of additional schemes present at this location including EGL2, the HLCP Project Preferred Route Corridor and the Drax Re-Power Project, as well as the requirement for a long span length over the River Ouse and likely tall river crossing pylons. high pressure gas pipelines traverse the corridor and converge into a gas site immediately north of the River Ouse. There may be an opportunity to route in close parallel to the existing 4VC 400kV overhead line on the western side of Corridor 1 from Spaldington across the River Ouse to Long Drax where the overhead line deviates away from Corridor 1. However, this route would require a longer length of overhead line in comparison to a non-close parallel route and would potentially require additional angle pylons to avoid the multiple aforementioned proposed developments that also occupy this part of the corridor.

6.3.15 The Loop to the east of Corridor 1 provides an alternative option for routeing between Spaldington to the River Ouse. The Loop is technically challenging. The M62 enters from the east and bisects the Loop from north to south. Due to the orientation of the M62, several crossings are likely to be necessary which would require multiple large angle pylons to facilitate perpendicular crossings. Sufficient separation between the motorway and the proposed overhead line would be required. There are also several complex junctions associated with this stretch of motorway that may have to be navigated on the western side, such as the A614 fly-over south of Howden. One railway line (Hull Line) would have to be crossed to the north of Howden. A crossing of the River Ouse within this Loop would likely require a long span length and tall river crossing pylons. Sufficient separation would be necessary between the proposed overhead line and the M62 which also crosses the River Ouse at this point.

South of the River Ouse to High Marnham

6.3.16 South of the River Ouse, Corridor 1 remains highly constrained and technically complex, which presents potential for construction and delivery concerns. The corridor requires crossings of several major and minor roads, one railway line, existing high pressure gas pipelines and overhead DNO assets which may limit the positioning of pylons and increase the volume of construction materials required and increase the volume of construction traffic.

6.3.17 The Loop to the south of the River Ouse also remains highly constrained and technically challenging. Routeing to the eastern side of the M62 is unlikely to be feasible as a significant proportion of the Loop to the west of Goole is occupied by the existing Rawcliffe Road Industrial Estate. Consequently, routeing would likely be required over the complex A614 junction on the western side of the M62 (including Glews Motorway Services) and across an existing oil pipeline. The Loop splits at Rawcliffe Bridge providing an option for routeing to the north or the south before re-joining into Corridor 1. Routeing to the east of Rawcliffe Bridge would also require crossing of a railway line (Wakefield and Goole Line) as well as the Aire and Calder Navigation and the Dutch River – all of which are orientated in parallel to one another which may increase technical complexity. Two high pressure gas pipelines and two oil pipelines would also have to be crossed which may limit the positioning of pylons. Traversing the HLCP Project Preferred Route Corridor would be required upon entry to the Loop. Sufficient stand-off distance may also be required from the Ministry of Defence (MoD) Establishment on the Loop boundary around Rawcliffe Bridge. Crossing of a high pressure gas pipeline would be required within the area around Rawcliffe Bridge which may limit the positioning of infrastructure.

6.3.18 Link 3 provides an opportunity for routeing from the Corridor 1 Loop into Corridor 2. The northern-most part of this Link is highly constrained by the presence of a Tesco Distribution Centre, the Breedon Concrete Plant, the A161, multiple railway lines, the Aire and Calder Navigation and the Dutch River. Therefore, routeing from the Loop into Link 3 would likely only be viable in its southern extent. Relatively few technical constraints were identified throughout the remainder of this Link, however a crossing of at least one railway line (Sheffield to Hull Line) is likely to be unavoidable and routeing through land associated with the HLCP Project Preferred Route Corridor may be required. Sufficient stand-off would be required from wind turbines within the Goole Fields Wind Farm to the south.

6.3.19 Upon routeing back into Corridor 1, perpendicular crossings of the M18, the Aire and Calder Navigation and the Dutch River may require additional angle pylons. Crossings of the River Aire, the Aire and Calder Navigation, the Dutch River and the River Don are

also necessary further south. The Aire and Calder Navigation and the Dutch River run in parallel to one another and the M62 Langham Interchange is situated immediately north of these watercourses meaning several complex crossings would likely be required in short succession. An oil pipeline also crosses the corridor at this location and the M18 continues south of the Langham Interchange. Depending on the detailed design, a crossing of the M18 may be avoidable when routeing within Corridor 1, however it would likely limit the positioning of infrastructure for the double watercourse crossing. Additional angle pylons may be required to facilitate a perpendicular crossing of the River Don and the A614 due to the orientation of these constraints and their parallel nature which may increase the technical complexity of the crossings.

6.3.20 North-west of Thorne, the existing ZDA 400kV overhead line crosses the corridor and a section of this would need to be undergrounded to allow the new line to cross it (approximately 1km, with SECs). Access to the facilitate the crossing is limited as there are a series of weight and width restrictions on the local road infrastructure crossing the River Don from the M18 to the east and south. A local plan employment allocation (EMP04) occupies the eastern portion of Corridor 1 between the M18 and the River Don potentially limiting feasible locations for the undergrounding. See **Figure 6-7**.

Figure 6-7 – Corridor 1 – Local Plan Employment Allocation (Thorne)

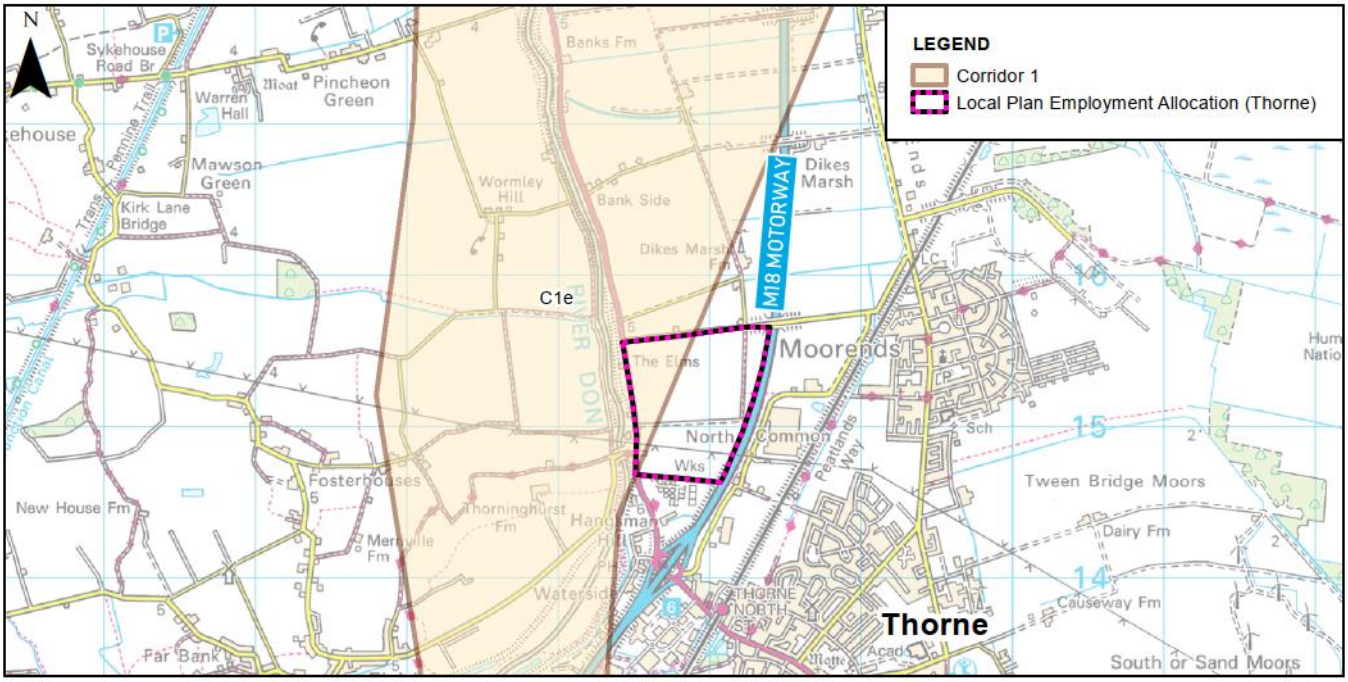


Figure 6-7 – Corridor 1 - Local Plan Employment Allocation (Thorne)

SCALE: 1:50,000

6.3.21 South of the existing ZDA 400kV overhead line crossing to the west of Thorne, Corridor 1 becomes highly constrained. Multiple potentially complex crossings may be required in short succession including the River Don, the Sheffield and South Yorkshire Navigation, two railway lines, the M18 and M180, the A614 and the A18 (including a roundabout). Additional angle pylons and potentially increased volumes of construction materials required and increased volumes of construction traffic may be required to facilitate perpendicular crossings. Routeing to the western side of the M18 may not be feasible as a large proportion of the corridor is occupied by a mixed-use local plan allocation (MIX03) as well as a potential spoil storage area (further investigations would be required to determine the exact land use and activity status of this area). However, routeing to the east is likely only to be feasible south of the Sheffield and South

Yorkshire Navigation due to the presence of Bunting Woods LNR and would likely require routeing through Kingswood and Thorne Golf Courses whilst also avoiding Meadow View Caravan Park and Pine Lake Fisheries. Several DNO overhead line assets also traverse the corridor at this point and would likely require mitigation such as removal, realignment or underground cabling. To the south-east of Thorne, Link 4 provides opportunity for routeing into Corridor 2. The A18 and the M180 motorway are present to the northern and southern edges respectively however crossings are likely to be avoidable and as such no significant technical risks were identified. An oil pipeline also enters the Link from the north but appears to terminate east of Cow Tree Bank.

6.3.22 South of Hatfield Woodhouse towards Misson, Corridor 1 becomes marginally less constrained. However, the presence of peaty soils is particularly notable in this portion of the corridor. Whilst their full extent and conditions are unknown, peaty soils pose a risk to pylon foundations, through ground subsidence and waterlogging. Should infrastructure be required within the peaty soils, there may be a requirement for geotechnical investigations, specific foundation designs and specialised accesses. South of Hatfield Woodhouse, the central portion of the corridor is occupied by Sunnybank Gardens, Dale Pitt Lakes, Woodhouse Grange Fishing Ponds, an Air Rifle Range, a water treatment works, Vulcan Renewables Anaerobic Digestion Plant, Redhouse Park Residential Area and the RAF 840 Signals Unit. Consequently, the available space for construction and the positioning of infrastructure is likely to be limited, and the utilisation of additional angle pylons to navigate these constraints may result in increased volumes of construction materials required and increased volumes of construction traffic. Furthermore, the A614 and the Hatfield Waste Drain traverse the corridor from south-east to north-west and south-west to north-east respectively, therefore further additional angle pylons are also likely to be required to facilitate perpendicular crossings.

6.3.23 Further south, Corridor 1 splits to the east and west of Great Gate ancient woodland. If routeing to the eastern side, the A614 bisects the corridor. Boston Park Farm occupies the majority of the available space for routeing to the west of the A-Road and consequently a road crossing is likely to be unavoidable. If routeing to the west, Woodward Lakes and Lodges, a caravan storage site and ‘Fat Cat’s Moto Parc’ (racetrack) occupy the corridor. Due to the adjacent nature and close proximity of these constraints, it is possible that oversail of at least one of the constraints may be required. Diggin Dyke also runs directly between these constraints and as such a crossing may be required and positioning of infrastructure may be further restricted. Additionally, marginally to the south, Armthorpe Quarry and a historic landfill site occupy the western corridor extent hence routeing would likely be confined to the east.

6.3.24 South of the Great Gate ancient woodland towards Misson, numerous commercial sites including CEMEX Doncaster Finningley Concrete Plant, Blaxton Aggregates, Bank End Quarry, Gravemaster Aggregate Suppliers and Hope Construction Materials as well as permitted waste sites, McCallums Fisheries and other waterbodies are present within Corridor 1. Oversailing or positioning infrastructure within these sites may be necessary which would introduce significant technical risk and complexity associated with the requirement for ground investigations as well as potential construction and access limitations due to the active status of these sites. Avoiding these sites would likely result in an increased route length as well as the positioning of infrastructure within the aforementioned peaty soils which has associated construction and access risks. Crossings of the River Torne, the A614, a railway line and multiple DNO overhead line assets would also be necessary within this area of the corridor. Furthermore, it should be noted that Doncaster Sheffield Airport is situated to the west of Corridor 1 which may impact proposed infrastructure and would be subject to further investigation.

6.3.25 To the north-east of Misson, Link 5 is relatively technically unconstrained and provides opportunity for routeing from Corridor 1 into Corridor 2. Due to their extensive nature, the positioning of infrastructure within peaty soils would likely be unavoidable if utilising this Link and consequently there would be some technical risk relating to foundation and access design. A crossing of the River Idle and multiple DNO overhead line assets would also be required.

6.3.26 Corridor 1 becomes technically complex to the south of Misson towards Eaton. Misson quarry, solar farms, the Tunnel Tech commercial farm and a local plan mixed-use allocation (MU4) occupy a large proportion of the available corridor to the west of Misson. Further investigation is likely required to determine the exact land use within this part of the corridor as some may also be associated with a disused quarry. Should any infrastructure be required within the used / disused quarry and excavation sites then this would warrant ground investigations and potentially increase technical complexity. Oversailing the waterbodies associated with the Idle Washlands on the eastern side of the corridor is unlikely to be feasible and as such additional angle pylons would likely be required to navigate the additional constraints to the west whereby there is likely to be minimal space for construction. This may result in increased volumes of construction materials required and increased volumes of construction traffic. Additionally, the Idle Washlands are situated in an area of Corridor 1 that is also highlighted as having peaty soils and as such a peat bog could be present. This could introduce technical risks surrounding infrastructure requirements and potential construction and access limitations.

6.3.27 South of these washlands and towards Morton, additional angle pylons are likely required to avoid scattered constraints including Scrooby Top Quarry, associated waste sites, Scrooby Top SSSI, Lodge Farm Fisheries, solar developments, a memorial park and a crematorium which may increase the volume of construction materials required and increase the volume of construction traffic. The potential requirement for additional angle pylons may be further exacerbated through facilitating perpendicular crossings of the River Idle, the Chesterfield Canal, multiple A-Roads (including the A631 dual carriageway) and the ECML. West of Torworth, towards Morton, a potential opportunity was identified to route in parallel to the existing XE 275kV overhead line however numerous deviations may be required to avoid the aforementioned constraints.

6.3.28 North-east of Ranskill, Link 6 provides opportunity for routeing from Corridor 1 into Corridor 2. Routeing is likely to be confined to the north and the south of the Link due to the presence of Clearwater Lakes Fishery, Mattersey Rifle and Pistol Club and an equestrian centre in the centre of the corridor. Crossings of the A620, the River Idle and Chesterfield Canal would be required however a large number of field drains were also identified within Link 6 which may limit the positioning of infrastructure and have associated construction and access risks. It is possible that infrastructure may be required within a historic landfill site which would necessitate ground investigations and therefore increase technical complexity. Furthermore, multiple DNO overhead line assets (including a 132kV overhead line) are likely to require mitigation and peaty soils are extensive throughout which may require specific foundation and access design due to potential risks with ground subsidence and waterlogging.

6.3.29 At Morton, routeing would likely be confined to the east of Corridor 1 due to the presence of HM Prison Ranby, a large solar development and a DNO Substation on the west. Multiple DNO overhead line assets associated with this Substation are also present and may require mitigation such as removal, realignment or underground cabling, including at least one 132kV overhead line. South of Ordsall, a local plan

allocation for housing (HS13) spans the full width of the corridor (as shown previously on **Figure 6-6**) and therefore limits opportunities for routeing at this location.

6.3.30 Between Eaton and High Marnham, Corridor 1 becomes less technically constrained. Although noting the presence of numerous low voltage DNO overhead line assets and the requirement for crossing of the ECML, watercourses and local A-Roads which may limit the positioning of infrastructure. Additionally, Darlton Gliding Club is situated approximately 1.5km from the boundary of Corridor 1 and may necessitate further investigation to determine any potential technical risks and constraints surrounding possible infrastructure in this area.

6.4 Holford Rules

6.4.1 Corridor 1 has been defined to exclude larger areas of the highest amenity value in accordance with Holford Rule 1. The Loop crosses the Humber Estuary designated sites and is therefore both less policy compliant than the main corridor and would conflict with Holford Rule 1, which seeks complete avoidance of nationally and internationally designated sites where possible.

6.4.2 Where there are smaller areas of high amenity value, for instance, SSSIs and Listed Buildings, sufficient space has been included within the corridor to enable routeing to avoid them, potentially by local deviation, in accordance with Holford Rule 2.

6.4.3 The corridor does deviate from the most direct route in places to avoid highly constrained areas, and specific constraints including settlements such as Walkington, Goole, Thorne, and Retford and areas of higher ground including to the west of Bawtry and south of East Markham (Holford Rule 4). The width of the corridor reflects the constraints in that area, with narrow sections where constraints are present such as in proximity to airports, and wide sections where the space is unconstrained such as in rural areas. The corridor includes more land than is needed for the construction of an overhead line which provides flexibility and options when it comes to routeing for further development in Stage 3. Although there are a large number of changes in direction due to the number of constraints, the flexibility provided within the corridor has the potential to reduce the need for sharp angles or changes in direction of the overhead line in accordance with Holford Rule 3.

6.4.4 Sections of Corridor 1 are bounded by the existing 4VC 400kV overhead line in the north and the existing XE 275kV overhead line in the south. The corridor also crosses the existing ZDA 400kV overhead line and several DNO 132kV overhead lines. Crossings of these existing 132kV overhead lines are unavoidable and potential adverse landscape and visual impacts may likely occur. This may be particularly intensified if a new overhead line is introduced, and it is not in close parallel with the existing overhead line. In these areas, there are likely to be properties and features between the overhead lines.

6.4.5 Apart from the sections considered for close parallel routeing, the majority of the corridor is separate from existing overhead lines. There are however two points where the corridor is sufficiently close to other lines that there is some risk of creating a wirescape. The first is at Drax where the western edge of the Corridor is less than 1.5km from the Power Station and its converging overhead lines. The second, and lesser risk, is to the east of Armthorpe where the western edge of the corridor appears to converge with the 4ZH 400kV line, coming is within 1.5km of it, for a short distance. In these locations, the corridor does not fully comply with the principles of Holford Rule 6, which seeks to avoid wirescape by keeping high voltage (400kV) overhead lines as

far as possible independent of converging routes. The approaches to High Marnham would inevitably and likely unavoidably add to the developing wirescape of this area.

6.5 Summary

6.5.1 Environmentally, there is the potential for a number of adverse impacts throughout Corridor 1 across the environmental and socio-economic topics considered. These are primarily in relation to landscape with potential adverse impacts on landscape character and visual with potential adverse impacts on residential properties and users of recreational sites. In addition to the introduction of an overhead line into the Wolds and particularly the high ground at the sensitive western edge of the Wolds. Potentially adverse ecological impacts were also identified where the Loop crosses the Humber Estuary designated sites. There may also be potential adverse impacts on historic environment assets in relation to views from registered parks and gardens and conservation areas. The southern section of Corridor 1 has potential adverse socio-economic impacts, relating to the proximity to Doncaster Sheffield Airport and Retford (Gamston) Airport and Local Plan allocations including the presence of the large housing allocation (HS13) to the south of Ordsall which would significantly limit opportunities for routeing.

6.5.2 A considerable proportion of Corridor 1 was deemed technically complex predominantly due to the high concentration of physical constraints present. Corridor 1 has a particularly high concentration of commercially active areas, including numerous quarries, aggregate sites and commercial holdings. These sites introduce risks associated with the requirement for ground investigations as well as potential construction and access issues should infrastructure be required within working sites. These risks are also exacerbated by the high potential for peaty soils to be present within the corridor which could give rise to foundation and access issues. Corridor 1 provides opportunity, in parts, for routeing in close parallel but may be particularly complex in places, for instance between Creyke Beck and Market Weighton due to the likely requirement for multiple line swap overs and /or underground cabling and SECs.

6.5.3 The River Ouse crossing is likely to be particularly technically complex due to the high concentration of additional development schemes and underground assets in the area which would likely limit the positioning of infrastructure. Moreover, a large number of angle pylons are likely to be required to navigate numerous crossings and clustered constraints throughout. This may result in increased volumes of construction materials required and increased volumes of construction traffic. Additionally, in parts of Corridor 1, notably south of Thorne and south of Hatfield Woodhouse routeing may not be feasible without the positioning of infrastructure within commercial / recreational areas. Flood Zone 2 and 3 are extensive throughout Corridor 1 and may pose a risk to construction, delivery and maintenance of the route, namely through potential waterlogging and possible access restrictions. Foundations would need to be designed to suit, as would temporary and permanent drainage and mitigation access routes.

6.5.4 A tabulated summary of the appraisal of Corridor 1 is provided in **Table 6-1**.

Table 6-1 – Summary of Corridor 1 Options Appraisal

Theme	Topic	Summary
Environmental	Landscape and Visual	• The routeing corridor and the presence of the existing 4ZR 400kV overhead line may in combination have adverse impacts on the landscape and on visual amenity through the Wolds. • Linear strips of woodland within the corridor would be hard to avoid. • The sensitivity of the local landscape within the corridor is reduced in places due to the presence of existing infrastructure such as energy development and the road and rail network. • There is potential for adverse impacts on views experienced by recreational receptors including users of the NCN, footpaths including the Trans Pennine Trail and along the River Ouse. • Scattered residential properties and settlements within and adjacent to the corridor may experience potential adverse visual impacts, particularly around the River Ouse due to the need for tall river crossing pylons.
	Ecology	• There is the potential for the corridor to have habitat connectivity and be hydrologically connected to designated sites including the Humber Estuary designated sites. The Loop crosses these sites and is the most notable ecological constraint for Corridor 1. • Several ecological sites including Buntings Wood Local Nature Reserve and Chesterfield Canal SSSI are located within the corridor and Link. Several ancient woodlands and SSSIs are located adjacent to the corridor, Loop and Links.
	Historic Environment	• Views from Registered Parks and Gardens and Conservation Areas would need to be considered during routeing, particularly where there is overlap with the corridor. • Several listed buildings and scheduled monuments are scattered throughout the corridor, and it is anticipated that these can be avoided through careful routeing. However, impacts on setting are likely to arise should the overhead line be developed where the corridor is closest to these heritage assets.
	Socio-economics	• There may be potential adverse impacts on the road network relating to disruption during construction.

Theme	Topic	Summary
		• The predominant land use within the corridor is agricultural and the Project may result in the permanent loss of agricultural land, classed as high-quality. However, the overall land take for the Project is considered to be a small percentage of the overall area of agricultural land. • Discussion and coordination with the developers associated with planning applications and applications for DCOs may be necessary to ensure the Project can be facilitated in combination with these proposed developments. • Doncaster Sheffield Airport and Retford (Gamston) Airport are located in proximity to the corridor and there is the potential for adverse impacts due to the marginal distance of the corridor boundary to the runway. • A large housing allocation covers the entire width of the corridor to the south of Ordsall and would substantially limit opportunities for routeing within this area.
	Other Considerations	• There is a potential risk of temporary impacts limited to localised changes in air quality and noise and vibration during construction. • Peaty soils could potentially be adversely impacted, particularly within Links 5 and 6 as they cover large swathes and are considered unavoidable when siting pylons.
Technical	Technical Complexity	• The presence of the existing National Grid 4ZR 400kV overhead line through the northern part of Corridor 1 gives potential for routeing in parallel to either the north or the south of this asset, in parts, between Creyke Beck and Market Weighton. • To navigate pinch points, facilitate crossings of the existing 4ZR 400kV overhead line and maximise close parallel routeing, multiple line swap overs and / or sections of underground cable with SECs may be necessary which could introduce network and capacity issues and added cost and programme risk. • An opportunity exists to route in close parallel to the existing National Grid 4VC 400kV overhead line from Spaldington, across the River Ouse to Long Drax – however, this would require a longer length of overhead line in comparison to a non-parallel route. • An opportunity exists to route in parallel to the existing National Grid XE 275kV overhead line west of Torworth towards Morton – however numerous deviations may be necessary to avoid constraints.

Theme	Topic	Summary
		• Multiple DNO overhead line assets may require mitigation which will need to be programmed in with the asset owner. • Northwest of Thorne, a section of the existing National Grid ZDA 400kV overhead line will need to be undergrounded to facilitate the proposed new overhead line – this would require underground cable, SECs and terminal pylons. The undergrounding location is limited by a local plan employment allocation between the M18 and the River Don (to the east).
	Construction and Delivery	• Coordination with developers will be required to ensure the proposed new overhead line can be facilitated in combination with the various developments located within Corridor 1 particularly around the Creyke Beck and the River Ouse. • Removal of wind turbines to the north-west of Creyke Beck Substation and the east of Sancton is likely to be required to ensure there is sufficient space for routeing the proposed new overhead line – subject to detailed design, the location of the new Creyke Beck Substation and confirmed turbine parameters. • Underground oil and high pressure gas pipelines may limit the positioning of pylons throughout the corridor. • Additional angle pylons may be required to enable deviations away from close parallel routeing around localised constraints. • Additional angles may be required to facilitate perpendicular road, rail and watercourse crossings, as well as to deviate around localised constraints, which could lead to increased volumes of construction traffic – technical complexity is further increased in certain areas due to multiple crossings in short succession. • Crossing of the River Ouse is likely to be particularly complex due to the likely requirement for a long span length and tall river crossing pylons, whilst also avoiding additional developments and assets in this area including the EGL2 development, the HLCP Project Preferred Route Corridor and the Drax Re-Power Project, as well as multiple high pressure gas pipelines and a gas site. • Routeing through the Loop to the east of Corridor 1 would require large angle pylons to facilitate several complex crossings of the M62 motorway and associated junctions.

Theme	Topic	Summary
		• Routeing through Kingswood and Thorne Golf Courses is likely to be required due to the highly constrained nature of the corridor to the southwest of Thorne. • Peaty soils are present at points throughout the corridor which may pose a risk to pylon foundations through ground subsidence and waterlogging. Geotechnical investigations, specific foundation designs and specialised accesses may be required in these areas. • Several quarries, aggregate sites and commercial holdings are present throughout the corridor which may lead to construction and access limitations and would necessitate ground investigations should infrastructure be required within working sites. • A local plan allocation for housing (HS13) spans the full width of the corridor south of Ordsall which severely limits opportunities for routeing. • Darlton Gliding Club is situated approximately 1.5km from the boundary of Corridor 1 – further investigation will be required to determine any technical risks and potential impacts on infrastructure associated with this land use. • Infrastructure is likely to be required within flood zones which could pose a risk to construction and maintenance – specific foundations, drainage and mitigation access routes would need to be designed to suit.

7. Options Appraisal – Corridor 2

7. Options Appraisal – Corridor 2

7.1 Introduction

7.1.1 Corridor 2 begins with a northern and southern option. The northern option begins to the west of South Cliffe, using Corridor 1 to route between Creyke Beck and Link 1 and the southern option begins to the west of South Cave, using Corridor 3 to route between Creyke Beck and South Cave. From Link 1, the corridor routes south and west around Gilberdyke and from Corridor 3, the corridor routes in a westerly direction to the north of Broomfleet. Both the northern and southern options merge at Bellasize and the corridor then routes south-west towards the River Ouse. Corridor 2 provides three separate crossing opportunities for the River Ouse to the east and west of Swinefleet and Saltmarshe. South of the River Ouse, Corridor 2 continues south passing settlements such as Crowle, Epworth and Sturton le Steeple before ending at the area around the existing High Marnham Power Station. The extent of the corridor is shown on **Figure 7-1**.

7.1.2 Key constraints to note for this corridor include the Yorkshire Wolds Important Landscape Area (ILA); River Ouse crossing; River Ouse and Thorne and Hatfield Moors designated sites; Isle of Axholme Area of Special Historic Landscape Interest; and proximity to several wind farms. There are shown on **Figure 7-2**.

Figure 7-1 – Corridor 2

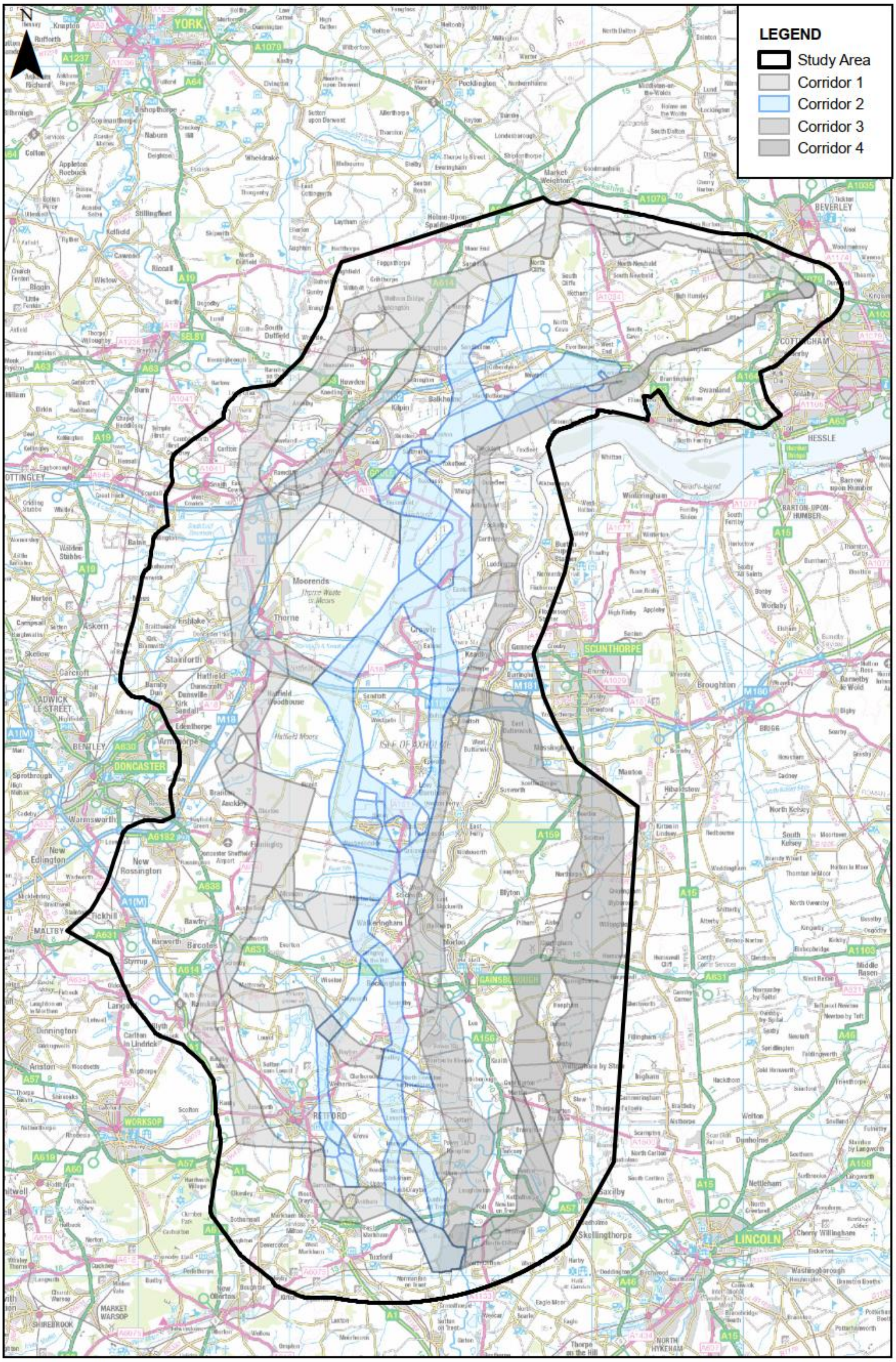


Figure 7-1 – Corridor 2

SCALE: 1:400,000

Figure 7-2 – Corridor 2 – Key Constraints

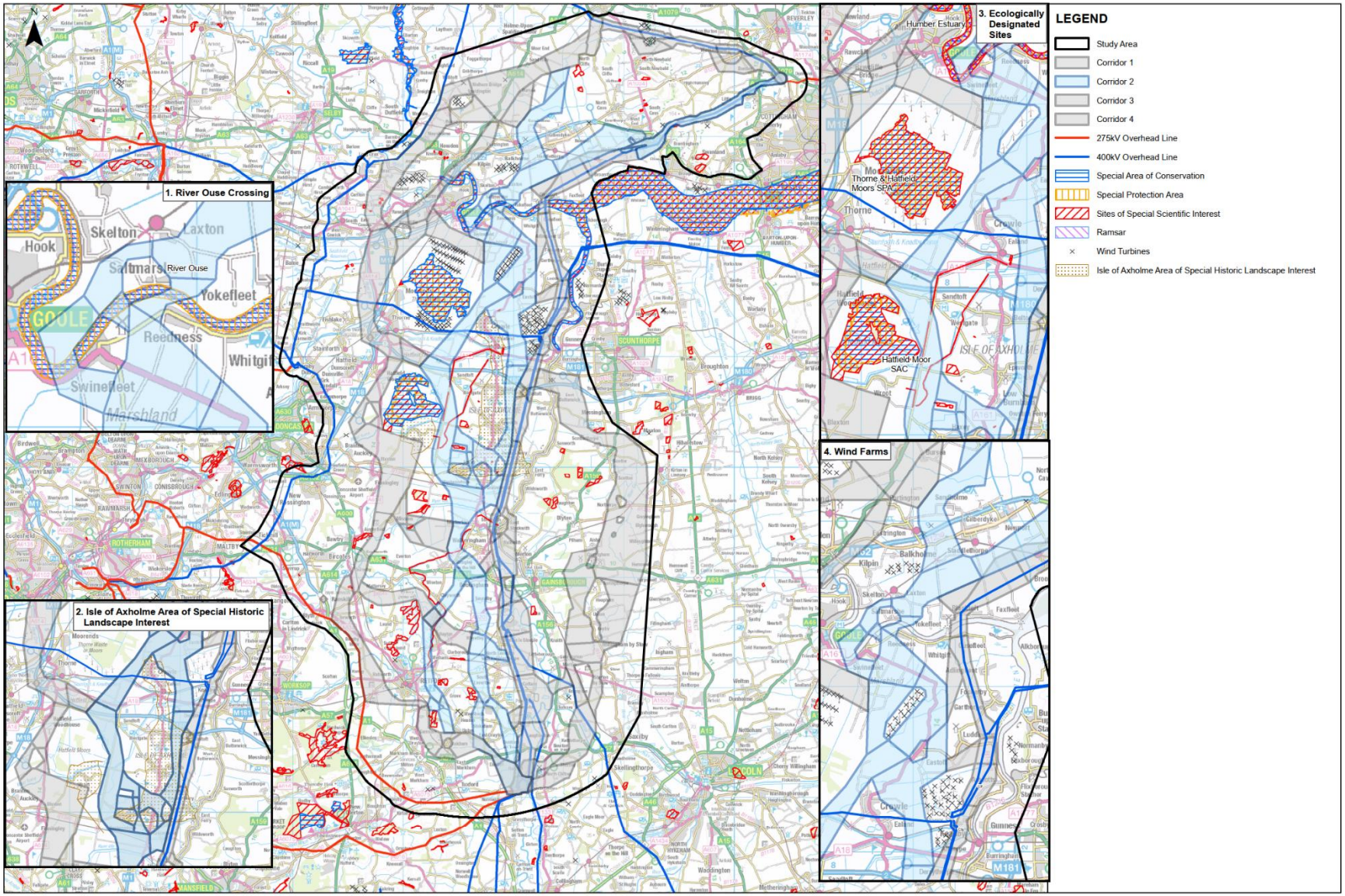


Figure 7-2 – Corridor 2 – Constraints

7.1.3 The corridor was identified primarily due to having several crossing opportunities across the River Ouse and the relatively straight linear nature of the corridor between the River Ouse and High Marnham. The majority of Corridor 2 comprises one complete corridor, however there are six locations where the corridor splits into two and routes either side of a cut-out to provide opportunities to avoid a receptor and/or constraint. The six splits are:

- To the east and west of Saltmarshe, to avoid the settlement (see C2c(w) and (e), **Figure 7-3**);
- To the east and west of Swinefleet, to avoid the settlement (see C2e(w) and (e), **Figure 7-3**);
- To avoid the wind farm to the north-west of Eastoft (see C2f(w) and (e), **Figure 7-4**);
- To avoid woodland to the north of Upperthorpe (see C2h(w) and (e), **Figure 7-4**);
- To the east and west of Westwoodside and Upperthorpe, to avoid the settlements (see C2i(w) and (e), **Figure 7-4**); and
- To avoid Rampton Secure Hospital and the residential areas of Stokeham and East Drayton, and a scheduled monument (Whimpton Moor medieval village and moated site), (see C2p(w) and (e), **Figure 7-1** and **Figure 7-4**).

7.1.4 In addition to the corridor itself, a Loop (C2-C3-Loop) has also been included leaving Corridor 2 to the east of Eastoft and routeing south before joining back with Corridor 2 south of Graizelound. This Loop was included to provide an alternative route along the A161 corridor, away from the Thorne and Hatfield Moors designated sites and due to the potential for adverse impacts on landscape character due to the higher ground within the locally designated landscape. The Loop contains three locations where the corridor splits into two and routes either side of a cut-out to provide opportunities to avoid a constraint. The three splits are located to the north and south of Eastoft, Haxey, Graizelond and East Lound. The first two splits in the Eastoft, Haxey, Graizelond areas, were introduced to avoid residential settlements; the third split to allow avoidance of Haxey Airfield. There were also two Links Connecting Corridor 2 and Corridor 1, and one link connecting Corridor 2 and Corridor 3, which were included to provide flexibility in the routeing process.

7.2 Environmental Factors

7.2.1 All descriptions are given moving from north to south along the corridor (including the Loop and Links).

7.2.2 The Options Appraisal undertaken for the section of corridor between Creyke Beck and South Cliffe/South Cave is presented in **Chapter 6**. To aid the reader, this report separates the Options Appraisal for Corridor 2 into two geographical sections:

- South Cliffe/South Cave to the River Ouse, including the River Ouse crossing (see **Figure 7-3**); and
- South of the River Ouse to High Marnham (see **Figure 7-4**).

7.2.3 The option of crossing the River Ouse with underground cables was considered and the likely environmental, technical and cost implications of this are summarised in **Appendix A**. The preliminary conclusions relating to the use of underground cables across the River Ouse are presented in **Section 11.4**.

Figure 7-3 – Corridor 2 between South Cliffe/South Cave and the River Ouse

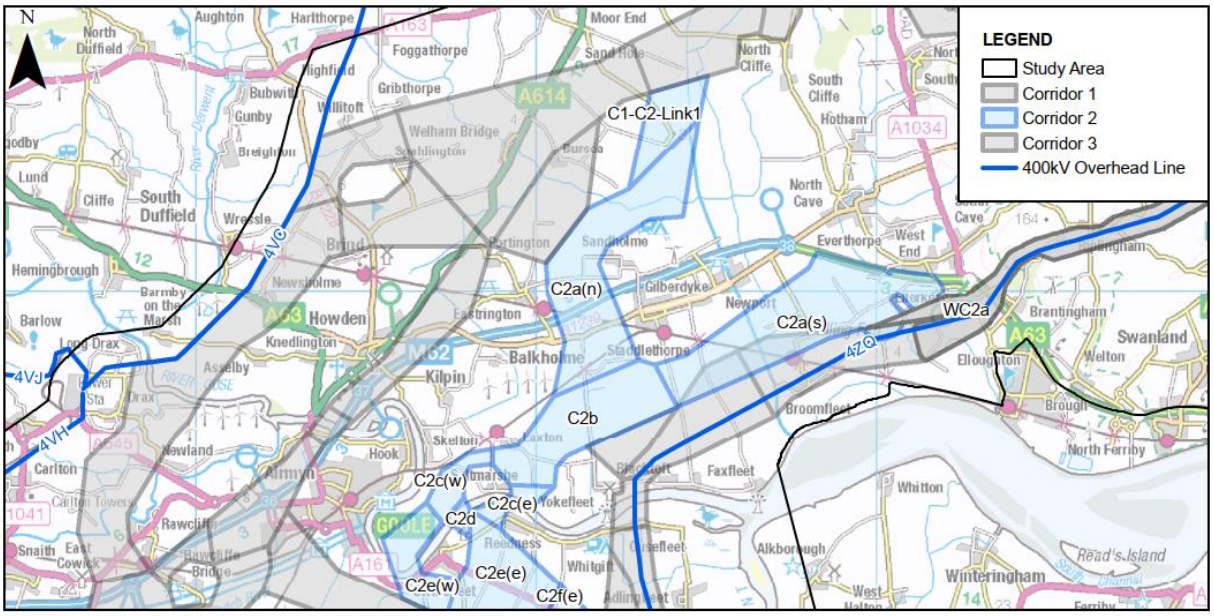
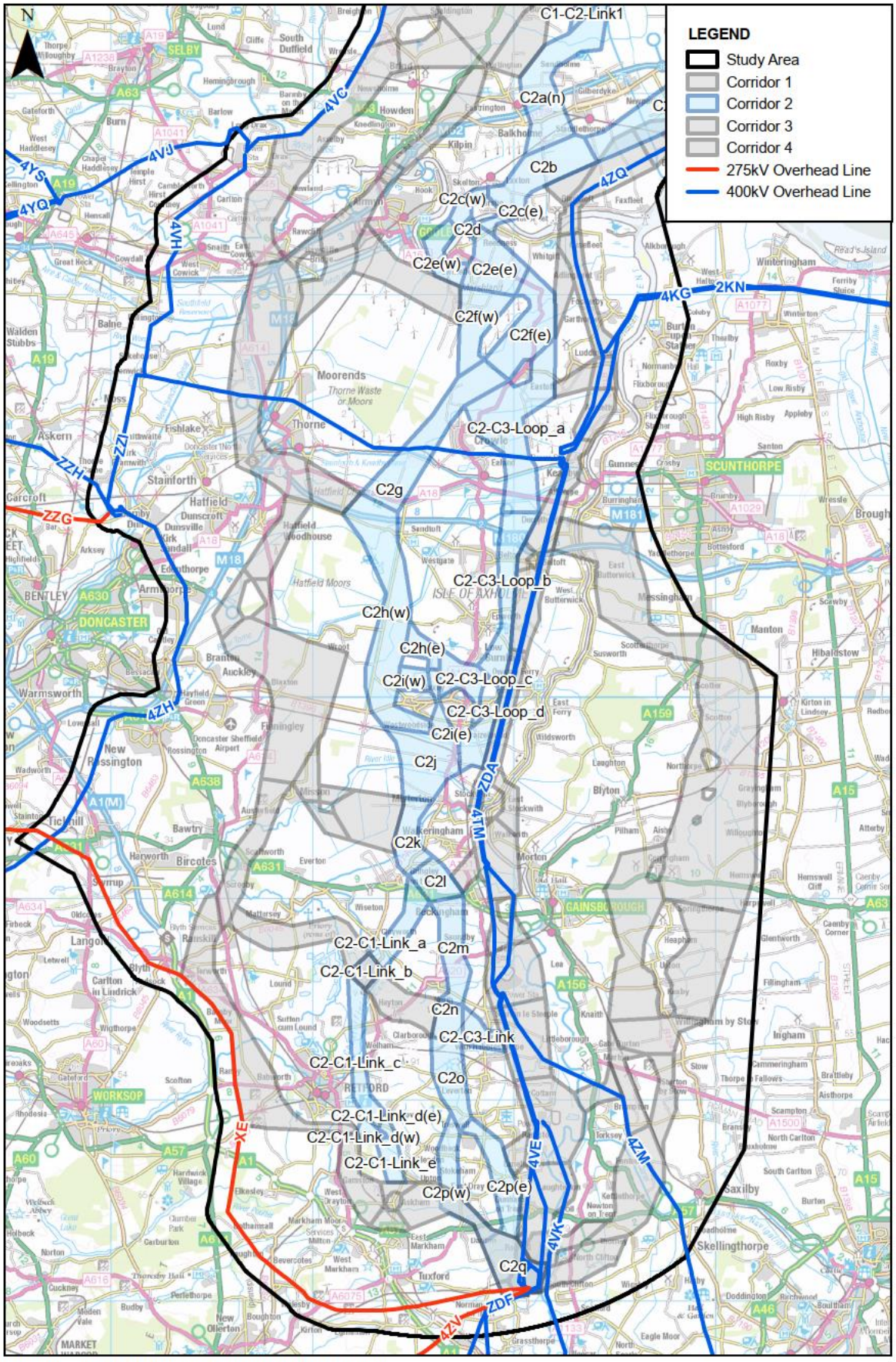


Figure 7-3 – Corridor 2 between South Cliffe/South Cave and the River Ouse

SCALE: 1:200,000

Figure 7-4 – Corridor 2 between the River Ouse and High Marnham



South Cliffe/South Cave to the River Ouse

7.2.4 Between the Wolds and the River Ouse, the corridor is within the Humberhead Levels NCA, characterised by flat, low-lying open landscape with long views. The presence of features including Holme Industrial Estate to the west of the corridor and the M62 and A63 which both cross the corridor, reduces the sensitivity of the local landscape to receiving new infrastructure in this area. However, there is the potential for adverse impacts on views experienced from residential properties in and around Gilberdyke. There is also the potential for adverse impacts on views from the Yorkshire Wolds ILA which is adjacent to the eastern end of Corridor 2. Further south, to the east of Laxton, the corridor crosses the NCN Route 65 and the Trans Pennine Trail with potential for impacts on views experienced by recreational users.

River Ouse Crossing

7.2.5 The tall pylons required for the crossing of the River Ouse would have an adverse landscape impact, potentially over a relatively wide area. The corridor within this area is narrow with little flexibility for routeing, and due to the meandering nature of the River Ouse through Corridor 2, angle pylons may be required close to the river crossing. Flood embankments and woodland may screen views from some residential properties but there is the potential for adverse impacts on views from Swinefleet, Saltmarshe including Saltmarshe Park, Reedness and the south-east of Goole.

South of the River Ouse to High Marnham

7.2.6 The corridor to the south of the River Ouse continues through the flat, low-lying open landscape of the Humberhead Levels NCA. There are several wind farms either side of the corridor between Eastoft and Crowle. A new overhead line may intensify potential adverse impacts, both landscape and visual, within this area. This would include residents of these settlements, and recreational receptors including users of the Peatlands Way as it traverses between Crowle and Haxey.

7.2.7 Further south, the corridor and Loop route through the Isle of Axholme Area of Special Historic Landscape Interest (North Lincolnshire)[37] located around Epworth and Haxey, which is a local landscape and heritage designation indicating regional value.

7.2.8 Both the corridor and the Loop cross the M180, with very locally reduced sensitivity around the motorway. There is the potential for adverse impacts on views experienced by recreational receptors at Humberhead Peatlands National Nature Reserve to the west of the corridor, and scattered residential properties within and adjacent to the corridor and Loop. Further south within the corridor, the settlements of Haxey and Westwoodside may experience potential adverse impacts if the overhead line crosses local high points and/or routes around them. This would make the overhead line potentially more widely visible to residential receptors in these settlements. Crossing the higher land in this area, within the Isle of Axholme Area of Special Historic Landscape Interest, may also have a wider landscape impact.

[37] North Lincolnshire Council (2022). North Lincolnshire Local Plan. Available at: https://localplan.northlincs.gov.uk/stages/3/policy-map.

7.2.9 To the south of Misterton, the corridor routes into the Trent and Belvoir Vales NCA, characterised by a gently undulating open landscape. The corridor routes on to higher ground near Gringley on the Hill where it may have adverse impacts on views from this settlement. Between Misterton and Retford, recreational users on the Cuckoo Way, Trent Valley Way and Chesterfield Canal may experience adverse visual impacts, particularly around Hayton where the western corridor follows the canal. Both visual amenity and landscape character of the Idle Valley, in which the Chesterfield Canal is located, may be adversely affected by the introduction of an overhead line in the western corridor.

7.2.10 The eastern corridor passes through more open undulating landscape, with reduced potential for adverse landscape impacts, though there is potential for adverse impacts on views from Beckingham, North and South Wheatley, Treswell and Woodbeck. On the approach to High Marnham, landscape character and visual amenity may be adversely affected as a result of the new overhead line being seen in combination with the existing double overhead line to the east of the corridor.

Ecology

South Cliffe/South Cave to the River Ouse

7.2.11 There are no notable ecological constraints within Corridor 2 as it routes south towards Gilberdyke. However, there are considerations to note including South Cliffe Common SSSI which is located approximately 450m to the east of the corridor. There is the potential for hydrological connectivity and direct and indirect adverse impacts on this site if routeing within the eastern extent of the corridor.

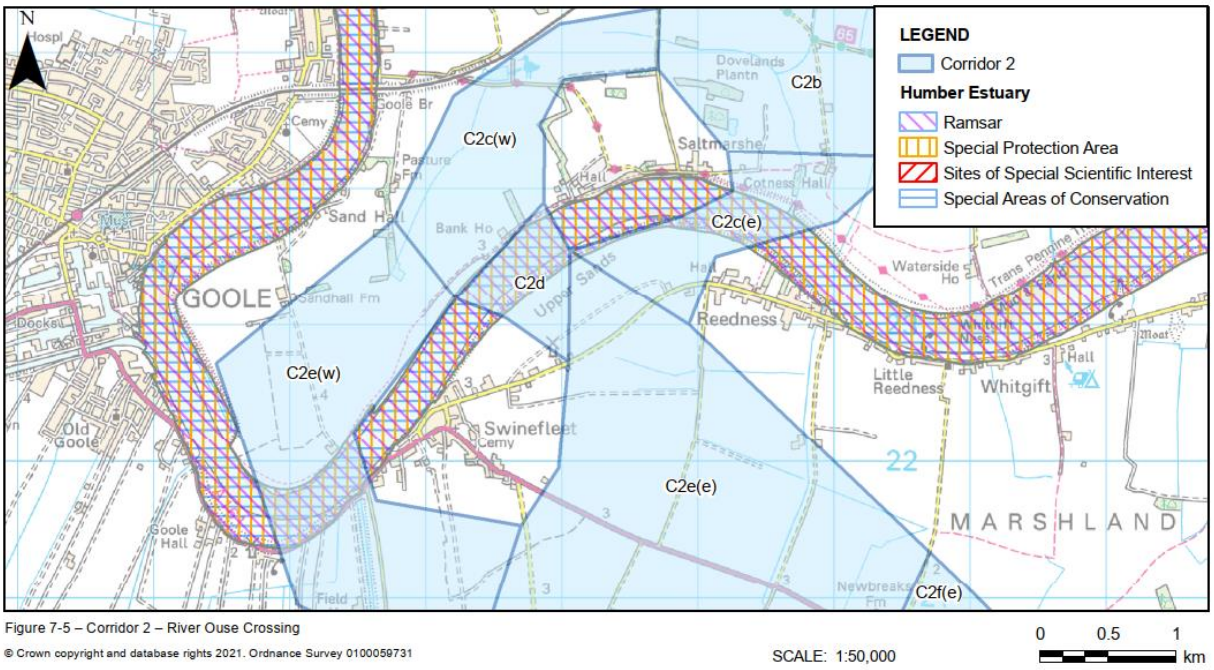
7.2.12 Within the corridor between Gilberdyke and the River Ouse, there is the potential for adverse impacts on the Humber Estuary SAC, SPA, Ramsar and SSSI sites ('Humber designated sites') due to the potential for habitats present including myriad of fields and ditches to support qualifying species of the designated sites. There is the potential for these species to experience indirect impacts through noise, light and vehicular disturbance during construction.

River Ouse Crossing

7.2.13 The most notable ecological constraint for Corridor 2 was the River Ouse which is crossed by the corridor at three separate points – an eastern, central and western crossing. The crossings are shown on **Figure 7-5**. All of the crossings are within the Humber Estuary designated sites. Blacktoft Sands RSPB Nature Reserve is also located approximately 2km to the east of the eastern corridor crossing. The Humber Estuary designated sites are designated for their extensive wetland and coastal habitats and support migratory and wintering waterbirds in addition to breeding populations of bittern, marsh harrier, avocet and little tern. Blacktoft Sands RSPB Nature Reserve supports similar bird species. The importance of the Humber Estuary designated sites poses a significant challenge to routeing and river bankside habitats would require assessment to determine whether they support qualifying species.

7.2.14 Corridor 2 crosses the River Ouse in an open stretch of river where no existing infrastructure is present. The closest overhead line crossing is downstream at Ousefleet and introduction of a new overhead line within Corridor 2 would create an additional barrier for birds travelling upstream. There is the potential for adverse ecological impacts associated with introducing a new overhead line in the previously open river landscape. There is also the potential for loss or degradation of priority habitat including coastal saltmarsh, mudflats and deciduous woodland as a due to the siting of pylons and access routes.

Figure 7-5 – Corridor 2 – River Ouse Crossing



South of the River Ouse to High Marnham

7.2.15 South of the River Ouse, the Humber Estuary designated sites remain a consideration due to the potential for habitats present to support qualifying species of the designated sites. The sites are both present to the north (along the River Ouse) and to the east (along the River Trent up to Althorpe) of the corridor. The corridor in places is also located adjacent to the Thorne and Hatfield Moors designated sites and NNR. There is the potential for habitats present to support qualifying species of the designated sites.

7.2.16 The Loop, which diverges from the corridor to the north-east of Crowle is located in closer proximity to the River Trent, and Humber Estuary designated sites, approximately 2.5km at its closest point. There are also several SSSIs located within and adjacent to the Loop. The sites can be directly avoided through careful routeing but there is the potential for adverse impacts should the siting of pylons and construction access routes take place in close proximity to the SSSIs.

7.2.17 SSSIs are also a consideration for the corridor. To the east of Hatfield Moors lies Hatfield Chase Ditches SSSI which crosses the corridor in several locations and is hydrologically connected to the corridor. Haxey Turbary SSSI and Epworth Turbary SSSI are also located adjacent to the corridor in this area around Epworth and are potentially hydrologically connected to the corridor. Further south, the Chesterfield Canal SSSI crosses the corridor to the west of Walkeringham. If the C2-C1 Link were to be used, there would be a requirement for a further two crossings, to the south-east of

Clayworth and to the west of Clarborough. There is the potential for adverse impacts should the siting of pylons and construction access routes take place in close proximity to SSSIs.

7.2.18 Throughout the corridor, and particularly in the southern extent, there are large swathes of coastal and floodplain grazing marsh and several areas of deciduous woodland and traditional orchard priority habitat within and adjacent to the corridor. There is the potential for direct and indirect impacts on this priority habitat as a result of pylon siting and construction access routes.

Historic Environment

South Cliffe/South Cave to the River Ouse

7.2.19 The first notable consideration for Corridor 2 is South Cave Conservation Area which partially overlaps the corridor. There is the potential for adverse impacts on the setting of this area, which could be minimised by careful routeing of the overhead line and siting of the pylons. There are a number of listed buildings (I, II, and II*) scattered throughout Corridor 2. There are also several groupings of listed buildings, and scheduled monuments located within 1km of the corridor. There is one scheduled monument (Moated Site 170m north of Wholsea Farm) located within the corridor, north-west of Newport. Although these receptors are considered a constraint, the impacts on the setting of these designated heritage assets should be avoided given the width of corridors and through careful routeing of the overhead line and siting of the pylons.

South of the River Ouse to High Marnham

7.2.20 There are a number of listed buildings (I, II, and II*) scattered throughout Corridor 2, the Loop and C2-C1 Link to the south of the River Ouse. There are also several groupings of listed buildings, scheduled monuments and conservation areas located within 1km of the corridor. There is the potential for adverse impacts on the setting of these heritage assets, which should be minimised by careful routeing of the overhead line and siting of the pylons. The Isle of Axholme Area of Special Historic Landscape Interest is located within the corridor and Loop. It was considered that a greater understanding of the sensitivity of the Isle of Axholme is required before recommending this as a viable corridor for selection from a historic environment perspective.

Socio-economics

South Cliffe/South Cave to the River Ouse

7.2.21 The A63 crosses the corridor to the west of South Cave and joins the M62 which crosses the corridor to the north-west of Gilberdyke. A crossing of both would be required. Two railway lines are present (Hull Line and Sheffield to Hull Line) to the south-east and south-west of Gilberdyke for which three crossings would be required. There may be potential adverse impacts relating to temporary disruption during construction. Suitable clearance levels would be established for crossings of roads and the onward design of railway crossings would seek to avoid sections where there is a raised embankment present.

7.2.22 The Trans Pennine Trail is located to the north of the River Ouse and crosses the eastern and central cut-outs of Corridor 2. There is the potential for disruption to access

during construction. Should closure or temporary diversions be required, alternative access arrangements would be put in place.

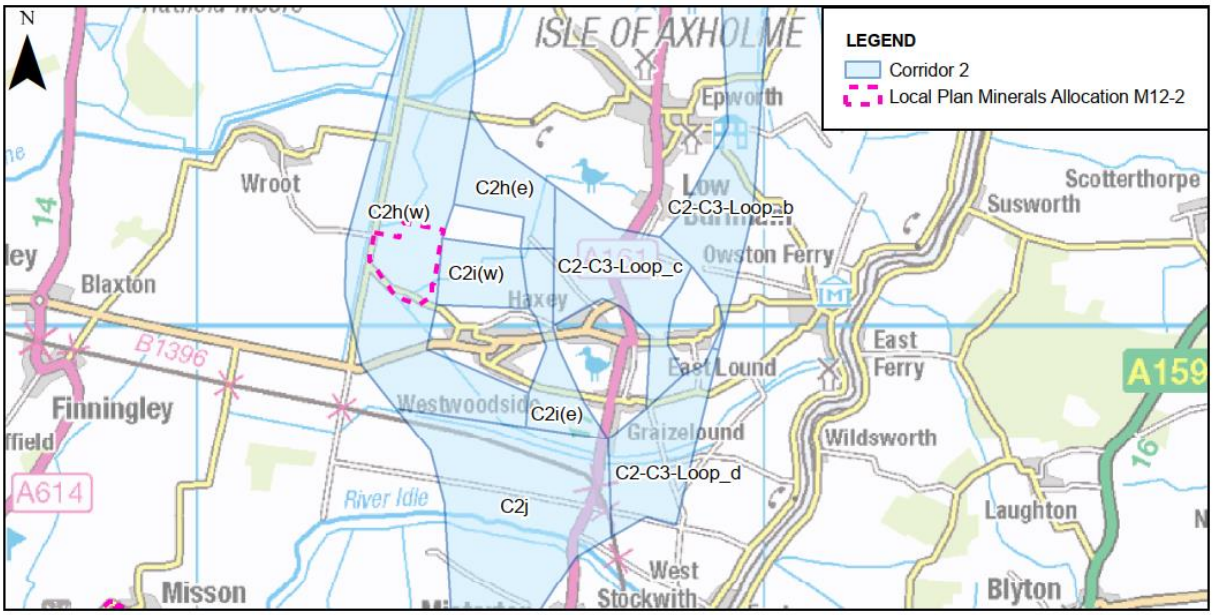
7.2.23 The predominant land use within the corridor, Loop and Link is agricultural and the Project may result in the permanent loss of agricultural land, classed as high-quality. However, due to the substantial amount of agricultural land within the corridor, the potential land take required would be a small percentage of the overall area of agricultural land and is not considered a differentiating factor for routeing and siting of infrastructure.

South of the River Ouse to High Marnham

7.2.24 South of the River Ouse, north and east of Crowle, there is a potential crossing of the HLCP Project Preferred Route Corridor on both the corridor and the northern section of the Loop south of Eastoft. The Keadby 3 Carbon Capture Power Station proposal intersects the northern section of the Loop west of Keadby. However, careful routeing and siting of infrastructure is likely to reduce, and where practicable avoid, impacts to the listed receptors.

7.2.25 To the north-west of Westwoodside the western cut-out of Corridor 2 is largely covered by an Aggregate and Minerals Resource Area (North Lincs Sand and Gravel Limited). This area is also covered by Local Plan Allocation M12-2 (Minerals) as shown in **Figure 7-6**. Neither the eastern cut-out of Corridor 2 or the Loop further to the east are constrained by the minerals planning allocation. If the western cut-out were to be selected routeing would be constrained to the west of Idle Bank.

Figure 7-6 – Corridor 2 – Local Plan Allocation Minerals Allocation M12-2



7.2.26 South of Gringley on the Hill the majority of the C2-C1 Link is covered by the West Burton Solar Project site, a DCO project, which is a proposed area for solar panels. It is assumed that any loss from an energy generation productivity perspective would need to be appropriately compensated.

7.2.27 A substantial section of the north and central sections of the corridor contains Grade 2 (very good) agricultural land whilst areas between south of Swinefleet and north of

Eastoft, west of Westoodside and south of Graizelound in the Loop contain Grade 1 (excellent) agricultural land. Whereas the southern section of the corridor from Walkeringham southwards including the Links contain Grade 3 (good) agricultural land. There may be land take as a result of the Project, but this is likely to be a small percentage of the overall agricultural land. This is not considered a differentiating factor for routeing and siting of infrastructure.

7.2.28 The key traffic and transport constraints include the crossings of multiple unavoidable transport routes such as the; A57, A631, A620, A161, A18, M180 and railway lines (Sheffield to Lincoln, ECML, South Humberside Mainline, Spalding and Doncaster Line). Routeing in proximity to these transport routes, is likely to result in temporary disruption to services during construction, however, this would not be the case during operation. Suitable clearance levels would be established for crossings of roads and the onward design of railway crossings would seek to avoid sections where there is a raised embankment present.

7.2.29 Corridor 2 is in proximity to several airfields predominately located within the central and southern sections. The Haxey Airfield, Willow Farm (private airport), and the Sandtoft Airfield are located close to the central section of the corridor. The southern section of Corridor 2 is located close to Headon Airfield, Forwood Farm Airstrip, Grove Farm Airstrip, Retford (Gamston) Airport, the West Burton Airstrip and the Darlton Gliding Club. Consultation would be required to identify the potential impacts to existing activity and lighting of these airfields, airstrips, and the gliding club. A MoD high priority low flying zone covers the corridor between the River Ouse and Westwoodside and consultation with the MoD would be required to identify areas of highest risk for low flying activity. Further consultation would also be required to identify impacts on the MoD Met Radar Zone which covers the corridor between Beckingham and High Marnham.

Other Considerations

7.2.30 Other environmental topics were also considered as part of the options appraisal and include air quality, geology and soils, noise and water. These are summarised below for the entirety of Corridor 2 and associated Loop and Links.

7.2.31 There are scattered, sparsely distributed residential, commercial and agricultural properties throughout the corridor and there is a potential risk of temporary impacts limited to localised changes in air quality and noise and vibration during construction. There may also be localised changes in air quality and noise and vibration on settlements adjacent to the corridor during construction. No potential adverse air quality or noise and vibration impacts are anticipated during operation.

7.2.32 There are several historic landfill sites and permitted waste sites throughout the corridor which cover a small area and are considered avoidable due to their localised nature. There is one active quarry (the Greenholme Bank Quarry) located north of Cove Road which is considered avoidable through careful routeing and siting.

7.2.33 Peaty soils (within the topic of geology and soils) could potentially be adversely impacted, particularly within the northern and central extents of the corridor where they cover large swathes and are unavoidable when siting pylons.

7.2.34 There are constraints associated with water, primarily due to the presence of the River Ouse and smaller watercourses, water framework directive watercourses, in combination with Flood Zone 2 and 3 which are present across the majority of the

corridor. However, there are no constraints which are considered to have potential adverse impacts to the extent which they would prevent routeing.

7.3 Engineering and System Factors

South Cliffe/South Cave to the River Ouse

7.3.1 There were some constraints located throughout Corridor 2 considered likely to reduce routeing flexibility and/or increase the technical complexity of the corridor, and which would also have associated construction and delivery impacts and potential network and capacity issues.

7.3.2 Corridor 2 begins as a corridor split to the north and south of Gilberdkye before joining together to the south-west of Gilberdyke. The northern split around Gilberdyke was identified as more technically complex than the southern split primarily due to the increased number of crossings likely to be required (including the M62 and railway lines), the presence of two wind turbines and the potential need for crossing, or routeing in parallel to, a high pressure gas pipeline. An expanse of peaty soil is also present within the northern split which could pose a risk to pylon foundations, through ground subsidence and waterlogging. Should infrastructure be required within peaty soils, there may be a requirement for geotechnical investigations, specific foundation designs and specialised accesses which would increase technical complexity. In comparison, only one railway line crossing would be required within the southern split. The Market Weighton Canal traverses both parts of the corridor meaning a crossing is likely to be unavoidable. Several field drains are also present which may result in possible access and construction constraints as well as multiple DNO overhead line assets which may require mitigation.

River Ouse Crossing

7.3.3 Corridor 2 has three potential River Ouse crossing points (eastern, central and western) all of which were deemed likely to be of similar technical complexity. All three potential crossing points are relatively unconstrained, noting the presence of DNO overhead line assets that may require mitigation. Tall pylons and long span lengths would likely be required to facilitate the river crossing and position infrastructure outside of the various environmental designations which may carry some technical risk. Additional angle pylons may also be required to facilitate a perpendicular crossing which could result in increased volumes of construction materials required and increased volumes of construction traffic. To the south-west of Swinefleet, the A161 runs in close proximity and in parallel to the River Ouse which necessitates a single-span crossing of both constraints likely, further potentially increasing the required span length and pylon heights at this point. Exact pylon heights would be subject to the detailed design.

South of the River Ouse to High Marnham

7.3.4 South of the River Ouse towards Eastoft, Corridor 2 is predominantly technically unconstrained again noting that mitigation of several DNO overhead line assets may be required. To the north of Eastoft, the corridor splits to the east and west of a windfarm. The A161 bisects the corridor north of the windfarm and the eastern split. Depending on the preferred routeing alignment, a crossing of the A161 may be required. Due to the orientation of the road, the positioning of infrastructure may be restricted, and additional large angle plyons may be required to facilitate a perpendicular crossing. The volume of

construction materials required, and volume of construction traffic may be higher as a result.

7.3.5 South-west of Eastoft and towards Misterton, Corridor 2 becomes more technically complex. Routeing through land associated with the HLCP Project Preferred Route Corridor is likely to be unavoidable as it bisects the corridor from north-west to south-east. A high pressure gas pipeline and an oil pipeline also traverse the corridor in a similar orientation to the south-west of Eastoft and as such crossings are likely required. Mitigation of several DNO overhead line assets throughout this corridor section may also be required. Peaty soils appear quite extensive throughout however further ground investigations would be necessary to determine their full extent and hence any potential risk to foundations and accesses.

7.3.6 Corridor 2 becomes particularly complex to the south-west of Crowle where there are a series of large constraints in short succession. The existing ZDA 400kV overhead line traverses the width of the corridor and consequently underground cabling and SECs would be required to underground a section of this existing overhead line and facilitate routeing of the new overhead line. This would increase technical complexity and introduce potential risks associated with construction and delivery as well as possible network and capacity issues.

7.3.7 Immediately south of the ZDA 400kV overhead line, a crossing of a railway, road, two large drains, and the Sheffield and South Yorkshire Navigation would be required, likely in one span as well as crossings of the A18 and the M180 further to the south. Lindholme Lakes Country Park and Fisheries occupies a significant proportion of the corridor to the west of West Carr and consequently at this point routeing may be confined to the eastern side. This may necessitate several crossings of watercourses including the River Torne, Hatfield Waste Drain, Hatfield Chase Ditches and SSSI which may limit the positioning of infrastructure and may also have construction and access implications. Several potential underground oil and high pressure gas pipeline crossings are likely to further limiting infrastructure positioning.

7.3.8 At Westwoodside, Corridor 2 splits several times – one to the west, two to the north (north and south of Haxey Turbary SSSI) and one to the east. To the north-west of Westwoodside, the North Lincs Sand and Gravel Quarry and an associated Local Plan Allocation M12-2 (Minerals) are situated on the eastern side. Should routeing through this area be feasible and infrastructure be required within, then this would increase the technical risk and complexity due to the requirement for ground investigations and potential construction and delivery limitations. Alternatively, if the site and allocation must be avoided then routeing would be confined to the western side of the western split and it would likely not be feasible to route into / out of the split south of Haxey Turbary SSSI.

7.3.9 There is some technical risk associated with the narrow nature of the corridor to the east of Westwoodside and therefore potentially limited space for construction. Irrespective of the routeing alignment, crossings of a railway line and the River Idle would be required to the south of Westwoodside. Misterton Golf Course and Haxey Quays Caravan Park occupy a significant proportion of Corridor 2 at this point and as such an oversail may be required introducing possible access and construction risks. To avoid these constraints to the west, routeing would likely be in close proximity to an oil pipeline. Several DNO overhead line assets are also present throughout this part of Corridor 2 and may require mitigation.

7.3.10 The C2-C3 Loop provides an alternative option for routeing between Eastoft and Misterton. There are several DNO overhead line assets situated throughout this Loop

that may require mitigation. The northern most section was identified as being of high technical complexity and risk. The HLCP Project Preferred Route Corridor and an existing high pressure gas pipeline bisect the Loop from north-west to south-east. Routeing through this corridor and over the high pressure gas pipeline is likely to be unavoidable. The A161 would have to be crossed to facilitate routeing from Corridor 2 into the Loop to the west of Eastoft.

7.3.11 West of Keadby Substation the existing ZDA 400kV overhead line traverses the width of the C2-C3 Loop. To facilitate routeing of the new overhead line, a section of this existing overhead line would likely need to be undergrounded requiring underground cabling and SECs. This would significantly increase technical complexity and introduce possible risks relating to construction and delivery as well as potential network and capacity issues. The positioning of infrastructure may be restricted due to the HLCP Project Preferred Route Corridor, two high pressure gas pipelines, a gas site and the Keadby 3 Carbon Capture Power Station DCO boundary located to the eastern side of the corridor. Sufficient stand-off from the Keadby wind turbines also on the eastern side would be necessary[38]. The aforementioned high pressure gas pipelines continue to bisect the corridor in a southerly direction towards Woodhouse. The orientation of this asset means that routeing in parallel may be required for a significant distance. South of the existing ZDA 400kV overhead line, there are a number of watercourse and infrastructure crossings including a number of large drains, Sheffield and South Yorkshire navigation, the River Torne, a railway line, the A18 and the M180. The presence of multiple crossings in short succession may increase the technical complexity and potentially limit the positioning of infrastructure. Crossing of an oil and a high pressure gas pipeline, which traverse the Loop to the north and the south of the M180 respectively, would also be required.

7.3.12 South-west of Beltoft towards Misterton, the C2-C3 Loop becomes somewhat less technically complex. At East Lound, the Loop splits to the east and west of the residential area before re-joining to the south. There is opportunity for routeing into Corridor 2 to the north-west of East Lound which would require a crossing of the A161. If routeing around East Lound to the east or the west and into Corridor 2 to the south, this would necessitate routeing through pinch points which would carry additional technical risk due to the potentially limited space for construction. Infrastructure may also be required within peaty soils if routeing around East Lound to the west which carries additional foundation and access risks. A double drain crossing of the Warping and Ferry Drains may also be necessary.

7.3.13 From Misterton southwards into High Marnham, Corridor 2 is largely technically unconstrained. It is likely that several DNO overhead line assets would require mitigation within this corridor section including a 132kV overhead line that bisects the corridor to the east of Sturton le Steeple. Several watercourse and infrastructure crossings would also be required including the Chesterfield Canal, two railway lines, the A631, the A620 and the A57. Additional angle pylons may be required to facilitate perpendicular crossings at certain points which could result in increased volumes of construction materials required and increased volumes of construction traffic.

7.3.14 Peaty soils are present to the west of Misterton which carry an increased technical risk for foundations and accesses in relation to potential ground subsidence and waterlogging. Further investigations would likely be required to determine the full extent

[38] Approximately three times the diameter of the rotary blade however this is to be confirmed following further investigation into turbine dimensions.

of these soils. To the north-west of Beckingham, a potential gas / oil / electricity station is present. Further investigation would be necessary to confirm the land use of this site however a utility search may be necessary to determine the extent of any underground assets in the vicinity which may impact the positioning of infrastructure.

7.3.15 Multiple solar proposals occupy the corridor to the east of Saundby, West Burton and Sturton le Steeple including the Enso Energy Proposed Solar Farm development, the West Burton Solar Project Connection and the South Wheatley Solar development. Routeing through land associated with these proposed developments is likely to be unavoidable as they span the full width of the corridor. To the south of Sturton le Steeple, the C2-C3 Link provides opportunity for routeing from Corridor 2 into Corridor 3. This link was deemed relatively technically unconstrained noting the presence of the West Burton Solar Project Connection within the northern half of the corridor. A railway line crossing would also be required to facilitate routeing into this Link.

7.3.16 Corridor 2 remains relatively technically unconstrained from Woodbeck, whereby the corridor splits to the east and west, and into High Marnham. An existing solar farm is present to the north of Woodbeck which may limit the positioning of infrastructure. Both corridor splits require a crossing of the A57 and a tributary of the River Trent. However, routeing through land associated with the High Marnham Anesco Solar development proposal south-west of Ragnall is likely to be unavoidable if utilising the eastern split. Routeing through the western split would avoid interaction with this development however a telecommunications mast is situated just south of the A57 which would likely necessitate discussions with the Telecommunications Operator to avoid any complications.

7.3.17 To the west of Beckingham, a relatively technically unconstrained Link (C2-C1 Link) provides an opportunity for routeing from Corridor 2 into Corridor 1 and southwards to High Marnham. The proposed West Burton Solar Project Site and Connection development occupies a large proportion of the northern-most part of the Link therefore routeing through this development boundary is likely to be unavoidable. Crossings of the A631 and Chesterfield Canal would also be required.

7.3.18 To the north-west of Hayton, there is a large expanse of peaty soils within the Link. Infrastructure is likely to be required within these peaty soils and as such technical risk would be increased due to potential waterlogging and ground subsidence which may impact pylon foundations and accesses. Several DNO overhead line assets also traverse the Link and as such would likely require mitigation, including a 132kV DNO overhead line which bisects the Link to the south-west of Hayton. To the north-west of Welham, an additional crossing of the Chesterfield Canal may be necessary. The orientation of the canal is such that multiple crossings may be required if routeing on the western side of the Link. A railway line also traverses the Link at the same point and therefore both of these constraints may need to be crossed in a single span which could increase technical complexity. The Link splits to the east and west around Beverley Spring Ancient Woodland to the south-west of Grove. Both appear to have few technical risks however if routeing through the eastern split into Corridor 1, an additional railway line crossing would be required. This could be avoided if continuing southwards and routeing into Corridor 1 to the north of Askham.

7.4 Holford Rules

7.4.1 With the exception of the Humber Estuary designated sites, the corridor has been drawn to exclude larger areas of the highest amenity value and interest in accordance

with Holford Rule 1. With regards to the Humber Estuary designated sites, development within these sites is unavoidable and some potential adverse impacts are likely. Neither the eastern, central or western crossing of the River Ouse for Corridor 2, adheres to the principles of Holford Rule 1, which seeks complete avoidance of nationally and internationally designated sites where possible.

7.4.2 The corridor, together with the Loop and Links, were developed to avoid highly constrained areas, and specific constraints including settlements such as Swinefleet, Crowle, Epworth and Haxey. The width of the corridor reflects the constraints in a given area, with narrow sections where constraints are present such as in proximity to Sandtoft Airfield and the Thorne and Hatfield Moors designated sites and wide sections where the space is unconstrained, such as around the crossing of the M180. Where there are smaller areas of high amenity value, for instance smaller SSSIs and listed buildings, sufficient space has been included within the corridor to enable an alignment to be found to avoid them and minimise impacts, potentially by local deviation, in accordance with Holford Rule 2.

7.4.3 The corridor largely allows substantial lengths of straight line with limited sharp changes in direction, in accordance with Holford Rule 3. The corridor does deviate from a straight path in places to avoid constraints including Thorne and Hatfield Moors, and settlements including Crowle, Epworth and Walkeringham. The corridor includes more land than is needed for construction of an overhead line which provides flexibility and options when it comes to routeing for further development in Stage 3. This also provides the opportunity to implement the most direct route within the corridor (avoiding constraints) and reduce the need for sharp angles or changes in direction of the overhead line in accordance with Holford Rule 3.

7.4.4 The corridor largely complies with Holford Rule 6, in terms of separation from other high voltage lines, except for three sections. The first eight kilometres of the southern option south of Gilberdyke, where the edge of the corridor is parallel to, and slightly less than a kilometre from, the 4ZQ 400kV overhead line. The eastern loop between Keadby and Misterton routes parallel to the 4TM and ZDA 400kV overhead lines, over a distance of approximately 13km and between approximately 0.5km and 1km to the west. The approaches to High Marnham would inevitably and likely unavoidably add to the developing wirescape of this area.

7.4.5 Corridor 2 would need to cross the ZDA 400kV overhead line south of Crowle. The crossing of the overhead line is unavoidable, and it is likely that some potential adverse landscape and visual impacts may occur due to the siting of SECs.

7.5 Conclusion

7.5.1 Environmentally, there is the potential for a number of adverse impacts throughout Corridor 2 across the environmental and socio-economic topics considered. These are primarily in relation to landscape and visual with potential adverse impacts on landscape character particularly on higher ground and the potential for adverse impacts on views from nearby residential properties, due to large river crossing pylons. Potentially adverse ecological impacts were also identified for the Humber Estuary designated sites and within any habitat located within the corridor which may support qualifying species. This is considered to be a significant constraint to the section of this part of the corridor. Corridor 2 has potential adverse socio-economic impacts, relating to a potential crossing of the HLCP Project Preferred Route Corridor in the northern section of the corridor and potential crossing in proximity to the West Burton Solar

Project Site, south of Gringley on the Hill, where the majority of the Link is covered by the site. The Local Plan Allocation M12-2 (Minerals) also cover a large swathe of the corridor to the north-west of Westwoodside which would limit opportunities for routeing.

7.5.2 Technically, the majority of Corridor 2 appears to be relatively unconstrained. In relation to the River Ouse crossings, although long span lengths and tall pylons are still likely to be required, the positioning of infrastructure is likely to be less limited due to the unconstrained nature of the corridor at this location. Additional angle pylons may be necessary to facilitate a perpendicular river crossing which in turn could result in increased volumes of construction materials required and increased volumes of construction traffic.

7.5.3 The most significant area of technical complexity within Corridor 2 is likely to be to the west of Keadby whereby underground cabling and SECs are likely to be required to facilitate undergrounding of a section of the existing 400kV ZDA overhead line, increasing the technical complexity and risk associated with construction and delivery as well as the potential for system and network issues. The technical complexity could be further exacerbated by possible limits to the positioning of infrastructure due to the multiple high pressure gas pipelines, a gas site, the HLCP Project Preferred Route Corridor and the Keadby 3 Carbon Capture Power Station DCO boundary that are located to the east within the C2-C3 Loop as well as the watercourses and railway line crossings to the south in Corridor 2.

7.5.4 Large expanses of peat are present throughout the central portion of the corridor, including in the vicinity of the potential underground cabling of the existing ZDA 400kV overhead line. There are potential technical risks associated with foundations and access due to the potential for waterlogging and ground subsidence. Whilst Corridor 2 appears to be relatively unconstrained for the most part, a number of proposed solar developments occupy parts of the corridor and the C2-C1 Link. Routeing through these proposed solar developments is likely to be unavoidable. Flood zones are extensive throughout Corridor 2 and may pose a risk to construction, delivery and maintenance of the route, namely through potential waterlogging and possible access restrictions. Foundations would need to be designed to suit, as would temporary and permanent drainage and mitigation access routes.

7.5.5 A tabulated summary of the appraisal of Corridor 2 is provided in **Table 7-1**.

Table 7-1 – Summary of Corridor 2 Options Appraisal

Theme	Topic	Summary
Environmental	Landscape and Visual	• There is the potential for adverse impacts on views experienced from residential properties in and around Gilberdyke, the Yorkshire Wolds ILA and recreational users of nearby footpaths and the NCN. • The sensitivity of the local landscape within the corridor is reduced in places due to the presence of existing infrastructure such as energy development and the major road and rail network. • Scattered residential properties and settlements within and adjacent to the corridor may experience potential adverse visual impacts, particularly around the River Ouse due to the need for tall river crossing pylons. • Crossing the higher land within the Isle of Axholme Area of Special Historic Landscape Interest would be likely to have a wider landscape impact. • Landscape character and visual amenity may be adversely affected on the approach to High Marnham as a result of the new overhead line being seen in combination with existing overhead lines.
	Ecology	• The corridor crosses the Humber Estuary designated sites and there is the potential for the wider corridor to have habitat connectivity and be hydrologically connected to these sites. There is also the potential for habitat connectivity for the Thorne and Hatfield Moors designated sites located adjacent to the corridor. • Several ecological sites including Hatfield Chase Ditches SSSI and Chesterfield Canal SSSI cross the corridor. • There are large swathes of coastal and floodplain grazing marsh and several areas of deciduous woodland and traditional orchard priority habitat within and adjacent to the corridor.
	Historic Environment	• A greater understanding of the sensitivity of the Isle of Axholme Area of Special Historic Landscape Interest is required, as it is located within the corridor and Loop. • Several listed buildings and scheduled monuments are scattered throughout the corridor and it is anticipated that these can be avoided through careful routeing. However, impacts on setting are likely to arise should the overhead line be developed where the corridor is closest to these heritage assets.

Theme	Topic	Summary
		Views from Conservation Areas would need to be considered during routeing, particularly where there is overlap with the corridor.
	Socio-economics	• There may be potential adverse impacts on the road network and recreational routes relating to disruption during construction. • The predominant land use within the corridor, Loop and Links is agricultural and the Project may result in the permanent loss of agricultural land, classed as high-quality. However, the overall land take for the Project is considered to be a small percentage of the overall area of agricultural land. • A large minerals Local Plan Allocation (M12-2) covers a large swathe of the corridor to the north-west of Westwoodside and would limit opportunities for routeing within this area. • Discussion and coordination with the developers associated with planning applications and applications for DCOs may be necessary to ensure the Project can be facilitated in combination with these proposed developments. • Consultation would be required with several airfields located in proximity to the corridor, and the MoD in relation to high priority low flying zones and the Met Radar Zone.
	Other Considerations	• There is a potential risk of temporary impacts limited to localised changes in air quality and noise and vibration during construction. • Peaty soils could potentially be adversely impacted, particularly within the northern and central extents of the corridor as they cover large swathes and are considered unavoidable when siting pylons.

Theme	Topic	Summary
Technical	Technical Complexity	• Corridor 2 provides three potential River Ouse crossing points all of which appear to be relatively technically unconstrainted, however long span lengths and tall river crossing pylons may be required for all options. • Multiple Distribution Network Operator overhead line assets may require mitigation which will need to be programmed in with the asset owner. • A section of the existing National Grid ZDA 400kV overhead line will need to be undergrounded to facilitate the proposed new overhead line in both Corridor 2 and the C2-C3 loop – this would require underground cable, SECs and terminal plyons, which could introduce network and capacity issues.
	Construction and Delivery	• Undergrounding of the existing National Grid ZDA 400kV overhead line in the C2-C3 loop may be limited in its location by the HLCP Project Preferred Route Corridor, two high pressure gas pipelines, a gas site and the Keadby 3 Carbon Capture Power Station DCO Boundary – all of which will require sufficient stand-off. • Additional angle pylons may be required to facilitate perpendicular road, rail and watercourse crossings, as well as deviate around localised constraints, which could lead to increased volumes of construction traffic – technical complexity is further increased in certain areas due to multiple crossings in short succession. • Underground oil and high pressure gas pipelines may limit the positioning of pylons throughout the corridor. • In proximity to Eastoft, routeing through land associated with the HLCP Project Preferred Route Corridor is likely to be unavoidable as it bisects the corridor – this may limit the positioning of infrastructure. • The North Lincs Sand and Gravel Quarry occupies a large proportion of the available corridor for routeing to the north-west of Westwoodside – routeing through this site would require ground investigations however, avoidance of this site would significantly reduce the flexibility for routeing.

Theme	Topic	Summary
		• The narrow width of the corridor split to the east of Westwoodside increases technical risk due to the significantly limited space for construction. • Multiple solar farms and solar proposals occupy Corridor 2 including the Enso Energy Proposed Solar Farm, the West Burton Solar Project Connection, the South Wheatley Solar Development and the High Marnham Anesco Solar Development – routeing through land associated with these is likely to be unavoidable and so the positioning of infrastructure may be limited. • Communication with the relevant Telecommunications Operator will be necessary to avoid any complications and interactions of the proposed new overhead line with a telecommunications mast situated south of the A57. • Peaty soils are present at points throughout the corridor which may pose a risk to pylon foundations through ground subsidence and waterlogging. Geotechnical investigations, specific foundation designs and specialised accesses will likely be required in these areas. • Infrastructure is likely to be required within flood zones which could pose a risk to construction and maintenance – specific foundations, drainage and mitigation access routes would need to be designed to suit.

8. Options Appraisal – Corridor 3

8. Options Appraisal – Corridor 3

8.1 Introduction

8.1.1 Corridor 3 begins to the north of Cottingham in the area around the existing Creyke Beck Substation and then routes in a south-westerly direction to Ellerker, passing to the north of Skidby and Brantingham. From Ellerker, the corridor continues in a south-westerly direction to the north of Yokefleet and Blacktoft, crossing the River Ouse in between these settlements. From the River Ouse, the corridor continues south passing the settlements of Garthorpe, Althorpesta, Epworth, Misterton and Gainsborough before ending at the area around the existing High Marnham Power Station. The extent of the corridor is shown on **Figure 8-1**.

8.1.2 Key constraints to note for this corridor include the Yorkshire Wolds ILA; River Ouse crossing and Humber Estuary designated sites and Blacktoft Sands RSPB Nature Reserve; Keadby Windfarm and existing transmission infrastructure. These are shown on **Figure 8-2**.

8.1.3 The corridor was identified primarily to close parallel existing electricity transmission infrastructure, including the existing 4ZQ 400kV overhead line between Creyke Beck and Keadby and the several existing 400kV routes south of Keadby to High Marnham.

Figure 8-1 – Corridor 3

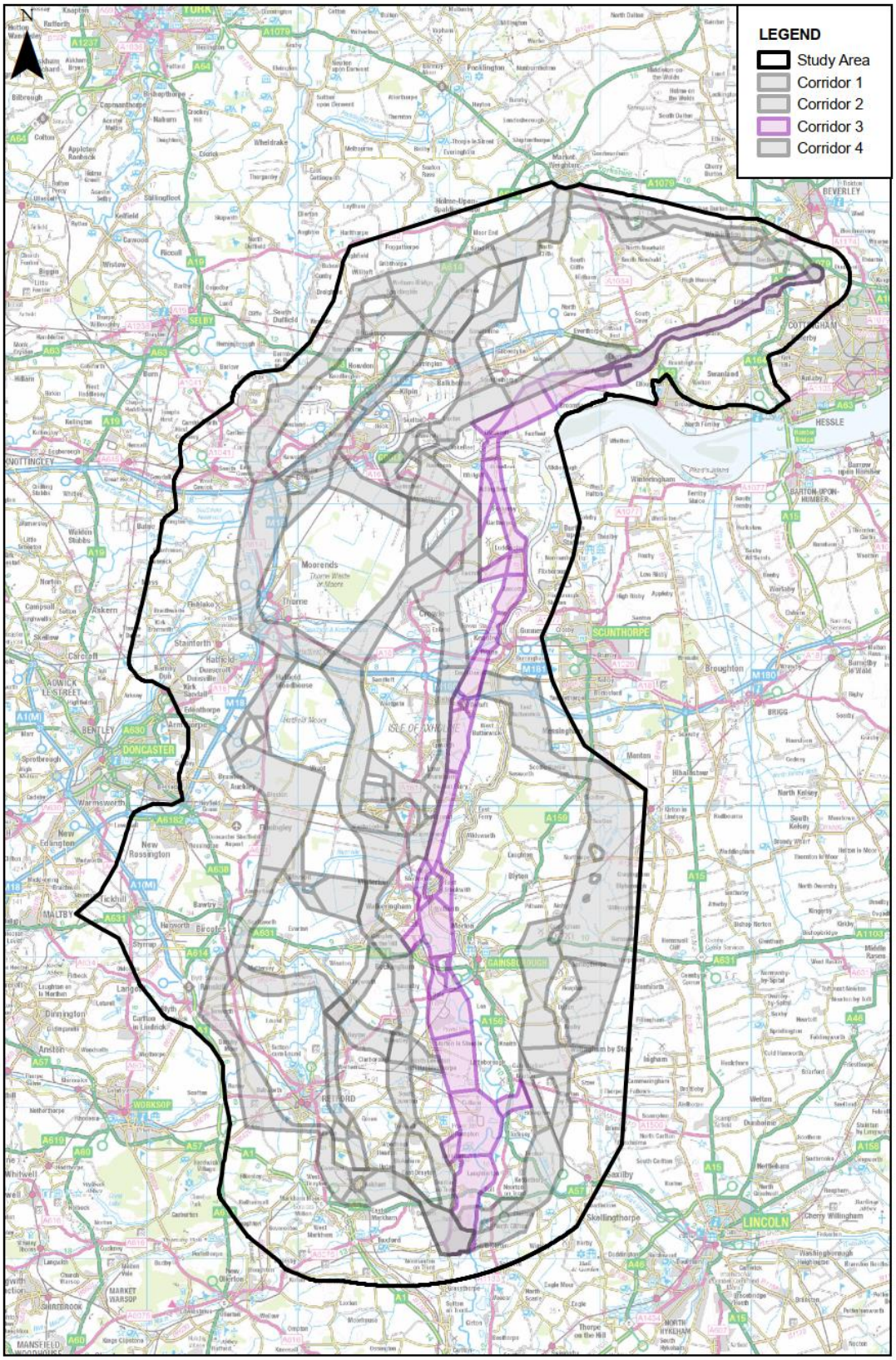


Figure 8-1 – Corridor 3

Figure 8-2 – Corridor 3 – Key Constraints

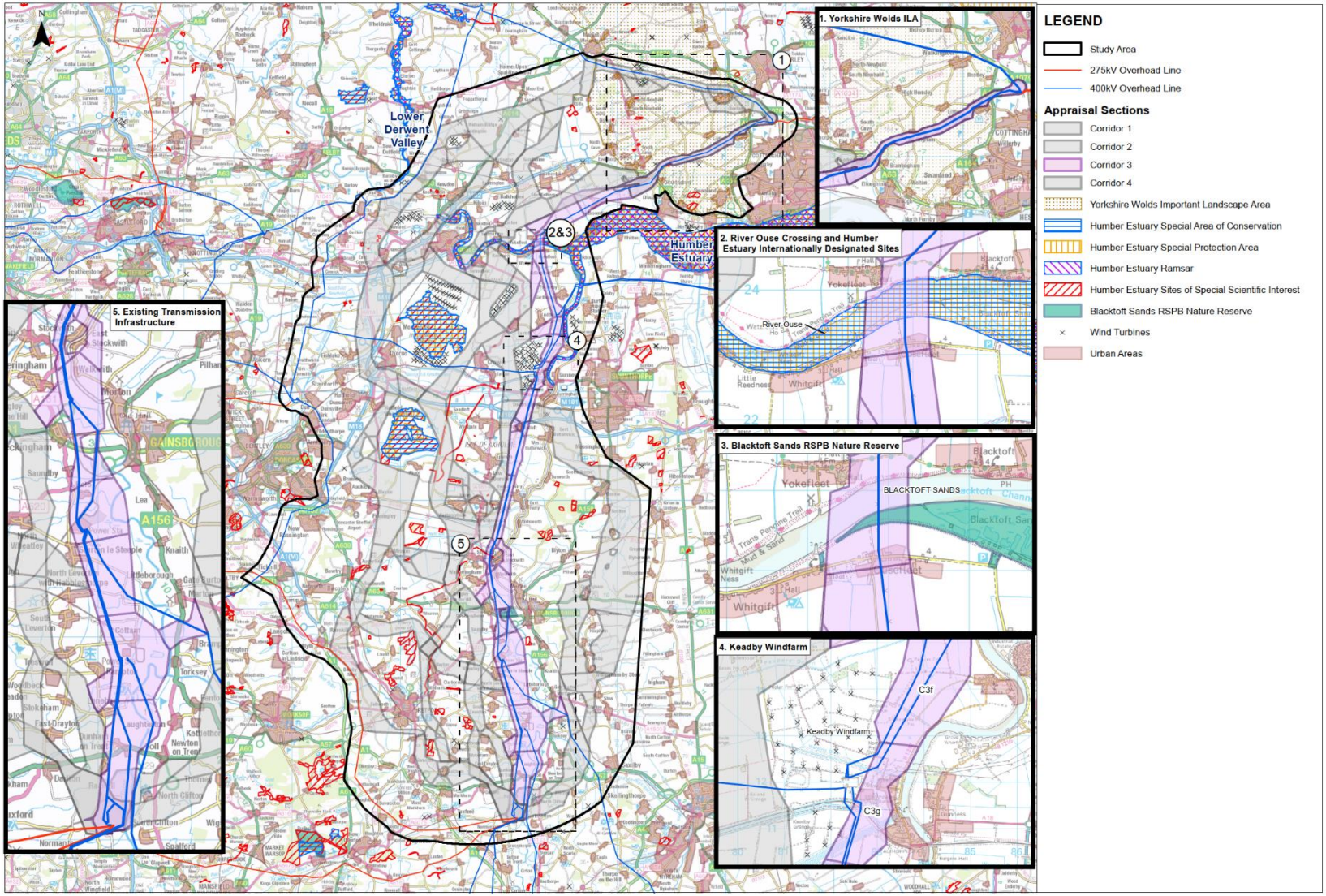


Figure 8-2 – Corridor 3 – Constraints

8.1.4 The majority of Corridor 3 comprises one complete corridor, however there are three locations where the corridor splits into two and routes either side of a cut-out to provide opportunities to avoid a constraint. The three splits are:

- To the east and west of Beltoft, to avoid the settlement (see C3i(w) and (e), **Figure 8-4**);
- To the east and west of East and West Stockwith, to avoid the settlements and convergence of the River Trent with the River Idle and Chesterfield Canal (see C3l(w) and (e), **Figure 8-4**Figure 8-1); and
- To the west of, and across Beckingham Marshes RSPB Nature Reserve, to follow the separate routes of two existing overhead lines – the 4TM 400kV route and ZDA 400kV route (see C3n(w) and (e), **Figure 8-4**Figure 8-1).

8.1.5 The corridor also has six links which were included to provide flexibility in the routeing process and are as follows:

- Link 1 (C3-C2-Link1), which connects to Corridor 2 and is located to the west of Garthorpe;
- Link 2 (C3-C2-Link2), which connects to Corridor 2 and is located to the south of Luddington;
- Link 3 (C3-C2-Link3), which connects to Corridor 2 and is located to the north of Beckingham;
- Link 4 (C3-C2-Link4), which connects to Corridor 2 and is located to the south of Rampton;
- Link 5 (C3-C2-Link5), which connects to Corridor 2 and is located to the north of Yokefleet; and
- C3-C4 Link, which connects to Corridor 4 and is located to the south of Marton.

8.1.6 The extent of the corridor and links are shown in **Figure 8-3** and **Figure 8-4**Figure 8-1.

8.1.7 The option of crossing the River Ouse with underground cables was considered and the likely environmental, technical and cost implications of this are summarised in **Appendix A**. The preliminary conclusions relating to the use of underground cables across the River Ouse are presented in **Section 11.4**.

8.2 Environmental Factors

8.2.1 All descriptions are given moving from north to south along the corridor (including the Loop and Links).

8.2.2 To aid the reader, this report separates the Options Appraisal for Corridor 3 into two geographical sections:

- Creyke Beck to the River Ouse, including the River Ouse crossing (see **Figure 8-3**); and
- South of the River Ouse to High Marnham (see **Figure 8-4**).

Figure 8-3 – Corridor 3 between Creyke Beck and the River Ouse

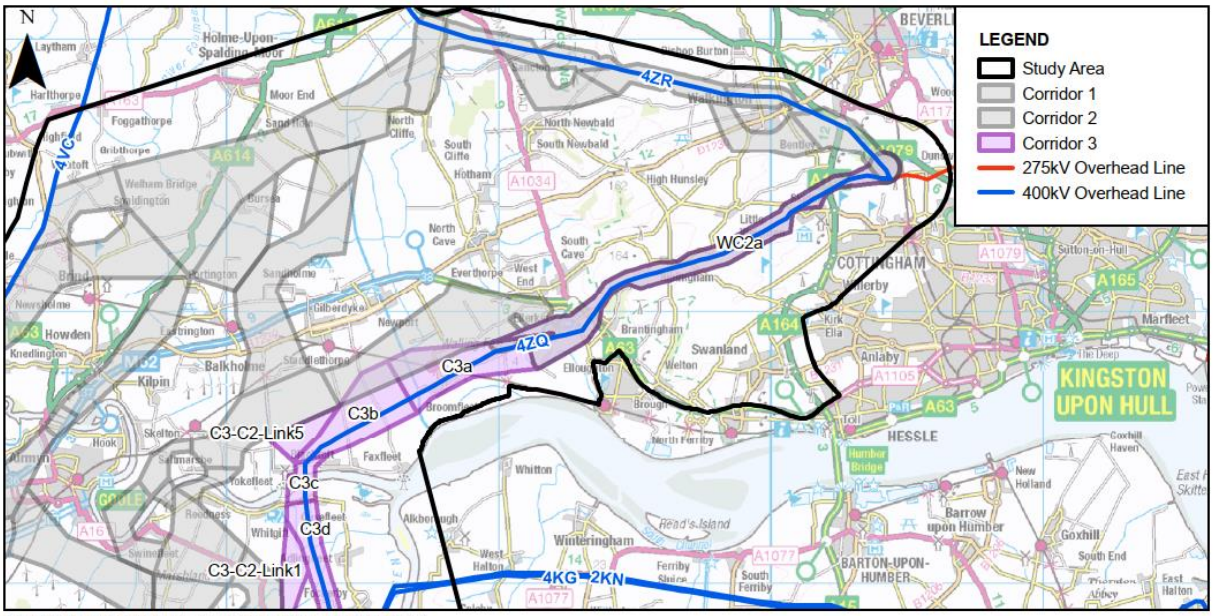


Figure 8-3 – Corridor 3 between Creyke Beck and the River Ouse

SCALE: 1:250,000

0 2 4 6 8 10 km

Figure 8-4 – Corridor 3 between the River Ouse and High Marnham

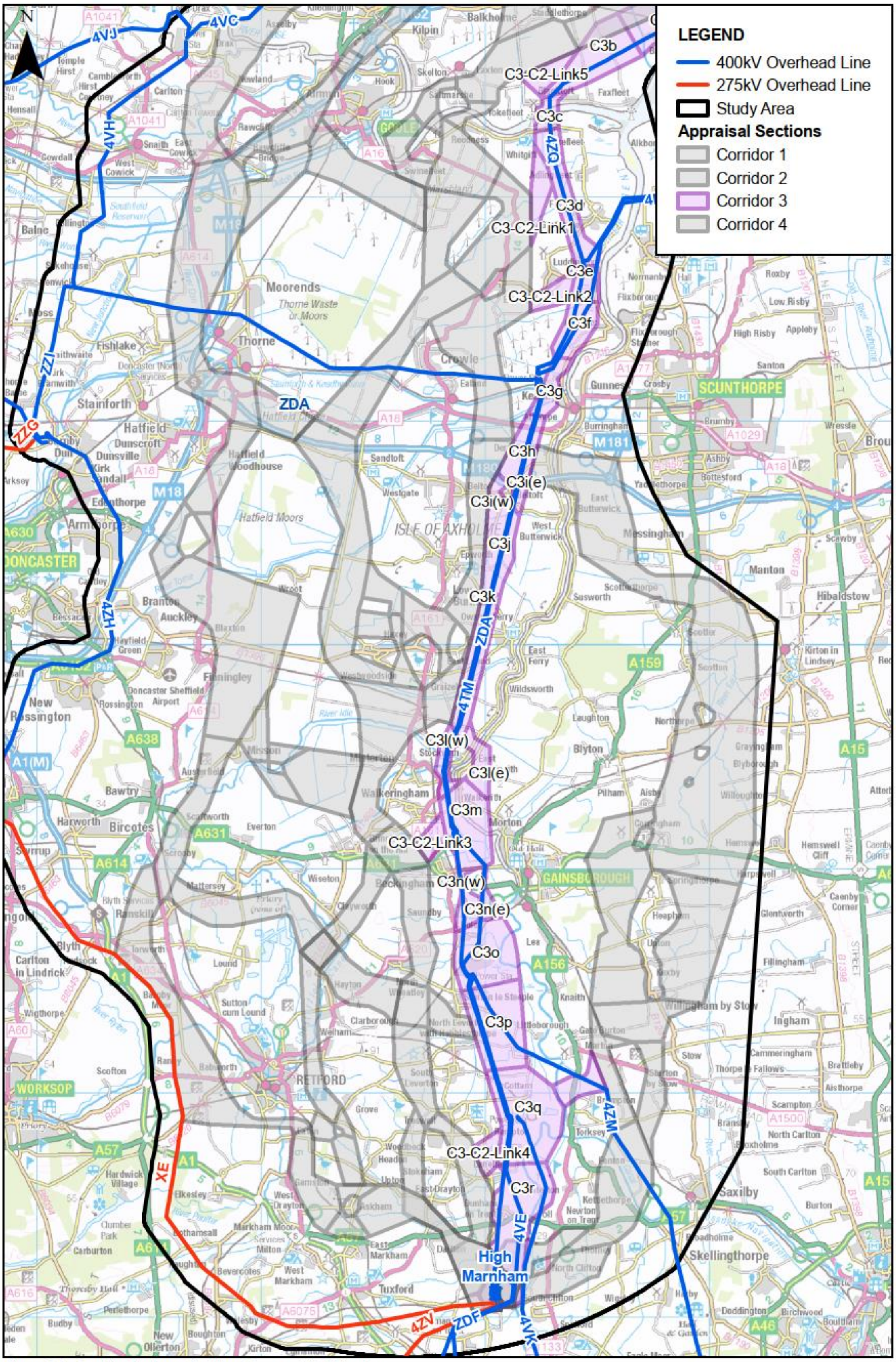


Figure 8-4 – Corridor 3 between the River Ouse and High Marnham

SCALE: 1:270,000

0 2.5 5 7.5 10 km

Creyke Beck to the River Ouse

8.2.3 Routeing to the west out of Creyke Beck, the corridor follows the existing 4ZQ 400kV overhead line to the south-west and is a fully close parallel corridor option. The presence of this existing overhead line and the A164 and A63 has the impact of locally reducing the sensitivity of the landscape to new infrastructure. However, the entirety of the corridor between the A164 and A63 is within the Yorkshire Wolds ILA ('the Wolds'), which signifies that the landscape is valued at a regional level. The western scarp, including Ellerker North Wold and adjacent wooded dales, is recognised in the Local Plan as being the area of highest landscape quality within the Wolds ILA.

8.2.4 There is the potential for adverse impacts on the landscape and visual amenity, in combination with the existing overhead line where the corridor narrows near Skidby and at the western scarp at Ellerker North Wold, which is within the areas of highest landscape quality. Potentially adverse impacts on the more sensitive wooded dales in this location would be difficult to avoid.

8.2.5 There is the potential for adverse impacts on visual amenity for residential receptors in Skidby and those in Ellerker and Brantingham as the preliminary corridor narrows in this location, as shown on **Figure 8-5**. There is also the potential for adverse impacts on views experienced from the settlements of Little Weighton, Riplingham and Ellerker.

Figure 8-5 – Corridor 3 at Brantingham and Ellerker

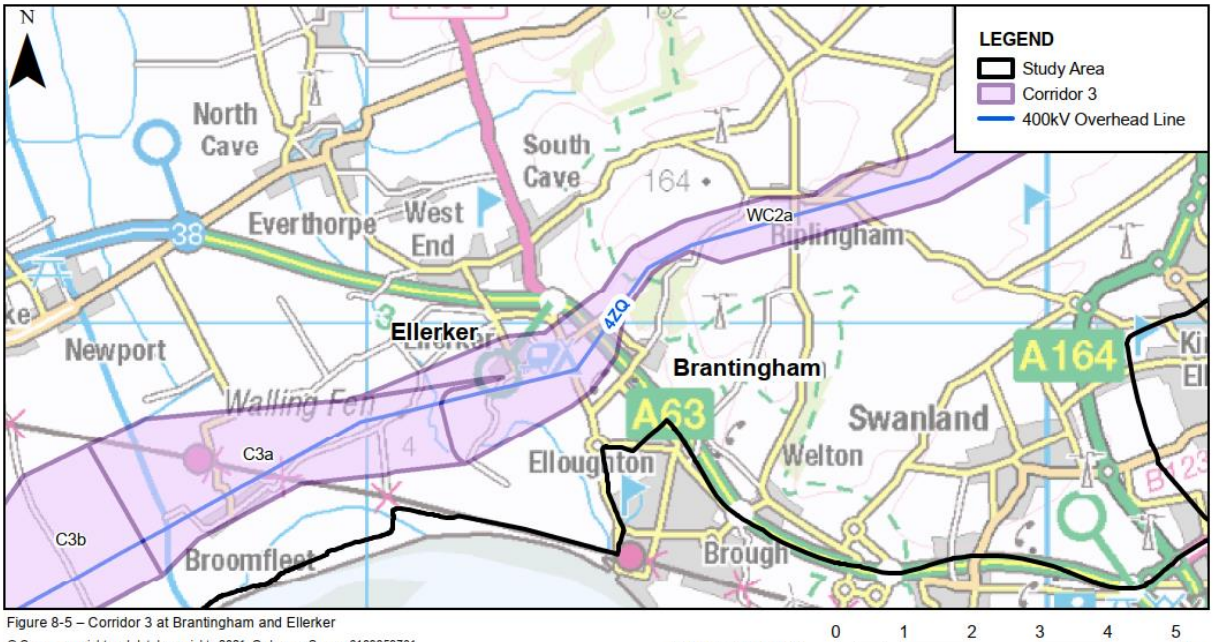


Figure 8-5 – Corridor 3 at Brantingham and Ellerker

8.2.6 The corridor between the Wolds and the River Ouse is within the Humberhead Levels NCA, characterised by flat, low-lying open landscape with long views. The corridor continues to follow the existing 4ZQ 400kV overhead line and due to the presence of this, the sensitivity of the landscape to potential adverse impacts from new infrastructure is reduced. However, there is the potential for increasing the degree of visual impact experienced from scattered residential properties and farms, Broomfleet and users of the Trans Pennine Trail and NCN Route 65.

River Ouse Crossing

8.2.7 The tall pylons required for the river crossing would have an adverse landscape and visual impact, potentially over a relatively wide area, potentially increased by a need for angle pylons either side of the river crossing. However, the presence of the existing 4ZQ 400kV overhead line reduces the sensitivity of the landscape to the Proposed Development. There is the potential for adverse impacts on the landscape and visual amenity in combination with the existing overhead lines on the residential receptors located in the nearby settlements of Ousefleet, Yokefleet, Whitgift and Blacktoft, and potentially on users of the Trans Pennine Trail and NCN Route 65 and visitors to Blacktoft Sands RSPB Nature Reserve.

South of the River Ouse to High Marnham

8.2.8 The corridor to the south of the River Ouse continues through the flat, low-lying open landscape of the Humberhead Levels NCA providing flexibility for routeing. The presence of the existing overhead line reduces sensitivity of the landscape to adverse impacts from new infrastructure, particularly in the Garthorpe area where three overhead line routes converge, although there would be a risk of creating a wirescape. There is potential for adverse impacts on the visual amenity of scattered residential properties and farms, and the settlements of Ousefleet, Adlingfleet, Fockerby, Garthorpe and Luddington.

8.2.9 South of Luddington, the corridor approaches Keadby bounded to the east by Keadby Windfarm and to the west by the River Trent. Two existing overhead lines route through the corridor in this area and, combined with Keadby Windfarm and Keadby Power Station, reduce the sensitivity of the landscape to the introduction of new infrastructure in this area. There is the potential for an adverse impact on visual amenity in combination with the existing infrastructure in the Keadby area, on views experienced by scattered residential receptors, those residents within the settlement of Amcotts and recreational receptors along the River Trent.

8.2.10 Further south, the corridor routes through the Isle of Axholme Area of Special Historic Landscape Interest[39] around Epworth, there is a local heritage landscape designation indicating regional value. Within this area, the corridor also routes to the east and west of the settlement of Beltoft. The M180 routes to the north of Beltoft, crossing the corridor and two existing overhead lines in close parallel route to the east of Beltoft. The presence of these features reduces sensitivity of the landscape to the introduction of new infrastructure in this area. However, the presence of existing overhead line infrastructure and the M180 suggests that there is the potential for a cumulative impact on the landscape and visual amenity within this area, due potentially to the combined impact of that infrastructure or wirescape.

8.2.11 Between East Lound and Owston Ferry, the corridor runs over higher ground and the potential adverse visual impacts from the new overhead line, alongside existing overhead lines, may be more pronounced in views from these settlements. Further south, there is the potential for adverse visual impacts on views from scattered residential receptors throughout the corridor, and residential receptors within settlements including East and West Stockwith, Walkeringham, Beckingham, Morton and Gainsborough. There is also the potential for adverse visual impacts on visitors to Beckingham Marshes Nature Reserve. East of East and West Stockwith there is the

[39] North Lincolnshire Council (2022). North Lincolnshire Local Plan. Available at: https://localplan.northlincs.gov.uk/stages/3/policy-map.

potential for large river crossing pylons to be required across the River Trent which would be more widely visible due to their greater height.

8.2.12 South of Beckingham, the corridor routes into the Trent and Belvoir Vales NCA, characterised by a gently undulating open landscape. The corridor continues to follow the existing overhead lines past West Burton Power Station and Cottam Power Station before ending at High Marnham Power Station. The presence of this existing infrastructure reduces the sensitivity of the landscape to new infrastructure, but there is the potential for impacts on landscape character and visual amenity in combination with the three existing overhead lines which converge and diverge in the areas around the power stations and which is particularly prevalent to the south of Misterton. The open landscape within this area results in the potential for adverse visual impacts on views experienced on residents of the settlements including Bole, North Leverton, Sturton le Steeple, Rampton, Laneham and Dunham-on-Trent. The visual amenity of recreational receptors along the River Trent and the NCN Route 647 may also be adverse impacted.

Ecology

Creyke Beck to the River Ouse

8.2.13 There are no notable ecological constraints within Corridor 3 as it routes west from Creyke Beck. Brantingham Dale SSSI is located within the corridor, to the north of Brantingham. It covers approximately two-thirds of the width of the corridor and comprises areas of scrub, grassland and woodland. There is an opportunity to avoid this SSSI through routeing. The corridor is located approximately 580m to the north of the Humber Estuary designated sites. Due to this proximity and the presence of likely habitat including a myriad of fields and ditches within the southern extent of the corridor, this area may support species cited as qualifying features of the Humber Estuary designated sites and may experience indirect impacts through noise, light and vehicular disturbance during construction. The corridor is hydrologically connected to the Humber Estuary designated sites due to the network of drains and becks in this area which may result in potential adverse indirect impacts on the designated sites.

River Ouse Crossing

8.2.14 The most notable ecological constraint for Corridor 3 was the River Ouse, which is crossed by the corridor between Yokefleet to the north and Ousefleet to the south. The corridor follows the existing 4ZQ 400kV overhead line across the River Ouse, as shown on **Figure 8-6**. The crossing is within the Humber Estuary designated sites and partially within Blacktoft Sands RSPB Nature Reserve. The Humber Estuary designated sites are identified for their extensive wetland and coastal habitats and support migratory and wintering waterbirds in addition to breeding populations of bittern, marsh harrier, avocet and little tern. Blacktoft Sands supports similar bird species. The importance of the Humber Estuary designated sites poses a significant challenge to routeing and river bankside habitats would require assessment to determine whether they support qualifying species. There is the potential for these species to experience indirect impacts through noise, light and vehicular disturbance during construction.

8.2.15 The opportunity was identified to close parallel the existing 4ZQ 400kV overhead line through the corridor across the River Ouse, thereby avoiding the introduction of a new overhead line into an open stretch of river. There are advantages associated with this close parallel option, including the grouping, rather than separation of infrastructure which would reduce the potential for adverse impacts on birds as their flightpaths would

likely already avoid the existing overhead line. However, there is the potential for adverse ecological impacts associated with introducing a new overhead line as two overhead lines would result in a wider area of avoidance for bird species travelling along the River Ouse. There is also the potential for loss or degradation of priority habitat in proximity to the River Ouse including coastal saltmarsh, mudflats and deciduous woodland from the pylons themselves, from construction operations and from construction access routes.

Figure 8-6 – Corridor 3 – River Ouse Crossing

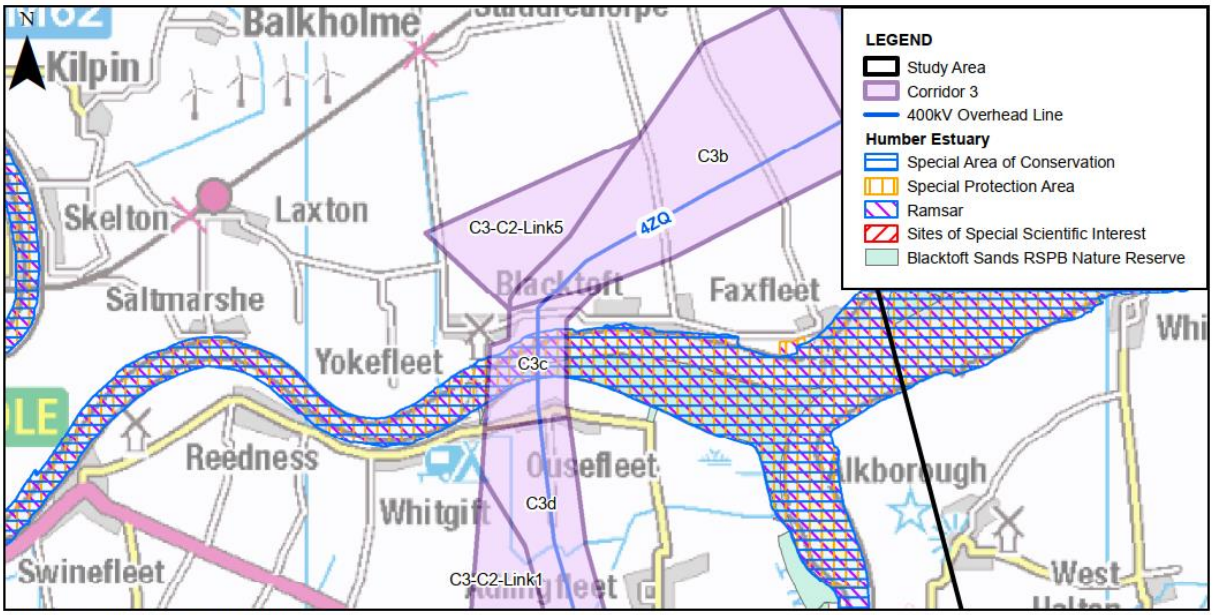


Figure 8-6 – Corridor 3 - River Ouse Crossing

South of the River Ouse to High Marnham

8.2.16 South of the River Ouse, the Humber Estuary designated sites remain a consideration due to the potential for habitats present to support qualifying species of the designated sites, hydrological connectivity and potential disruption during construction. The sites are both present to the north (along the River Ouse) and to the east (along the River Trent down to Althorpe) of the corridor. Between Luddington and Althorpe, the corridor is adjacent to the River Trent and Humber Estuary designated sites in places. There is also the potential for loss or degradation of priority habitat in proximity to the River Ouse including coastal saltmarsh and deciduous woodland from the pylons themselves, from construction operations and from construction access routes.

8.2.17 Between Althorpe and Misterton, the corridor is unconstrained from an ecological perspective.

8.2.18 At Misterton, the corridor follows the existing 4TM and ZDA 400kV overhead line across the Mother Drain SSSI and further south, at Beckingham, the corridor follows the existing 4TM 400kV overhead line across Beckingham Marshes RSPB Nature Reserve. There is the potential for adverse impacts on these sites due to the siting of pylons and access routes.

Historic Environment

Creyke Beck to the River Ouse

8.2.19 The first notable considerations for Corridor 3 are Skidby Conservation Area and Grade II Risby Hall Registered Park and Garden with associated listed building and scheduled monument. Skidby Conservation Area is located approximately 70m south of the corridor and Risby Hall Registered Park and Garden is approximately 600m to the north. Brantingham Conservation Area is also located approximately 210m to the south of the corridor. Key views from these heritage assets would need to be considered during routeing.

8.2.20 Further south, Ellerker Conservation Area and associated listed buildings are entirely located within the corridor, to the north of the existing 4ZQ 400kV overhead line. There is the potential for adverse impacts on setting due to a new overhead line, which would be intensified due to the additional presence of the existing overhead line.

South of the River Ouse to High Marnham

8.2.21 There are numerous listed buildings and several scheduled monuments (Hall Garth moated site, associated drainage channels and fishpond; Axholme Carthusian Priory and post-Dissolution garden earthworks, Melwood Park; Medieval settlement and open field system immediately south east of Low Farm; Fleet Plantation moated site) located within and within 1km of the corridor. There is the potential for adverse impacts on the setting of these heritage assets, which could be minimised by careful routeing of the overhead line and siting of the pylons. Hall Garth moated site scheduled monument located within Ousefleet is within the corridor and there is the potential for adverse impacts on setting should routeing take place in the western extent of the corridor.

8.2.22 Moving further south through the corridor, there are clusters of heritage assets located within the settlements of Adlingfleet, Garthorpe, Owston Ferry, East and West Stockwith, Gainsborough and Dunham on Trent. There are also Conservation Areas situated within the nearby settlements of Aldingfleet, East Stockwith, Gainsborough and South Clifton. There is the potential for adverse impacts on setting due to a new overhead line, which would be intensified by the additional presence of the existing overhead line. Consideration during routeing should be given to how a new overhead line may impact on the setting and key views of nearby heritage assets.

Socio-economics

Creyke Beck to the River Ouse

8.2.23 The A164 and A63 cross the corridor to the west of Creyke Beck and Brantingham, respectively. A crossing of both would be required, along with a crossing of the Yorkshire Wolds Way to the north of Brantingham and the Trans Pennine Trail to the west. There may be potential adverse impacts relating to temporary disruption during construction.

8.2.24 The corridor primarily comprises Grade 2 (very good) agricultural land. There may be land take as a result of the Project, but this is likely to be a small percentage of the overall agricultural land present. This is not considered a differentiating factor for routeing and siting of infrastructure.

8.2.25 A large number of planning applications occupy the land surrounding the existing Creyke Beck Substation including the Hornsea P4 DCO, potential sites for the Continental Link Converter Station, a small swathe of the Albanwise Solar Farm Development and the new Creyke Beck 400kV Substation. Within the remainder of the preliminary corridor there is also the proposed A164 Jock's Lodge Road Widening Scheme. Discussion and coordination with the developers may be necessary to ensure the new overhead line can be facilitated in combination with these proposed developments.

South of the River Ouse to High Marnham

8.2.26 There are several proposed developments in the vicinity of Keadby, West Burton and Cottam Power Stations - Keadby 2 Power Station, West Burton C Power Station, West Burton Solar Project, Cottam Solar Project and Gate Burton Energy Park. Of these developments, Keadby 2 Power Station, West Burton C Power Station and West Burton Solar Project are partially or fully within the corridor. Consideration would need to be given to the routeing of the new overhead line and the potential for impacts and interactions with these developments.

8.2.27 The key traffic and transport constraints include the crossings of multiple transport routes, including the M180, A18, A631 and A57, the South Humberside main line railway, the Spalding and Doncaster Line / Doncaster to Lincoln Line and the Sheffield to Lincoln Line. Routeing in proximity to these transport routes, is likely to result in temporary disruption to services during construction. Suitable clearance levels would be established for crossings of roads and the onward design of railway crossings would seek to avoid sections where there is a raised embankment present. The Dukeries Train, also a NCN route is located to the north of High Marnham Power Station and there may be potential impacts relating to temporary disruption during construction.

8.2.28 A substantial section of the corridor is Grade 2 (very good) agricultural land whilst areas around East and West Stockwith is Grade 1 (excellent) agricultural land. There may be land take as a result of the Project, but this is likely to be a small percentage of the overall agricultural land present. This is not considered a differentiating factor for routeing and siting of infrastructure.

8.2.29 West Burton Airstrip is located approximately 500m west of the corridor, close to North and South Wheatley. Consultation with the airstrip would be required to identify impacts on existing activity and lighting. Consultation with the MoD would be required to identify potential impacts on the existing MoD Met Radar Zone which covers a substantial part of the southern extent of the preliminary corridor from near Beckingham to South Clifton.

Other Considerations

8.2.30 Other environmental topics were also considered as part of the options appraisal and include air quality, geology and soils, noise and water. These are summarised below for the entirety of Corridor 3 and associated Links.

8.2.31 There are scattered, sparsely distributed residential, commercial and agricultural properties throughout the majority of the corridor. Larger settlements including, but not limited to, Ellerker, Ousefleet and Dunham-on-Trent are located within the corridor. There is a potential risk of temporary impacts limited to localised changes in air quality and noise and vibration during construction. There may also be localised changes in air quality and noise and vibration on settlements adjacent to the corridor during

construction. No potential adverse air quality or noise and vibration impacts are anticipated during operation.

8.2.32 There are several historic landfill sites and permitted waste sites throughout the corridor which cover a small area and largely are considered avoidable due to their localised nature. However, the site which is both historic and currently a landfill covers the entire width of the corridor to the south of Little Weighton and is unavoidable. There is a potential risk should the soil be disturbed during construction in this area.

8.2.33 There are constraints associated with water, primarily due to the presence of the River Ouse and smaller watercourses, in combination with Flood Zone 2 and 3 which are present across the majority of the corridor. Mill Beck runs north to south at the southern-most extent of the corridor and is a water framework directive river waterbody which may require crossing. However, there are no constraints which are considered to have potential adverse impacts to the extent which they would prevent routeing.

8.2.34 There are also abandoned quarries and areas of peaty soils throughout the corridor, which are considered avoidable due to their scattered and localised nature.

8.3 Engineering and System Factors

Creyke Beck to the River Ouse

8.3.1 There are several constraints located throughout Corridor 3 considered likely to reduce routeing flexibility and/or increase the technical complexity of the corridor, constraints of which would also have associated construction and delivery impacts and potential network and capacity issues. Multiple DNO overhead assets are also present throughout Corridor 3 and may require mitigation.

8.3.2 Routeing out of the new Creyke Beck Substation there are several proposed developments which may limit the positioning of infrastructure and increase technical risk. These include: the Hornsea P4 DCO, potential sites for the Continental Link Converter Station and a small swathe of the Albanwise Solar Farm Development. Routeing through land associated with some, if not all, of these proposed developments is likely to be unavoidable and as such coordination with developers may be necessary to facilitate the multiple developments. Additionally, removal of a wind turbine may be required to facilitate the proposed new overhead line however this would be subject to confirmation of the technical parameters of the turbine and the detailed design.

8.3.3 Throughout parts of the initial section of Corridor 3 from Creyke Beck to Skidby, an opportunity was identified for routeing in parallel to the existing 4ZQ 400kV overhead line on the northern side. A crossing of the A164 and the A164 Jock's Lodge Road Widening Scheme would be necessary to the north-east of Skidby. To the east of the A164, additional angle pylons would be required to deviate away from parallel and to route around the Lazaat Hotel which may increase construction and access volumes. There is unlikely to be sufficient room for routeing and construction on the southern side of the existing overhead line at this point due to surrounding constraints which limit the available corridor.

8.3.4 From the north-west of Skidby (west of Little Weighton Road) and towards Riplingham, there is opportunity for close parallel routeing to the north or the south of the existing 4ZQ 400kV overhead line. Routeing to the southern side is likely to carry more technical risk and complexity due to the requirement for underground cabling and SECs to facilitate a crossing of the existing overhead line from the northern side. This would

introduce technical risk associated with potential construction and delivery issues as well as possible network and capacity issues. Alternatively, a line swap over could facilitate routeing on the southern side of the existing overhead line. This could introduce technical challenges with the reutilisation of existing structures, foundations, fittings and conductors as well as a potential requirement for additional outages and temporary diversions. To ensure that the correct circuit and overhead line is terminated into the relevant substation, it would be necessary to have an even number of line swap overs throughout the final end-to-end solution. Furthermore, when routeing on the southern side, additional angle pylons may be necessary to avoid a residential property to the south-east of Riplingham. Remaining on the northern side of the existing 4ZQ 400kV overhead line would be less technically complex as no crossing of the existing overhead line would be required therefore negating the need for underground cabling and SECs or a line swap over. Moreover, no deviations away from close parallel are likely to be required if routeing to the north of the existing 4ZQ 400kV overhead line within this part of the corridor and hence fewer angle pylons would be required.

8.3.5 From the south of Riplingham to the north-west of Brantingham, there is unlikely to be sufficient space for routeing and construction on the southern side of the existing overhead line due to Brantingham Dale SSSI and the surrounding woodland which constrains the available corridor. Consequently, if routeing was to the south of the existing overhead line to the east of Brantingham Dale SSSI, underground cabling and SECs or a line swap over would be needed to facilitate a cross over to the north and to avoid the aforementioned constraints. This would have significant technical complexity and risk relating to construction and delivery as well as the potential for network and outage issues. Conversely, if routeing was to the north of the existing overhead line, to the east of the SSSI, no underground cabling and SECs or line swap over would be required at this point and therefore technical complexity and risk would be significantly reduced. Routeing around Brantingham Dale SSSI to the north would necessitate a deviation away from close parallel which would require additional angle pylons, potentially leading to increased construction and access volumes. There may also be technical risk with routeing down the escarpment at Brantingham Dale – the very steep nature of the topography would need to be factored into the detailed design.

8.3.6 To the north-west of Brantingham, continuation of routeing to the north of the existing overhead line would maintain a reduced level of technical complexity through avoiding any underground cabling and SECs or line swap overs. However, deviation away from close parallel would be necessary to route to the north around Ellerker as there is unlikely to be sufficient room for routeing and construction between the existing overhead line to the south and Ellerker to the north. Alternatively, there is opportunity to the north-west of Brantingham to utilise underground cabling and SECs or a line swap over to enable routeing to the south of the existing 4ZQ 400kV overhead line which would be associated with significant technical complexity and risk, as outlined above. On the southern side of the existing overhead line, routeing through a historic landfill site to the south of Ellerker may be required. Should infrastructure need to be situated within the historic landfill site then ground investigations would likely be needed. Irrespective of the preferred routeing alignment, a crossing of the A63 dual carriageway would be necessary to the north-west of Brantingham.

8.3.7 To the north of the River Ouse, the opportunity to route in close parallel to the existing 4ZQ 400kV overhead line was identified both north and the south of the existing overhead line. However, to avoid receptors such as the residential area of Broomfleet and the Sandtoft Roof Tiles Clay Extraction Site and expansion plan, it may be necessary to alternate between routeing on different sides of the existing overhead line. To achieve routeing on different sides, line swap overs may be required which would

likely involve reconfiguration of the existing 4ZQ 400kV overhead line. Line swap overs present challenges with reutilisation of existing structures, foundations, fittings, conductor ratings and conditions, system outages, staging of works and circuit configurations. An alternative method to facilitate routeing on different sides of the existing overhead line would be to utilise underground cabling and SECs. Additionally, within this part of Corridor 3, crossings of the Market Weighton Canal and a railway line are also necessary which would likely require crossing protections and sufficient clearances.

8.3.8 Link 5 has minimal constraints and provides an opportunity to route from Corridor 3 into Corridor 2 immediately prior to the River Ouse.

River Ouse Crossing

8.3.9 There is opportunity to cross the River Ouse to the east or the west of the existing 4ZQ 400kV overhead line. This River Ouse crossing was identified as a likely area of technical complexity primarily due to the long span length required to cross the river. Tall river crossing pylons would be required to maintain sufficient clearances to the navigable watercourse, and to ensure infrastructure can be located outside of sensitive sites. The exact height of these pylons would be subject to the detailed design. The River Ouse crossing pylons for the existing 4ZQ 400kV overhead line are approximately 115m tall.

8.3.10 In proximity to the River Ouse crossing, residential receptors and a scheduled monument (Hall Garth moated site, associated drainage channels and fishpond) would require consideration when routeing. This may introduce construction and delivery issues as multiple large angle pylons may be necessary to avoid the constraints as well as routeing through narrow pinch points with limited space for construction. Depending on the preferred routeing alignment, further line swap overs or sections of underground cabling and SECs may be required south of the River Ouse. This would further increase technical complexity as well as cost and programme risk.

South of the River Ouse to High Marnham

8.3.11 South of the River Ouse, routeing in close parallel to the existing 4ZQ 400kV overhead line is likely feasible, with the corridor being relatively unconstrained until Garthorpe. South of Garthorpe and towards Keadby Power Station, routeing becomes increasingly complex due to the requirement to cross the existing 2KN and 4KG 400kV overhead lines on the eastern side of the 4ZQ 400kV overhead line. The network of existing overhead lines around Keadby is shown on **Figure 8-7**. This would likely require line swap overs or sections of underground cabling and SECs, therefore increasing technical complexity as well as introducing significant construction and delivery issues, and the potential for network and system capacity issues. Routeing three overhead lines in close proximity introduces operational and maintenance issues as it restricts space for any additional infrastructure, such as temporary diversions, or placement of plant and machinery should maintenance need to be carried out particularly on the central overhead line. Moreover, to the east of Keadby Power Station, multiple 132kV DNO overhead lines are present which pose additional constraints to routeing. There are also multiple existing underground assets in the vicinity of the Keadby Substation, however the full extent of these is not yet known as utility searches have not been conducted. Deviating around Keadby Power Station to the east would require routeing through land associated with the development proposals and existing industrial / commercial land use in addition to a further crossing of an additional 132kV DNO asset. Multiple large angle pylons may be required to navigate pinch points and avoid constraints in this area

whilst also facilitating a perpendicular crossing of a railway line and the Three Rivers which run in parallel to the corridor.

Figure 8-7 – Corridor 3 – Concentration of Existing Overhead Lines around Keadby Power Station

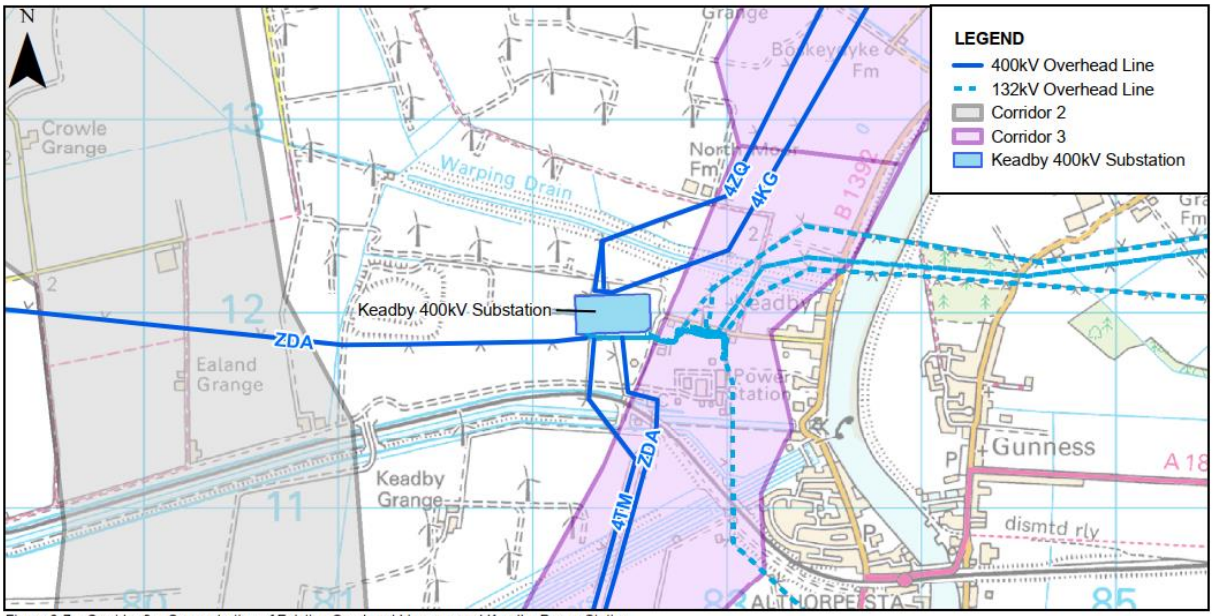


Figure 8-7 – Corridor 3 – Concentration of Existing Overhead Lines around Keadby Power Station

8.3.12 Routeing on the western side of the existing 4ZQ 400kV overhead line is unfeasible towards Keadby Power Station due to the wind farm, existing assets connecting into the substation and the planned Keadby Power Station development. However, south of the River Ouse and north of Keadby, there are two relatively unconstrained Links (Link 1 and Link 2) that provide opportunity for routeing from Corridor 3 into Corridor 2 avoiding this constrained area.

8.3.13 Immediately south of Keadby Power Station, parallel routeing to the east of the existing ZDA and 4TM 400kV overhead lines may be feasible however the presence of a wind farm prevents close parallel routeing to the west. For parts of the corridor south of Althorpe and towards East Stockwith, triple close parallel routeing may be possible on either side of the existing overhead lines. However, as aforementioned, this could introduce technical issues for future maintenance of the central overhead line if sufficient stand-off cannot be maintained, hence potentially limiting the space available for the positioning of machinery and additional infrastructure, such as temporary diversions. Deviations from close parallel may be required in places to avoid localised blocks of woodland, scheduled monuments, and residential receptors, especially on the west to avoid the village of Beltoft. Throughout this section, routeing over A-roads, motorways, high pressure gas pipelines, oil pipelines and the HLCP Project Preferred Route Corridor is required, which may limit the positioning of infrastructure. Near Owston Ferry, ground investigations may also be necessary due to the potential for routeing through a disused quarry.

8.3.14 From East Stockwith, routeing to the west of the existing ZDA and 4TM 400kV overhead lines is unlikely to be feasible as the corridor narrows substantially due to the surrounding residential areas of Misterton, Beckingham and Saundby to the west, and Beckingham Marshes RSPB Nature Reserve on the east. Sufficient stand-off from the existing overhead lines to enable future maintenance works is unlikely to be achievable

without oversailing residential properties and curtilage. South of Beckingham Marshes RSPB Nature Reserve, West Burton Power Station, various underground assets and multiple planning applications occupy the corridor to the west of the existing ZDA 400kV overhead line and consequently close parallel routeing on the western side is also unlikely to be feasible at this down towards West Burton.

8.3.15 Diverting around East Stockwith to the east would require deviation away from close parallel due to the narrowing of the corridor. This would necessitate two crossings of the River Trent likely requiring crossing protection and sufficient clearances due to its navigability. At this location, it may be possible to route through Link 3 into Corridor 2, subsequently crossing a railway line, two oil pipelines and an A-road. However, as routeing to the western side of the overhead line is unlikely to be feasible at this point, utilisation of this linking corridor may require underground cabling and SECs to facilitate a crossing of the existing ZDA and 4TM 400kV overhead lines from the eastern side thus increasing technical complexity and risk.

8.3.16 Towards Beckingham, the corridor narrows significantly again predominantly due to Beckingham Marshes RSPB Nature Reserve. To avoid construction of any new infrastructure within the reserve, and to navigate the narrow corridor, reconfiguration and line deviations of the exiting overhead lines, or sections of underground cabling and SECs, would be required all of which would increase the technical complexity, introduce construction and delivery issues and give potential for system and network issues. Further south, towards West Burton Power Station and the West Burton C development, deviation is likely required around the site to the east, necessitating two additional crossings of the River Trent, in addition to crossings of two railway lines and a high pressure gas pipeline. Infrastructure would also likely be required within landfill sites, waste sites and land associated with the redundant power station. Consequently, ground investigations would be required to determine ground conditions and subsequently inform foundation designs.

8.3.17 Continuing south of West Burton Power Station, routeing in close parallel to the west of the existing ZDA and 4VE 400kV overhead lines may be feasible but may require additional cable underground cabling and SECs to cross the existing overhead line assets if routeing from the eastern side of the corridor. The requirement for these could be avoided if routeing from Corridor 2 into Corridor 3 south of Sturton le Steeple, via the C2-C3-Link. Routeing to the west of the existing overhead lines is likely only to be feasible as far south as Church Laneham and would require crossing a railway line and traversing land associated with the West Burton, Gate Burton and Cottam solar developments. The corridor narrows significantly north-west of Church Laneham and therefore utilisation of Link 4 into Corridor 2 and continuing south to High Marnham would likely be the necessary. Few technical constraints were identified within this Link. Alternatively, underground cabling and SECs to the eastern side of the existing overhead line within Corridor 3 may be feasible but would significantly increase the technical complexity and risk.

8.3.18 Routeing on the eastern side of the corridor south of West Burton would require crossing of a 132kV DNO overhead line, and potential line swap overs or underground cabling and SECs to navigate the existing 4ZM, 4VE and ZDA 400kV overhead lines, all of which increase the technical complexity, cost and programme risk. Various solar developments including Cottam, West Burton and Gate Burton also cover a large portion of the corridor. To avoid Cottam Power Station, deviation east around the existing site would be required although some infrastructure may still be required within; ground investigations would be necessary to determine suitability. To the east of Cottam, the C3-C4 Link provides an option for routeing from Corridor 3 into Corridor 4

however, this would be unlikely to significantly reduce any technical risk or complexity as several of the aforementioned planning applications also extend into this link and underground cabling and SECs would still be required to enable a crossing of the existing 4ZM 400kV overhead line which traverses the corridor at this point. Additionally, a crossing of the River Trent would also be unavoidable. South of Cottam Power Station, navigation of the existing 4VK, 4VE and ZDA 400kV overhead lines would be necessary, likely requiring further line swap overs or underground cabling and SECs. Furthermore, additional crossings of the River Trent are likely to be unavoidable as is a crossing of the Anesco Solar development on the approach to High Marnham Substation.

8.3.19 Throughout the preliminary corridor, various low voltage DNO assets would need to be crossed. These assets would need to be mitigated in advance of the Project, therefore coordination and staging of works is important to deliver the connection with the detailed design. In addition, peaty soils are present throughout the corridor. Whilst their full extent and conditions are unknown, peaty soils pose a risk to pylon foundations, through ground subsidence and waterlogging. Should infrastructure be required within the peaty soils, there may be a requirement for geotechnical investigations, specific foundation designs and specialised accesses. Furthermore, Corridor 3 falls largely within Flood Zones 2 and 3 which poses a risk to construction, delivery and maintenance of the route, namely through potential waterlogging and possible access restrictions. Foundations would need to be designed to suit, as would temporary and permanent drainage mitigation and access routes.

8.4 Holford Rules

8.4.1 With the exception of the crossing of the River Ouse and thus the Humber Estuary designated sites, the corridor has been drawn to exclude major areas of the highest amenity value and interest in accordance with Holford Rule 1.

8.4.2 Where there are smaller areas of high amenity value for instance, SSSIs and listed buildings, sufficient space has been included within the corridor to enable routeing to avoid them and to minimise impacts, potentially by local deviation, in accordance with Holford Rule 2.

8.4.3 The corridor largely allows for the overhead line to follow a direct line, with limited sharp changes in direction, in accordance with Holford Rule 3. The corridor and Links were developed to avoid highly constrained areas, and specific constraints including settlements such as Broomfleet, Luddington, Beltoft and East and West Stockwith, and the corridor deviates from a straight path in places to avoid constraints including Brantingham Dale, Keadby Wind Farm and the River Trent.

8.4.4 The narrow width of the corridor over much of its length reflects both the surrounding constraints and the intent to provide a primarily close parallel design, but it is wide enough to provide flexibility and alignment options during later stages of design development. The balance required by Holford Rule 6 when considering close parallel alignments (planning for pylons, spans and conductors to form a coherent appearance; but allowing sufficient separation to limit the impacts on properties and features between the lines where they have to diverge) is addressed by the inclusion of wider sections including at Broomfleet and Beltoft to allow options for routeing either side of the settlements, and between Luddington and Keadby to allow for options around the parallel but widely spaced 4ZQ and 4KG routes. South of the Nottinghamshire boundary, the corridor is sufficiently wide to allow design flexibility at later stages for the

development of a range of options to address the integration of the new overhead line with the complexities of the existing overhead lines to West Burton, Cottam and High Marnham. Given the complexity of the existing network, it is likely to be difficult to avoid adding to the existing wirescape in places, contrary to Holford Rule 6, particularly at Keadby, Cottam and on the approaches to High Marnham.

8.5 Conclusion

8.5.1 Environmentally, there is the potential for adverse landscape and visual impacts in relation to landscape character and visual amenity due to the potential combination of a new overhead line with existing electricity transmission infrastructure where the corridor narrows near Skidby, Ellerker North Wold and Misterton where existing overhead lines converge and diverge. The wooded dales to the north-east of Ellerker would also be difficult to avoid when routeing the overhead line. There is likely to be the potential for ecological and historic environment impacts. Brantingham Dale SSSI is partially located within the corridor and can be avoided through routeing. The habitats within the corridor may support species cited as qualifying features of the Humber Estuary designated sites. Ellerker Conservation Area is entirely located within the corridor and there is the potential for adverse impacts on its special character. There may be potential temporary disruption during construction for users of the A road network and recreational routes within the corridor. A landfill site covers the entire width of the corridor to the south of Little Weighton and is unavoidable. There is a potential risk should the soil be disturbed during construction in this area. A crossing of the Mill Beck which is a water framework directive river waterbody may also be required.

8.5.2 The technical complexity and risk associated with the northern extent of Corridor 3 is primarily related to the potential requirement for multiple sections of underground cabling and SECs or line swap overs if switching between routeing to the north and the south of the existing 4ZQ 400kV overhead line. Underground cabling and SECs carry technical risks associated with construction and delivery as well as potential network and capacity issues. Moreover, line swap overs would introduce technical challenges with the reutilisation of existing structures, foundations, fittings and conductors as well as a potential requirement for additional outages and temporary diversions. Routeing to the northern side of the existing 4ZQ 400kV overhead line throughout the entirety of the corridor would negate the need for either of these measures and therefore would reduce the technical complexity significantly. For parts of Corridor 3, opportunity for close parallel routeing was identified to both the north and the south of the existing overhead line. Due to localised constraints, additional angle pylons may be required at points to facilitate a deviation away from close parallel. At Creyke Beck Substation, the positioning of infrastructure may be limited by the various proposed developments that occupy the available corridor. Additionally, the escarpment to the west of Brantingham Dale SSSI is likely to be an area of notable technical complexity due to the very steep topography which would need to be taken into account during the detailed design.

8.5.3 Technically, there are multiple constraints throughout Corridor 3 that would need to be overcome when routeing – namely main and major roads, railways, underground pipelines, solar farms, planning developments, designated sites, residential receptors, DNO assets and flood zones. The navigation of the multiple existing 400kV overhead lines is likely to be technically complex. Several line swap overs or underground cabling and SECs are likely to be required, all of which would increase technical complexity, introduce construction and delivery issues and could give rise to potential system and network issues. Additionally, due to the nature and orientation of constraints, the corridor is limited in places on the east and west of the existing overhead lines, thus

preventing a full solution on one side and further increasing the requirement for line swap overs or underground cabling and SECs. Corridor 3 also presents some unique technical challenges relating to the potential for triple parallel routeing. This introduces technical risk through restricting the available space for additional infrastructure such as temporary diversions or the placement of machinery to facilitate maintenance of the lines. Notably however, this risk can be reduced through ensuring sufficient separation distances. The presence of several redundant power stations and associated waste sites, as well as peaty soils and disused quarries, also introduces risks associated with ground conditions and the potential for pollution and contamination thus heightening the necessity for ground investigations. Various underground assets would also likely impact the positioning of infrastructure throughout the corridor, however the full extent of these is currently unknown as extensive utility searches have not yet been conducted.

8.5.4 A tabulated summary of the appraisal of Corridor 3 is provided in **Table 8-1**.

Table 8-1 – Summary of Corridor 3 Options Appraisal

Theme	Topic	Summary
Environmental	Landscape and Visual	• The presence of the existing 4ZQ 400kV overhead line may intensify existing adverse impacts on the landscape and on visual amenity through the Wolds ILA. • There is potential for adverse impacts on views experienced by recreational receptors including users of the NCN, footpaths including the Trans Pennine Trail and along the River Ouse and River Trent. • Scattered residential properties and settlements within and adjacent to the corridor are likely to experience potential adverse visual impacts, although for the most part these would be in combination with existing infrastructure rather than the introduction of impacts into new areas. This includes at the River Ouse where tall river crossing pylons would be required. • Around and between West Burton, Cottam and High Marnham Power Stations there is a complex network of existing overhead lines which converge and diverge in several placesand there is the potential for the creation of wirescape, particularly close to the power station sites. • The sensitivity of the local landscape within the corridor is reduced in places due to the location of existing infrastructure such as energy development and the road and rail network.
	Ecology	• The corridor crosses the Humber Estuary designated sites following the route of the existing 4ZQ 400kV overhead line crossing. There is the potential for the wider corridor to have habitat connectivity and be hydrologically connected to these sites. • The corridor follows the existing 4TM and ZDA 400kv overhead lines across the Mother Drain SSSI and Beckingham Marshes RSPB Nature Reserve. There is the potential for adverse impacts on these sites due to the siting of pylons and access routes.
	Historic Environment	• Ellerker Conservation Area and associated listed buildings are entirely located within the corridor and there is potential for adverse impacts on setting. Key views from Skidby Conservation Area, Risby Hall Registered Park and Garden and Brantingham Conservation Area would need to be considered during routeing.

Theme	Topic	Summary
		• Several listed buildings and scheduled monuments are scattered throughout the corridor and it is anticipated that these can be avoided through careful routeing. However, impacts on setting are likely to arise should the overhead line be developed where the corridor is closest to these heritage assets. • There are clusters of heritage assets located within the settlements of Adlingfleet, Garthorpe, Owston Ferry, East and West Stockwith, Gainsborough and Dunham on Trent.
	Socio-economics	• There may be potential adverse impacts on the road network and recreational routes relating to disruption during construction. • The predominant land use within the corridor and Links is agricultural and the Project may result in the permanent loss of agricultural land, classed as high-quality. However, the overall land take for the Project is considered to be a small percentage of the overall area of agricultural land. • Discussion and coordination with the developers associated with planning applications and applications for DCOs may be necessary to ensure the Project can be facilitated in combination with these proposed developments. • There are several proposed developments located within the vicinity of Keadby, West Burton and Cottam Power Stations. • Consultation would be required with West Burton Airstrip, and the MoD in relation to the Met Radar Zone.
	Other Considerations	• There is a potential risk of temporary impacts limited to localised changes in air quality and noise and vibration during construction. • A landfill site covers the entire width of the corridor to the south of Little Weighton and is unavoidable. There is a potential risk should the soil be disturbed during construction in this area.
Technical	Technical Complexity	• From Creyke Beck to Althorpesta, parallel routeing on either side of the existing National Grid 4ZQ 400kV overhead line may be feasible in parts. • From Althorpesta to East Stockwith, parallel routeing to the east or the west of the existing National Grid ZDA and 4TM 400kV overhead lines may be feasible in parts.

Theme	Topic	Summary
		• From East Stockwith to West Burton, parallel routeing is likely only to be feasible to the east of the ZDA and 4TM 400kV overhead lines. • From West Burton to Church Laneham, routeing in parallel to either side of the existing ZDA and 4VE 400kV overhead lines may be possible in parts. • From Church Laneham, routeing in parallel to the existing ZDA and / or 4VE 400kV overhead lines is likely only to be possible on the eastern side of these assets. • Triple parallel routeing could introduce potential construction and maintenance issues for the central line should sufficient stand-off distances not be implemented. • To navigate pinch points, facilitate crossings of existing overhead lines (including the: 4ZQ, 2KN, 4KG, 4TM, ZDA, 4VE, 4ZM and 4VK) and maximise close parallel routeing, multiple line swap overs and / or underground cable with SECs are likely to be necessary which could introduce network and capacity issues and added cost and programme risk. • Multiple Distribution Network Operator overhead line assets may require mitigation which will need to be programmed in with the asset owner – of particular note is the multiple 132kV DNO overhead lines to the east of Keadby Substation.
	Construction and Delivery	• Coordination with developers will be required to ensure the proposed new overhead line can be facilitated in combination with the various developments and major infrastructure projects located within Corridor 3 particularly around the new Creyke Beck Substation and West Burton Substation. • Removal of a wind turbine to the north-west of Creyke Beck Substation may be required to ensure there is sufficient space for routeing the proposed new overhead line – subject to detailed design of the new Creyke Beck Substation and confirmed turbine parameters. • The very steep nature of the topography at the Brantingham Dale would need to be factored into the detailed design to minimise technical risk. • Crossing of the River Ouse is likely to be particularly complex due to the likely requirement for a long span length and tall river crossing pylons – routeing may be feasible to the east or the west of the

Theme	Topic	Summary
		existing 4ZQ 400kV OHL, noting significant surrounding constraints including residential properties and Hall Garth moated site scheduled monument. • Underground oil and high pressure gas pipelines may limit the positioning of pylons throughout the corridor. • Additional angle pylons may be required to enable deviations away from close parallel routeing around localised constraints. • Additional angles may be required to facilitate perpendicular road, rail and watercourse crossings, as well as to deviate around localised constraints, which could lead to increased volumes of construction traffic – technical complexity is further increased in certain areas due to multiple crossings in short succession. • Ground investigations may be required to determine ground conditions and inform foundation design should infrastructure be required within the disused quarry near Owston Ferry or within waste sites and land associated with the redundant power station sites at West Burton and Cottam. • Peaty soils are present at points throughout the corridor which may pose a risk to pylon foundations through ground subsidence and waterlogging. Geotechnical investigations, specific foundation designs and specialised accesses will likely be required in these areas. • Infrastructure is likely to be required within flood zones which could pose a risk to construction and maintenance – specific foundations, drainage and mitigation access routes would need to be designed to suit.

9. Options Appraisal – Corridor 4

9. Options Appraisal – Corridor 4

9.1 Introduction

9.1.1 Corridor 4, which branches from Corridor 3, begins with a crossing of the River Trent to the south-west of Scunthorpe and south of Burringham. The corridor then routes south-east through agricultural fields crossing the M180, M181 and A159 to the west and south of Scunthorpe, before routeing south-east to avoid Scotter and Laughton Forest. From Scotter, the corridor continues south past Scotton, Kirton in Lindsey and Northorpe before crossing the A631 at Corringham, and continuing south passing settlements including Upton, Willingham by Stow and Stow. The corridor then routes south crossing the A1500, A156, A57 and A1133 before routeing in a south-west direction ending at the area around the existing High Marnham Power Station. The extent of the corridor is shown in **Figure 9-1**.

9.1.2 Corridor 4 is the furthest east corridor option, and is the shortest as it does not connect to Creyke Beck, instead connecting to the northern section of Corridors 2 or 3 at a point southwest of Scunthorpe to complete the route. Key constraints to note for this corridor include five existing 400kV overhead lines, which would need to be crossed, the River Trent and the road and rail network. These key constraints are shown in **Figure 9-2**.

9.1.3 The corridor was progressed primarily to avoid the Trent Valley and route away from the existing electricity transmission infrastructure in this area through a relatively open and unconstrained landscape within west Lincolnshire. Corridor 4 is the only corridor to predominantly route to the east of the River Trent and is the only corridor to route into High Marnham from the north-east.

Figure 9-1 – Corridor 4

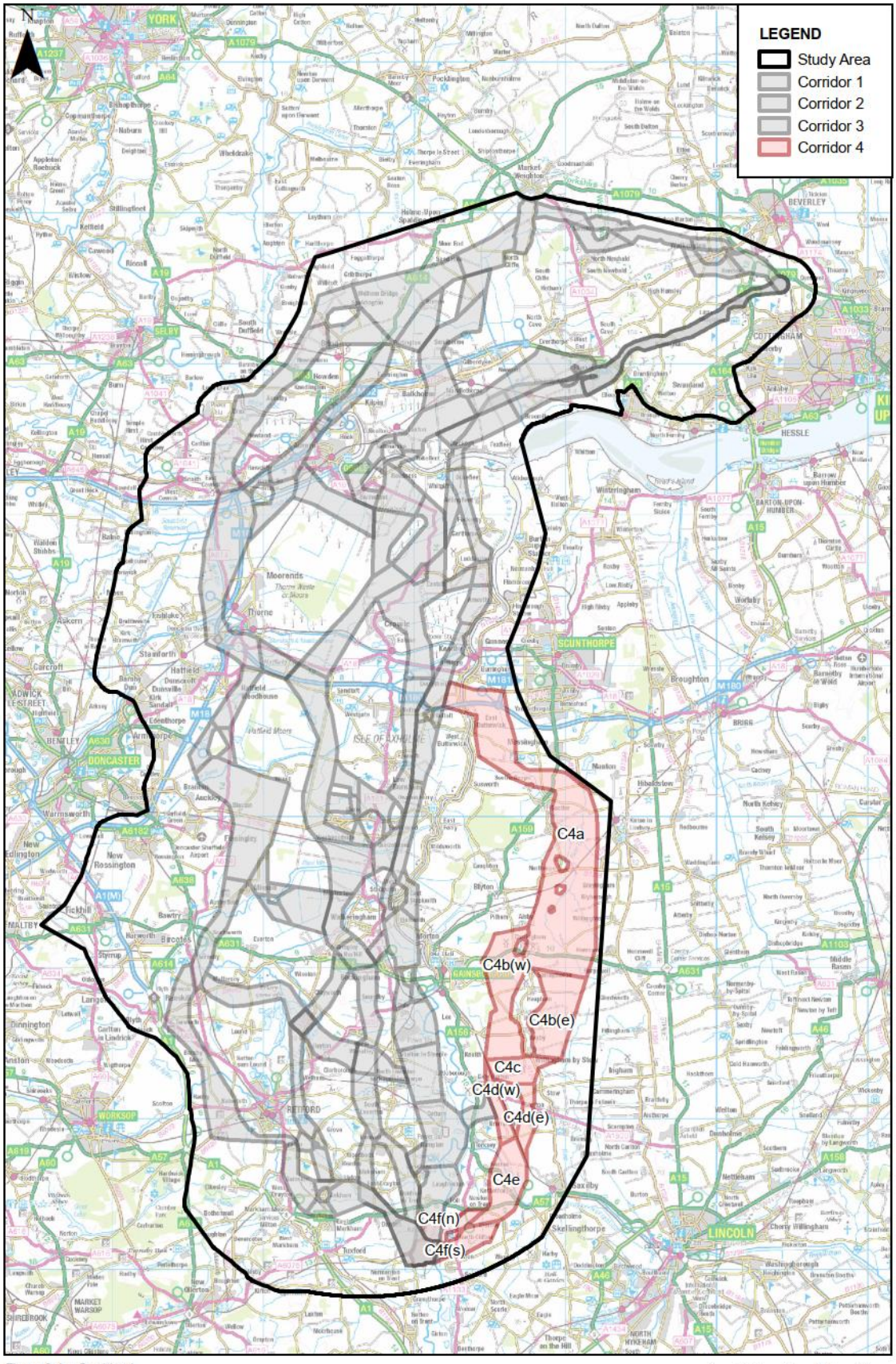


Figure 9-1 – Corridor 4

Figure 9-2 – Corridor 4 – Key Constraints

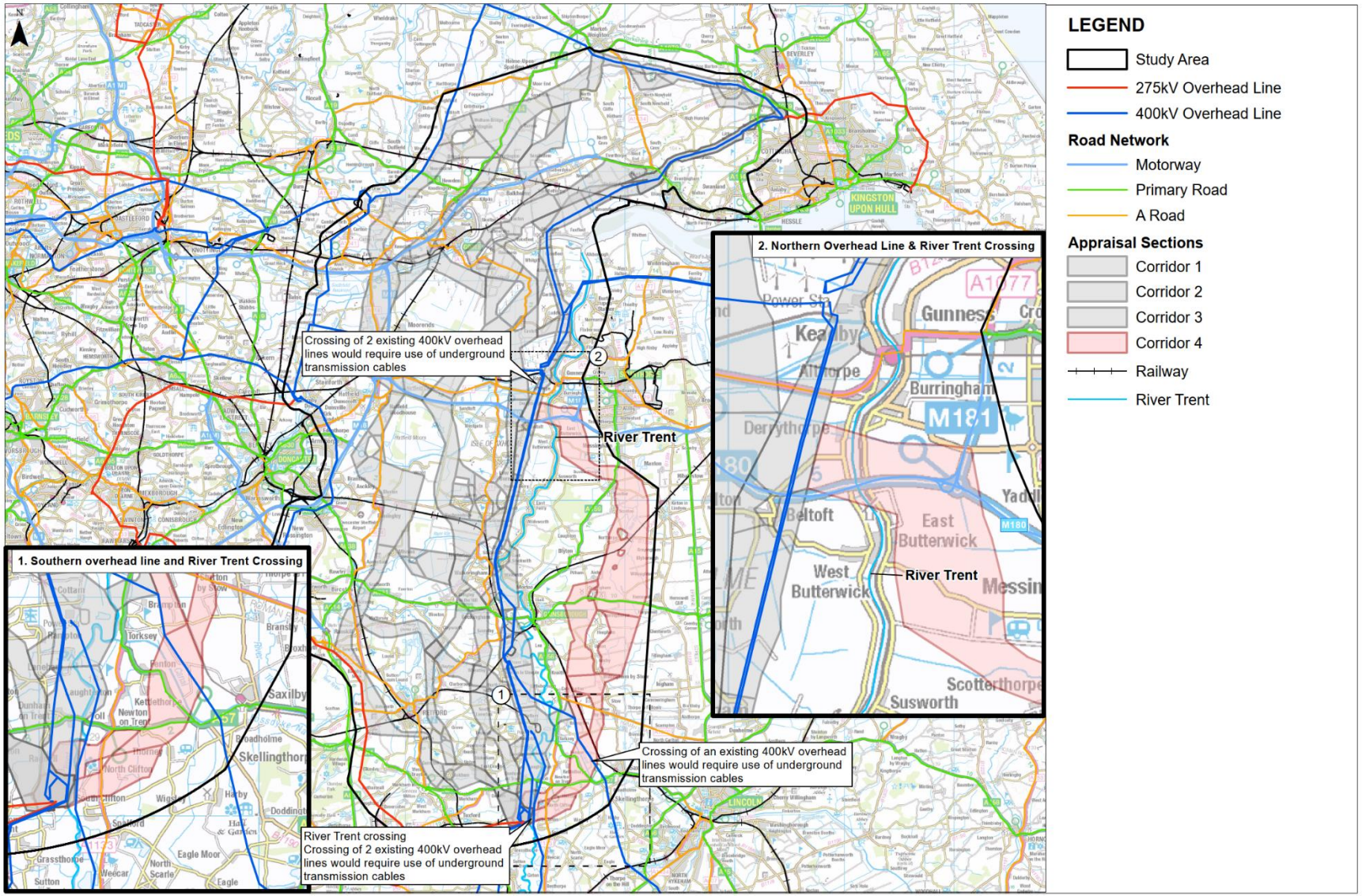


Figure 9-2 – Corridor 4 - Constraints

SCALE : 1:300,000

0 2.5 5 7.5 10 km

9.1.4 The majority of Corridor 4 comprises one complete corridor, however there are three locations where the corridor splits into two and routes either side of a cut-out to avoid a receptor and/or constraint. The three splits are:

- Around Sturgate Airfield – to avoid the airfield and the residential settlements of Springthorpe, Heapham, Upton, Kexby and Willingham by Stow (see C4b(w) and (e), **Figure 9-1**);
- Around Stow Park – to avoid the Stow Solar Farm and Stow Park, including the Scheduled Monument present within the grounds of Stow Park (The Medieval Bishop's Palace and Deer Park) (see C4d(w) and (e), **Figure 9-1**); and
- To the north and south of North Clifton, to avoid the residential settlement (see C4f(n) and (s), **Figure 9-1**).

9.1.5 The northern end of Corridor 4 is located to the east of the existing 400kV overhead lines located within Corridor 3. If routeing from Corridor 3 into Corridor 4 these lines would need to be crossed at a point north of Keadby Substation due to routeing constraints on the western side of the Substation. In this case the new overhead line would also need to cross the routes of three existing 132kV overhead lines to the northeast of Keadby Substation. The appraisal of this section of Corridor 3 'South of the River Ouse to High Marnham' is discussed in **Chapter 8** of this Report and sets out the significant land-use, technical and cost constraints associated with adopting this corridor.

9.1.6 Alternatively, Corridor 4 could be approached from the Corridor Loop between Corridor 2 and Corridor 3. Whilst this would avoid the constraints to routeing a new line around Keadby Substation, the two existing 400kV overhead lines south of Keadby would still need to be crossed in order to reach Corridor 4.

9.1.7 Whilst it is practicable to cross one overhead line with another, this results in taller pylons on the higher line and introduces significant operational and safety concerns. As a result, it is typically considered more appropriate to replace one overhead line with a short section of underground cables. In this way operational and safety concerns are substantially reduced, and taller pylons which may have increased visual impacts can be avoided. The appraisals of Corridor 4 were therefore undertaken on this basis.

9.1.8 Further south, Corridor 4 crosses the route of the existing 400kV overhead line between West Burton and Walpole in Norfolk (the 4ZM). As described above, it is typically considered more appropriate to replace one overhead line with a short section of underground cables. The appraisals for Corridor 4 were therefore undertaken on this basis.

9.1.9 As Corridor 4 approaches High Marnham, two further 400kV overhead lines (the 4VK and 4VE) would also need to be crossed. These lines are located either side of the River Trent. Again, it was assumed for the purpose of appraisal that both would need to be crossed using underground cables. Given the short distance between the two lines it was also considered likely that both lines would be crossed by a single section of cable, meaning that the cables would need to be installed in ducts in order to cross beneath the River Trent. The secure compound that would form the start point for the sections of cable was assumed to be located within Corridor 4, either to the north or south of the village of North Clifton. It was assumed that the underground cables would terminate at the new High Marnham Substation, thereby avoiding the need for a sixth discrete compound location. The appraisals for Corridor 4 were therefore undertaken on this basis.

9.2 Environmental Factors

9.2.1 All descriptions are given moving from north to south along the corridor.

Landscape and Visual

9.2.2 The corridor begins within the Humberhead Levels NCA, characterised by flat, low-lying open landscape with long views. The M180 and M181 reduce sensitivity of the landscape to new infrastructure in the northern section of the corridor. However, there is the potential for large river crossing pylons to be required across the River Trent and these are likely to be more widely visible due to their greater height. This may result in adverse impacts on the landscape and setting of the River Trent and surrounding area and on recreational users travelling along the River Trent. Similar adverse impacts are also possible at Fossdyke Navigation, a tributary of the River Trent, which the corridor crosses further south, to the east of Fenton. Residential receptors at Burringham, East and West Butterwick and Althorpe, as well as recreational users of Grange Park Golf Course may experience adverse visual impacts. There is the potential for an adverse landscape and visual impact in combination with the existing overhead lines on residents to the east of Beltoft.

9.2.3 South of Scunthorpe, the corridor routes eastwards, moving out of the Trent Valley and into the Northern Lincolnshire Edge with Coversands NCA, an area characterised by low-lying farmland with scattered blocks of woodland. To the east and south, the landscape becomes slightly more undulating with scattered woodland blocks. There is the potential for adverse visual impacts on scattered residential receptors and settlements in the northern section of the corridor. There is also the potential for adverse landscape impacts on characteristic woodland belts.

9.2.4 Further south, to the north of Corringham, the corridor routes into the Trent and Belvoir Vales NCA, an area characterised by a gently undulating open landscape. There is the potential for Corringham to be significantly impacted if the new overhead line is routed across slightly elevated ground in this area. The corridor splits into eastern and western sections to the south of Corringham to avoid Sturgate Airfield and narrows in this location limiting flexibility for routeing. Scattered residential receptors and the settlements of Springthorpe, Heapham, Upton, Kexby and Willingham by Stow may experience adverse visual impacts due to the proximity of the overhead line.

9.2.5 The southern area of the corridor between Willingham by Stow and High Marnham has several major roads crossing including the A1500, A156, A57 and A1133, as well as two railway lines. The existing 4ZM 400kV overhead line forms the western boundary of the corridor to the south-east of Marton and crosses the corridor to the south-east of Torksey. This existing infrastructure locally reduces the sensitivity of the landscape to new infrastructure.

9.2.6 The approach to High Marnham Power Station is constrained as the corridor narrows to the north and south of North Clifton. To the north of North Clifton, the corridor crosses higher ground and includes a reservoir and a crossing of the River Trent such that flexibility for routeing is reduced in this area. The use of underground cables in this area could help to locally reduce visual impacts, especially for recreational receptors travelling along the Trent Valley Way and users of the NCN Route 647. However, the potential for visual impacts on North Clifton and South Clifton and on scattered residential properties would remain due to the need for permanent SECs (as described in **Section 2.3**).

Ecology

9.2.7 Corridor 4 is located approximately 2.4km south of the Humber Estuary designated sites and is hydrologically connected via the River Trent. Due to this proximity and the presence of likely habitat within the corridor, this area may support species cited as qualifying features of the Humber Estuary designated sites. Messingham Heath SSSI is located adjacent to the corridor to the south-west of Messingham and there is the potential for adverse impacts on this site should routeing take place in proximity. Further south, there is the potential for adverse impacts on the several parcels of ancient woodland within and adjacent to the corridor between Corringham and Willingham by Stow. These would be avoided through careful routeing.

9.2.8 Due to the hydrological connectivity of the River Trent to the Humber Estuary designated sites, should underground cables be used to cross the River Trent there is the potential for indirect adverse hydrological impacts.

Historic Environment

9.2.9 Towards the north of the corridor near Scunthorpe and Kirton in Lindsey, there are potential impacts to the setting of nearby designated assets and to the archaeology of scheduled monuments, notably Southorpe Medieval Settlement and Cultivation Remains and the Deserted Village of Dunstal which are located adjacent to the boundary of the corridor. Careful routeing would need to be considered.

9.2.10 There are a number of listed buildings (I, II, and II*) scattered throughout Corridor 4. There are also several scheduled monuments located adjacent to the corridor, and two scheduled monuments within the corridor to the east of Torksey both part of the Medieval Bishop's Palace and Deer Park. Although these receptors are considered a constraint, the adverse impacts on the setting of these designated heritage assets can be avoided given the width of corridors and through careful routeing of the overhead line and siting of the pylons.

9.2.11 Similar impacts apply for the use of underground cables to cross the River Trent and the 4ZM 400kV overhead line due to the requirement for SECs on either side of the River. The compound to the east of the River Trent would be located in close proximity to a number of listed buildings (I, II, and II*) around Fledborough and North Clifton.

9.2.12 There are also several groupings of listed buildings, scheduled monuments and conservation areas located within 1km of the corridor. However, there is the potential to avoid adverse impacts through careful routeing.

Socio-economics

9.2.13 The M180, M181, A159, A631, A1500, A156, A57 and A1133 route through the corridor. Whilst they are scattered throughout, there is an increased risk of impacts to traffic and transport receptors in the north of the corridor due to the high number of major roads (M180, M181, A159, A631) and a railway line (Doncaster to Lincoln Line) present, with works likely to require crossings of roads and the railway line. A crossing of Dukeries Trail, also a NCN Route, and Gainsborough Cycle Trail may also be required. There may be potential impacts relating to temporary disruption during construction.

9.2.14 Low Hill Farm Airstrip, Sturgate Airfield, Stow Airfield and Carr Farm Airstrip are located within 1km of the corridor and RAF Kirton in Lindsey is located approximately 2km to the east of the corridor. Consultation with both would be required to identify impacts on

existing activity and lighting. Consultation with the MoD would also be required to identify potential impacts on the existing MoD Met Radar Zone which covers a substantial part of the southern extent of the corridor.

9.2.15 There are several proposed developments located within, and in proximity to Corridor 4; West Burton Solar Project (connection and site), Cottam Solar Project Connection, Gate Burton Energy Park and the HLCP Project Preferred Route Corridor. Consideration should be given to the routeing of the new overhead line and the potential for indirect impacts to these proposed developments.

9.2.16 The majority of the corridor is Grade 3 (good) agricultural land although there are some areas of Grade 1 (excellent) and Grade 2 (very good) near East and West Butterick and Burringham. There would be permanent land take as a result of the five separate SECs required, but this is likely to be a small percentage of the overall agricultural land present. This is not considered a differentiating factor for routeing and siting of infrastructure.

9.2.17 Similar socio-economic impacts would apply if underground cables were used to cross the River Trent.

Other Considerations

9.2.18 Other environmental topics were also considered as part of the options appraisal and include air quality, geology and soils, noise and water.

9.2.19 There are scattered, sparsely distributed residential, commercial and agricultural properties throughout the corridor as well as several nearby settlements including Burringham, East and West Butterick, Scotter, Northorpe, Corringham, Springthorpe, Willingham by Stow, and North and South Clifton. There may be localised changes in air quality and noise and vibration on settlements adjacent to the corridor during construction. No potential adverse air quality or noise and vibration impacts are anticipated during operation.

9.2.20 There are several scattered historic landfill sites, abandoned mines and quarries, and areas of peaty soils located throughout and nearby to the corridor which are considered avoidable due to their scattered and localised nature. There is also an active well located in section C4a which is considered avoidable through careful routeing.

9.2.21 There are constraints associated with water, primarily due to the presence of the River Trent and smaller watercourses, water framework directive watercourses, in combination with Flood Zone 2 and 3 which are present throughout the corridor. However, there are no constraints which are considered to have potential adverse impacts to the extent which they would prevent routeing.

9.2.22 Careful siting of SECs would be required where underground cables are used to cross the River Trent to avoid the historic landfill site to the west of the River Trent. The design of the SECs would also need to take account of Flood Zone 3 which cover the River Trent and the surrounding area as there is a potential risk that the location of the SECs increases flood risk, however adverse impacts are expected to be minimal given the relatively small size of SECs.

9.3 Engineering and System Factors

9.3.1 There were several constraints located throughout Corridor 4 considered likely to reduce routeing flexibility and/or increase the technical complexity of the corridor,

constraints which would also have associated construction and delivery impacts and potential network and capacity issues.

9.3.2 The northern-most section of Corridor 4 from the River Trent towards Springthorpe was deemed likely to be technically complex. At the connection with Corridor 3, as shown on **Figure 9-3**, the River Trent bisects the corridor in a north-south direction. Tall pylons would likely be required to facilitate the river crossing, the exact heights of which would be subject to the detailed design. The positioning of infrastructure may be limited by the HLCP Project Preferred Route Corridor which bisects the corridor to the west of the river and the M180 which crosses the River Trent on the southern side. Additionally, sufficient stand-off would be required from the two wind turbines located towards the centre of the corridor on the eastern side of the River Trent; this may further limit the positioning of infrastructure.

Figure 9-3 – Corridor 4 – Connection with Corridor 3

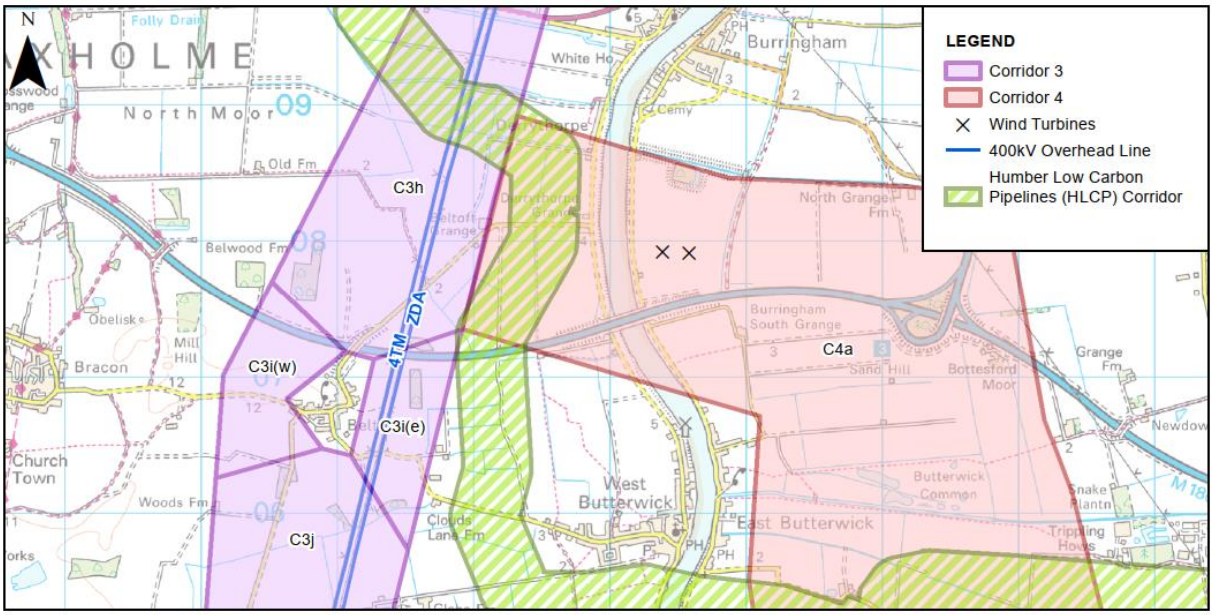


Figure 9-3 – Corridor 4 - Connection with Corridor 3

9.3.3 Routeing through land associated with the HLCP Project Preferred Route Corridor is likely to be required twice; once to the west of the River Trent and once to the south-east of East Butterwick. A crossing of the M180 is also likely to be required in the northern part of Corridor 4 as it horizontally bisects the corridor. Due to the orientation of the motorway, additional angle pylons would likely be required to facilitate a perpendicular crossing which may result in increased volumes of construction materials required and increased volumes of construction traffic.

9.3.4 The River Eau also meanders through the corridor at certain points and therefore a crossing may be required. Several overhead and underground assets are present within this section of Corridor 4. Multiple DNO overhead lines may require mitigation including a 132kV DNO overhead line to the north-east of Scotterthorpe. Two high pressure high pressure gas pipelines are present at Messingham Common and Northorpe and these would need to be crossed. Also, at Northorpe, a railway line traverses the corridor from south-west to north-east. Several additional infrastructure crossings including the A159, the A631 and the railway line are also likely to be required.

9.3.5 South of Springthorpe towards Torksey, Corridor 4 is less technically complex. The corridor splits to the east and west of Heapham and Sturgate Airfield. Further

investigation would be required to determine if this airfield may impact on what type of infrastructure can be used. To facilitate routeing into either of these splits, traversing land associated with the proposed Cottam Solar Project Connection development would be required. This proposed development boundary covers a particularly large proportion of the eastern split and could limit the positioning of infrastructure when crossing the River Till to the west of Willingham by Stow. The proposed development also extends across the full width of the corridor to the south of Willingham by Stow where the split re-joins the main corridor. Within the western corridor split, a crossing of the A631 would be necessary as it horizontally bisects the corridor. Additionally, a high pressure gas pipeline traverses the corridor split from north-east to south-west. At the southern-most end of the western split, the Gate Burton Energy Park development proposal occupies the majority of the corridor width and as such routeing through this proposed development may be required.

9.3.6 Immediately after the splits re-join the main corridor, Corridor 4 once again splits to the east and west around a solar farm to the south of Willingham by Stow. A railway line bisects the corridor from north-west to south-east and therefore a crossing would be required at the northern end of the western split or alternatively, at the southern end of the eastern split. This railway line forms the corridor boundary for the western split and as such could impact the positioning of infrastructure due to the requirement for sufficient separation distances. This may be further exacerbated should stand-off distances also be required from the MoD land located to the south of Stow Park. The western corridor split could be particularly constrained due to the large number of major infrastructure proposals that occupy this proportion of the corridor including the Gate Burton Energy Park, the Cottam Solar Project Connection, the West Burton Solar Project Connection and Project Site. The West Burton Solar Project Connection also extends across the southern end of the eastern split. The extent and orientation of these major infrastructure proposals is such that routeing through land associated with some, if not all, of these may be unavoidable. Numerous oil pipelines are also present within the eastern and western corridor splits. Multiple DNO overhead line assets are likely to require mitigation irrespective of which corridor splits are utilised – this includes a 132kV DNO overhead line that traverses the corridor to the south of Stow Park.

9.3.7 Corridor 4 becomes more technically complex to the east of Torksey. This is primarily in relation to the existing 4ZM 400kV overhead line that bisects the corridor from north-west to south-east. To facilitate a crossing of this asset, underground cabling and SECs would likely be required. The necessity for this crossing increases the technical complexity and risk associated with construction and delivery as well as the potential for system and network issues. Additionally, the positioning of infrastructure for this crossing may be restricted due to the presence of an oil pipeline that traverses the corridor southwards through the aforementioned western split and towards Drinsey Nook. Two wind turbines located north of the existing 4ZM 400kV overhead line would require sufficient stand-off and may further impact infrastructure positioning. The Fossdyke Navigation runs in parallel to the south-west of the existing 4ZM 400kV overhead line and would also require a crossing. Crossings of the A156 and the A57 would also be necessary and may require additional angle pylons to cross perpendicularly. Furthermore, additional angle pylons may be required to navigate the large number of commercial farms that are clustered around Hardwick. The potential requirement for additional angle pylons could increase the volume of construction materials required and increase the volume of construction traffic.

9.3.8 Corridor 4 again splits to the north and south of North Clifton. The northern split was deemed likely to be somewhat more technically challenging than the southern split primarily due to the potential for significant limitations to the positioning of infrastructure

in relation to the wind turbine, reservoir and farm (with a small solar farm) that occupy the northern split. Depending on the stand-off distance required from the wind turbine (subject to further investigations into the turbine dimensions), there may be limited space within the corridor for construction of an overhead line. Crossing of an oil pipeline that bisects the corridor from north-south would be required upon routeing into either split. Additionally, the A1133 traverses both splits in a north south direction and as such a crossing would also be required.

9.3.9 Entry into the High Marnham area is constrained by the River Trent and the associated area of Flood Zone 3, in addition to three 400kV overhead line crossings. An underground crossing of the River Trent would likely be required, using trenchless crossing techniques (such as horizontal directional drill). The trenchless crossing would likely be in excess of 600m, with further design and survey work required to confirm feasibility and suitable launch/reception pits.

9.3.10 A cable SEC would be required to transition to overhead line east of the River Trent. Cable SEC siting is constrained by North Clifton, Hall water reservoir, an existing wind turbine, an existing 400kV overhead line and Flood Zone 3. To the South of North Clifton, siting of a cable SEC would be constrained by a primary school, sewage treatment works and church. Siting the SEC to the west of the A1133 would lead to a requirement for an overhead crossing of the road, whereas siting to the east of the A1133 would introduce the requirement for an underground crossing of the road and would also increase the length of underground cable required.

9.3.11 Routeing underground cables to the High Marnham area on the western bank of the River Trent would present risks from shallow bedrock, as well as potential contamination, services and ground obstructions likely to be present in the brownfield High Marnham Power Station site. Multiple watercourse crossings and the disused railway (now part of the national cycle route) increase complexity of cable routeing.

9.4 Holford Rules

9.4.1 The corridor has been drawn in accordance with Holford Rule 1, which seeks complete avoidance of nationally and internationally designated sites where possible.

9.4.2 Where there are smaller areas of high amenity value, for instance listed buildings and National Forest Inventory Woodland, sufficient space has been included within the corridor to enable an alignment to be found to avoid them, potentially by local deviation, in accordance with Holford Rule 2. An example of this is the avoidance of four scheduled monuments, through the use of cut-outs within the corridor. An example of which is shown in **Figure 9-4**.

9.4.3 The corridor largely allows for the development of alignments with substantial lengths of straight line with limited sharp changes in direction, in accordance with Holford Rule 3. It deviates from the most direct route in places to avoid constraints including Laughton Forest, Gainsborough and the River Trent. The width of the corridor reflects the constraints in that area, with narrow sections where constraints are present such as in proximity to airports, and wide sections where the space is unconstrained in rural areas. The corridor also provides eastern and western routeing options to avoid settlements including around Corringham and to avoid elevated ground (Holford Rule 4). The corridor includes more land than is needed for construction of an overhead line which provides flexibility and options when it comes to routeing for further development in Stage 3. Although there are several changes in direction due to constraints, the

flexibility provided within the corridor has the potential to reduce the need for sharp angles or changes in direction of the overhead line in accordance with Holford Rule 3.

Figure 9-4 –Corridor 4: Example of Scheduled Monument Avoidance

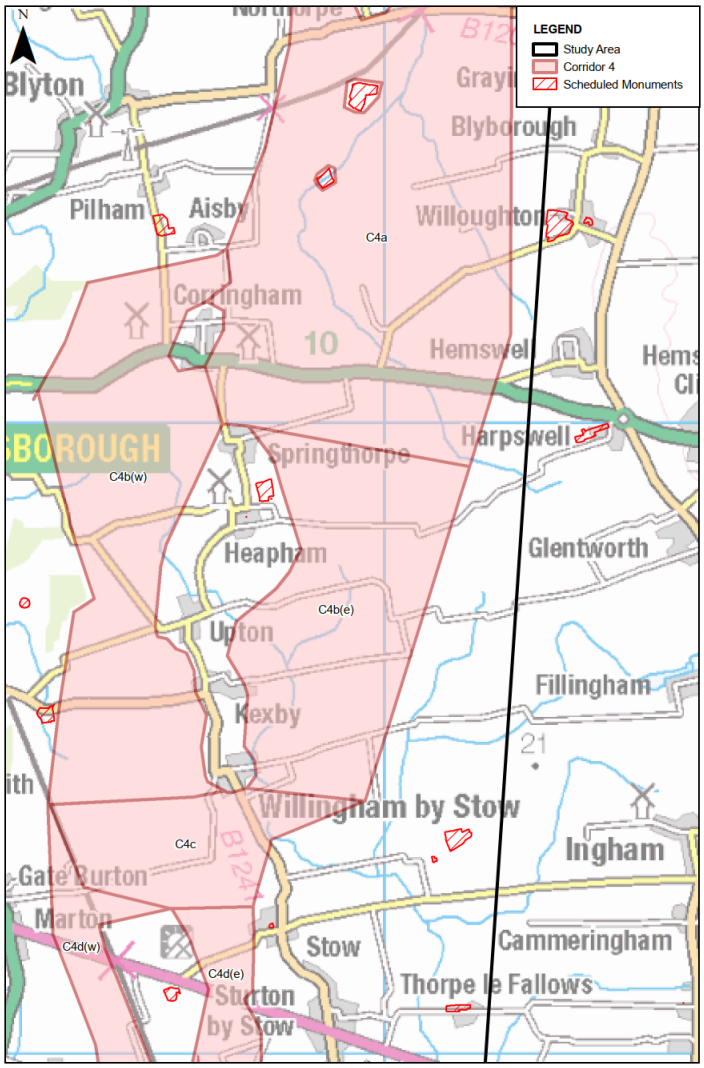


Figure 9-4 – Corridor 4 - Example of Scheduled Monument Avoidance

9.4.4 The corridor, together with the two transition zones on approach to High Marnham, were developed to avoid highly constrained areas, and specific constraints including settlements such as Northorpe, Corringham, Willingham by Stow and North Clifton alongside other constraints such as Sturgate Airfield (Holford Rule 4). The width of the corridor reflects the constraints in a given area, with narrow sections where constraints are present such as between Sturton by Stow and Marton and wide sections where the space is unconstrained, such as around the A156.

9.4.5 Corridor 4 would only require one crossing of the existing 4ZM 400kV overhead line to the east of the Fossdyke Navigation and one crossing of the 132kV DNO overhead line south of Messingham. Underground cabling would route below the existing 400kV overhead lines on the immediate approach to High Marnham (4VK, 4VE and ZDA routes). No crossings would be required of 275kV overhead lines on this corridor. Corridor 4 has fewer crossing of overhead lines compared to the other corridors and therefore there are likely to be fewer adverse landscape and visual impacts associated with crossings (Holford Rule 6). In the congested area around High Marnham, the corridor does not fully comply with the principles of Holford Rule 6, which seeks to avoid

wirescape by keeping high voltage (400kV) overhead lines as far as possible away from smaller overhead lines and other electricity transmission infrastructure. Potential impacts may be reduced through underground cabling in this area.

9.5 Conclusion

9.5.1 Environmentally, there is the potential for a number of adverse impacts throughout Corridor 4 across the environmental and socio-economic topics considered. These are primarily in relation to landscape with potential adverse impacts on landscape character as a result of large river crossing pylons and routeing across low-lying land; and visual with potential adverse impacts on residential properties, settlements and users of recreational sites. The potential for adverse ecological impacts were identified for several parcels of ancient woodland within and adjacent to the corridor and nearby designated sites including Messingham Heath SSSI and the Humber Estuary designated sites. There may also be potential adverse impacts on heritage assets in relation to the setting of listed buildings, scheduled monuments and conservation areas, however there is the potential to avoid adverse impacts through careful routeing. Consultation with aviation receptors within 1km of the corridor and the MoD in relation to RAF Kirton in Lindsey and the Met Radar Zone would likely be required. Consideration of the proposed solar developments within, and in proximity to Corridor 4 and the HLCP Project Preferred Route Corridor would also be required during routeing of the new overhead line due to the potential for indirect impacts to these proposed developments.

9.5.2 Parts of Corridor 4 were deemed to be technically complex including the northern-most section whereby a crossing of the River Trent would likely require tall angle pylons, the positioning of which may be limited by the presence of the HLCP Project Preferred Route Corridor, the M180 and two wind turbines (which would require sufficient stand-off distances). Routeing through land associated with the HLCP Project Preferred Route Corridor is likely to be required on two separate occasions. Additionally, to the west of Torksey Lock, underground cabling and SECs are likely required to facilitate a crossing of the existing 4ZM 400kV overhead line. This would increase the technical complexity and risks associated with construction and delivery as well as the potential for system and network issues. A considerable number of major infrastructure proposals also occupy large parts of Corridor 4 and as such routeing through these developments may be necessary. These include the Cottam Solar Project Connection, Gate Burton Energy Park and the West Burton Solar Project (connection and site). The extent of these major infrastructure proposals within the corridor may limit the positioning of infrastructure. Furthermore, there are a number of underground and overhead assets including gas and oil pipelines as well as DNO overhead lines (including 132kV DNO overhead lines) which may necessitate mitigation. Infrastructure is likely to be required within flood zones which could pose a risk to construction, delivery and maintenance of the route, namely through potential waterlogging and possible access restrictions. Foundations would need to be designed to suit, as would temporary and permanent drainage and mitigation access routes.

9.5.3 Routeing into High Marnham from east of the River Trent is technically complex. A cable SEC would be required to transition from overhead line to underground cable and then a section of underground cable into the High Marnham area, including trenchless crossing of the River Trent. Constraints such as the river, associated Flood Zone 3, potential services and contamination from the demolished power station site and multiple 400kV overhead lines increase complexity.

9.5.4 A tabulated summary of the appraisal of Corridor 4 is provided in **Table 9-1**.

Table 9-1 – Summary of Corridor 4 Options Appraisal

Theme	Topic	Summary
Environmental	Landscape and Visual	• There is the potential for landscape and visual impacts in combination with the existing overhead lines for residents to the east of Beltoft and in the area around High Marnham. • There is the potential for Corringham to be significantly affected if the new overhead line is routed across slightly elevated ground in this area. • Scattered residential properties and settlements within and adjacent to the corridor may experience adverse visual impacts. This includes around the River Trent and from North Clifton and South Clifton where the corridor approaches High Marnham. • The sensitivity of the local landscape within the corridor is reduced in places due to the presence of existing infrastructure such as the road and rail network.
	Ecology	• The corridor routes across the River Trent to the south of the Humber Estuary designated sites and is hydrologically connected to the sites. • There is the potential for adverse impacts on Messingham Heath SSSI located adjacent to the corridor, should routeing take place in proximity. • There is the potential for adverse impacts on several parcels of ancient woodland within and adjacent to the corridor between Corringham and Willingham by Stow. These would be avoided through careful routeing.
	Historic Environment	• Towards the north of the corridor near Scunthorpe and Kirton in Lindsey, there are potential impacts to the setting of nearby designated assets and to the archaeology of scheduled monuments. • Several listed buildings and scheduled monuments are scattered throughout the corridor and it is anticipated that these can be avoided through careful routeing. However, impacts on setting are likely to arise should the overhead line be developed where the corridor is closest to these heritage assets.
	Socio-economics	• There may be potential adverse impacts on the road network and recreational routes relating to disruption during construction.

Theme	Topic	Summary
		• The predominant land use within the corridor and Links is agricultural and the Project may result in the permanent loss of agricultural land, classed as high-quality. However, the overall land take for the Project is considered to be a small percentage of the overall area of agricultural land. • Discussion and coordination with the developers associated with planning applications and applications for DCOs may be necessary to ensure the Project can be facilitated in combination with these proposed developments. • There are several proposed developments located within the vicinity of Keadby, West Burton and Cottam Power Stations. • Consultation would be required with several airfields in proximity to the corridor, and the MoD in relation to potential impacts on RAF Kirton in Lindsey and the Met Radar Zone.
	Other Considerations	• There is a potential risk of temporary impacts limited to localised changes in air quality and noise and vibration during construction.
Technical	Technical Complexity	• Multiple Distribution Network Operator overhead line assets may require mitigation which will need to be programmed in with the asset owner. • East of Torksey, a section underground cable will be required to facilitate a crossing of the existing National Grid 4ZM 400kV overhead line – this would require underground cable, SECs and terminal pylons, which could introduce system and network issues. • To connect into the new High Marnham Substation a section of underground cable will be required to facilitate a crossing of two existing National Grid 400kV overhead lines (the 4VE and 4VK routes) – this would require underground cable, SECs and terminal pylons, which could introduce system and network issues. • Entering Corridor 4 from the north would also require a further section underground cable to facilitate a crossing of two existing National Grid 400kV overhead lines (the 4TM and ZDA routes) – this would require underground cable, SECs and terminal pylons, which could introduce system and network issues.

Theme	Topic	Summary
	Construction and Delivery	• Crossing of the River Trent is likely to be particularly complex due to the requirement for a long span length and tall river crossing pylons – the location of this crossing may be limited by the M180 motorway to the south and two wind turbines in the centre of the corridor, east of the river. • Coordination with developers will likely be required to ensure the proposed new overhead line can be facilitated in combination with various major infrastructure projects located within Corridor 4 including: the HLCP Project Preferred Route Corridor, the proposed Cottam Solar Project Connection, the West Burton Solar Project (connection and site) as well as the Gate Burton Energy Park – the positioning of infrastructure may be limited. • Underground oil and high pressure gas pipelines may limit the positioning of pylons throughout the corridor. • Additional angle pylons may be required to facilitate perpendicular road, rail and watercourse crossings, as well as deviate around localised constraints, which could lead to increased volumes of construction traffic – technical complexity is further increased in certain areas due to multiple crossings in short succession. • The corridor splits into two legs around Sturgate Airfield – further investigation will be required to determine any technical risks and potential impacts on infrastructure associated with this land use. • Sufficient stand-off distances may be required from the MoD land situated south of Stow Park. • Upon entry to High Marnham Substation, there may be limited space for construction in the northern-most corridor leg due to the presence of a reservoir, farm, small solar farm and a wind turbine (subject to confirmation of turbine dimensions and required stand-off distances). • Infrastructure (including permanent SECs) is likely to be required within flood zones which could pose a risk to construction and maintenance – specific foundations, drainage and mitigation access routes would need to be designed to suit.

10. Cost and Programme Performance

10. Cost and Programme Performance

10.1 Introduction

10.1.1 In line with the methodology identified within **Chapter 5**, following the corridor appraisal process, the overhead line corridors were costed and an outline schedule was produced for each one to provide an estimated of the likely earliest operational date (in-service date).

10.1.2 Cost and programme estimates are high level at this stage, and are subject to further design, survey work and are also subject to market forces such as resource availability and external market rates.

10.2 Costing

10.2.1 **Table 10-1** shows the best and worst performing corridor options based on a single point cost estimate for potential end-to-end solutions identified during the appraisal process. The costs, shown in **Table 10-1 (Section 10.4)**, are based on a start point at the new Creyke Beck Substation and an end point at the new High Marnham Substation.

10.2.2 The technology choice, in line with the outputs of the Strategic Optioneering Report (SOR), was for a fully overhead line solution from start to finish with added scope associated cost elements included for what were deemed major engineering challenges as identified in **Chapter 6** to **Chapter 9**.

10.2.3 Pylon type and circuit configuration were assumed in order to satisfy the design requirements, allowing for a unit cost per kilometre of overhead line to be defined. This cost was applied to a reasonable route length within the corridors, based on professional judgement, before adding secondary costs such as likely requirements for localised underground cabling, associated transitional equipment, line swap overs or existing overhead line reconfigurations.

10.3 Programme

10.3.1 To provide robust estimates for a schedule duration for each corridor, the programme tool was defined at activity level based on a unit duration per kilometre before the differentiating variables for each corridor option were inputted to calculate a duration of construction and testing. The critical path construction activities were used to define the earliest in-service date, as shown in **Table 10-1 (Section 10.4)**.

10.4 Indicative Results

10.4.1 **Table 10-1** portrays the indicative cost and programme for the end-to-end overhead line corridors.

Table 10-1 – Cost and Programme Summary Table for End-to-End Solutions

Corridor	Length (km)	Indicative Cost (£m)	Indicative In-Service Date
Corridor 1	110	422	Q3 2032
Corridor 2	86	335	Q3 2031
Corridor 3	84	610	Q1 2032
Corridor 3 – Corridor 2*	84	328	Q3 2031
Corridor 4	87	552	Q1 2032

10.4.2 As shown in **Table 10-1**, the indicative costs range from £328m to £610m. The lowest indicative cost is Corridor 3 – Corridor 2, deviating at a point north of West Stockwith using C2-C3 Loop D, passing to the east of Misterton and Walkeringham before continuing to High Marnham. The highest indicative cost is Corridor 3.

10.4.3 All options appraised include a crossing of the River Ouse for which an overhead crossing has been assumed and included but is not deemed a cost differentiating factor. Corridors 1, 2 and Corridor 3 – Corridor 2 also require a crossing of the existing 400kV ZDA overhead line. The 400kV ZDA overhead line crossing was assumed to be undergrounding for a length of approximately 1km at a cost in the region of £30m. Any major cost differentiators and engineering challenges are explored in the following paragraphs.

10.4.4 Corridor 1 assumes a less direct route to be taken from Creyke Beck pushing to the western edge of the study area before progressing on to High Marnham with an estimated length of 110km. This represents an additional 31% when compared to the most direct corridors appraised (Corridor 3 and Corridor 3 – Corridor 2). The additional length for Corridor 1 is reflected in the indicative capital expenditure with the estimated cost at completion around £422m.

10.4.5 Corridor 2 represented a more cost-effective corridor with the overall estimated length of 86km. With comparatively very few cost differentiating engineering challenges to be included within the estimate, the indicative capital expenditure is low with the estimated cost of £335m.

10.4.6 Corridor 3 was identified to offer the opportunity to close parallel the existing 400kV infrastructure, largely to reduce the potential for adverse visual and environmental impacts. The corridor was identified as one of the most direct from start to finish with a total estimated corridor length of 84km. While this corridor does not cross the 400kV ZDA overhead line, in order to remain close parallel for the entirety of the corridor, multiple secondary costs were factored in including a minimum of eight line swap overs, five 132kV underground crossings and five 400kV underground crossings. Additional work is required for a reconfiguration of existing overhead lines close to the Garthorpe

Tee to facilitate the works around Keadby Substation which could range from £5m to £10m, dependent upon final length of overhead line to be rerouted. The capital expenditure for these items combined was estimated to be approximately £300m taking the total estimated cost to £610m, representing the highest cost of all corridors appraised, 86% higher than the lowest cost corridor (Corridor 3 – Corridor 2).

10.4.7 The alternative Corridor 3 – Corridor 2 option allowed for close paralleling for the majority of the northern section of the corridor: 56km from Creyke Beck to West Stockwith. A deviation around Keadby windfarm and the link into Corridor 2 avoided the majority of engineering complexities associated with the equivalent Corridor 3 close parallel option. The route length was the lowest of all options appraised and the limited number of engineering challenges encountered throughout led to the lowest cost of all corridors appraised, at £328m.

10.4.8 Corridor 4 shared commonality with Corridor 3 (close parallel) from Creyke Beck until reaching the south of Keadby substation, as such, the same engineering challenges of line swap overs and 132kV and 400kV overhead line crossings were encountered and included in the secondary costing components. For reference, the 400kV underground crossings are estimate to be each in the region of £50m. Corridor 4 deviates from Corridor 3 to the south of Keadby, crossing the River Trent (from west to east) before continuing southwards, requiring three 400kV underground crossings. Two of these crossings are in close proximity to the River Trent (from east to west) meaning an underground cable with a trenchless crossing, such as horizontal directional drill (likely to be in excess of £600m) across the watercourse would be required, adding a further estimated £64m to the indicative cost. Each of these additional components led to a high estimated cost of around £552m.

10.4.9 Another key performance indicator to be considered for each corridor appraised was the duration of the construction schedule leading to the commissioning of the overhead line. A shorter schedule offers an earlier in-service date. The schedules for each corridor ranged by 12 months from Q3 2031 to Q3 3032.

10.4.10 Corridor 1 represented the worst performing schedule estimate with the earliest in-service date of Q3 2032. The additional overhead line length of 26km (when compared to the shortest corridor) represented a longer duration for construction as approximately 75 additional pylons would be required, with activities such as foundation excavation and steelwork erections adding to the timescales.

10.4.11 The remaining corridors show similar route lengths and therefore the overhead line construction duration is estimated to be comparable. Corridor 3 includes additional schedule duration due to the complexity of the line swap overs and underground crossings. These additional construction activities are estimated to assume the critical path, adding six months to the duration when compared to the best performing option, Corridor 3 – Corridor 2 which is estimated for completion in Q3 2031.

10.5 Conclusion

10.5.1 While cost was not deemed a primary factor for decision making during the corridor selection process, the best performing, appraised options were differentiated on cost and programme following the technical and environmental appraisals.

10.5.2 Corridor 1 demonstrated a high cost due to the additional corridor length required to navigate to the western edge of the study area with the estimated expenditure reaching £422m and an in-service date of Q3 2032.

10.5.3 Corridor 2 shows reduced overall length and minimal secondary costs leading to an estimated expenditure of £335m and an in-service date of Q3 2031.

10.5.4 Corridor 3 represented the most expensive corridor with secondary costs attributable to the complexity of routeing close to existing infrastructure increasing the estimated expenditure to £610m and an in-service date of Q1 2032.

10.5.5 Corridor 4 has a slightly increased length but a number of secondary engineering costs attributable to the complexity of routeing increasing the estimated expenditure to £552m and an in-service date of Q1 2032.

10.5.6 The best value corridors were estimated to be Corridor 3 – Corridor 2 which provided opportunities to close parallel with existing infrastructure in Corridor 3 to the north of the study area; before linking into Corridor 2. This corridor avoids costly engineering challenges on the approach to High Marnham. Fewer engineering complexities and the shortest corridor length resulted in an estimated expenditure to £328m. Since the Corridor 3 – Corridor 2 option had the shortest length and the least engineering challenges, the duration estimate was also favourable when compared to the other corridors with the earliest in-service date being Q3 2031. With the reduction in delivery timescale this corridor would enable the Project objectives to be met at the earliest opportunity. The reduction in delivery timescale results in:

- Opportunity for earlier connection of renewable generation;
- Reduction in constraint charges, due to earlier increase in boundary transfer capability (B8); and
- Reduction in the carbon impact of UK energy generation, based on facilitating earlier connections of renewable generation.

10.5.7 The reduced length of Corridor 3 – Corridor 2, along with the limited requirements for line swap overs and underground crossings means that the carbon impact during the construction phase is also reduced, although the size of carbon reduction is likely to be insignificant when compared to the carbon impacts caused by constraining renewable generation (i.e. later in-service dates).

11. Option Selection

11. Option Selection

11.1 Introduction

11.1.1 Following the Options Appraisal (presented in **Chapter 6** to **Chapter 9**), the appraisal findings were considered by the Project Team considering environmental, engineering, cost and technical aspects. The various constraints and opportunities identified in the preliminary corridors were discussed and considered alongside the likely cost performance, and the performance of the different corridor options, loops and links were compared. A preferred preliminary option was identified in each section of the Study Area having regard to relevant National Planning Policy and NGET's statutory duties. On balance, the preliminary option was considered to provide the most appropriate overall solution.

11.1.2 The preferred preliminary corridors were not considered as whole end-to-end corridors for the purposes of the comparative evaluation of options because each preliminary corridor has localised constraints which could be avoided through alternative routeing opportunities (i.e., use of links and loops between sections of preliminary corridors). Therefore, it was likely that a combination of sections of preliminary corridors, links and loops, rather than a single corridor would be used to route between Creyke Beck and High Marnham. As a result, the comparative evaluation was undertaken on the basis of defined components of any given preliminary corridor, link or loop and comparison of these more locally defined evaluation components rather than the end-to-end preliminary corridor. The defined components considered under each step are set out below. The defined components were considered in isolation and broadly approached in a sequential manner routeing north to south:

- Step 1 – Consider the preliminary corridors across the Yorkshire Wolds;
- Step 2 – Consider how to link the optimum preliminary corridor from Step 1 between the Yorkshire Wolds and the River Ouse;
- Step 3 – Consider the best performing preliminary corridor across the River Ouse;
- Step 4 – Consider options from the River Ouse crossing point to High Marnham. Step 4 comprises several sub-steps (Step 4a – 4e) which are outlined below; and
- Step 5 – Consider all evaluation components as end-to-end solutions to ensure that there were no circumstances where an accumulation of smaller constraints in a 'discarded' option might justify reconsidering decisions in identification of the components.

11.1.3 The steps are graphically shown in **Appendix B**.

11.1.4 As discussed in **Chapter 4**, underground cabling was considered across the Yorkshire Wolds in response to the announcement in June 2021 that the area was being considered for designation as an AONB. Having considered the possible need to use underground cables across the Yorkshire Wolds, Natural England subsequently consulted upon a provisional AONB 'candidate area' in June 2022. This 'candidate area' was located outside of the Study Area for the Project. On this basis any new overhead line routed across the Study Area is considered unlikely to cause significant impacts upon any future Yorkshire Wolds AONB. National Planning Policy would suggest that an

overhead line could comply with the relevant policies and that no clear policy exists requiring the use of higher cost, technically more complex and physically disruptive underground cables. Consequently, the comparative appraisals were based upon overhead line technology. The need to use underground cables in any part of the route will be reviewed as the design process progresses, in response to survey findings to obtain baseline data and stakeholder and community feedback.

11.1.5 This Chapter presents the factors considered to influence the decision-making process for determining the emerging preferred corridor. As the design progresses, regular reviews will be undertaken to ensure the emerging preferred corridor taken forward at this stage is still the optimum corridor when all environmental, socio-economic and technical aspects are considered.

11.2 Step 1 – Yorkshire Wolds

11.2.1 Step 1 considered the following corridors between Creyke Beck and the western boundary of the Yorkshire Wolds NCA ('Yorkshire Wolds'):

- Corridor 1 (Section WC1a to WC1f); and
- Corridor 2 (Section WC2a).

11.2.2 Both preliminary corridors considered in Step 1 are designed to provide the potential to parallel an existing 400kV overhead line. This approach was informed by the view that those areas that already contained overhead line should experience less significant landscape and visual impacts from the introduction of new overhead infrastructure than unaffected landscapes of a similar type.

11.2.3 The defined components of the preliminary corridors considered in Step 1 are shown on **Figure 11-1**.

Figure 11-1 – Step 1 – Yorkshire Wolds

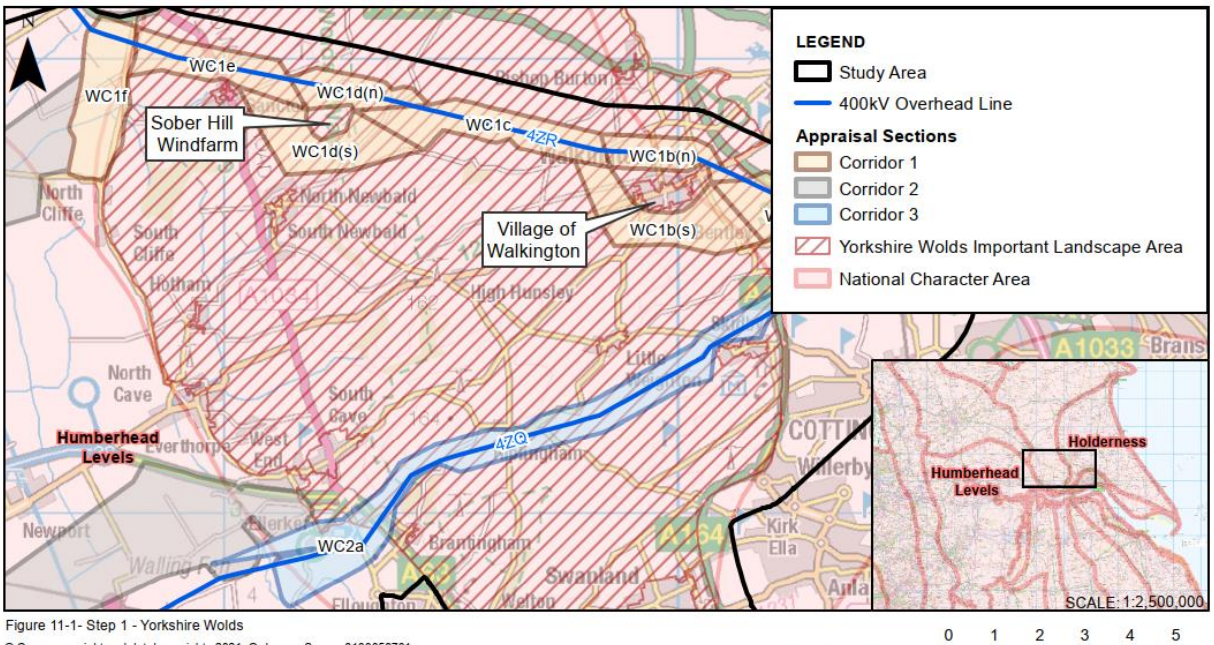


Figure 11-1- Step 1 - Yorkshire Wolds

Corridor 1 (Sections WC1a to WC1f)

11.2.4 This preliminary corridor provided the potential to parallel the existing 4ZR 400kV overhead line through the Yorkshire Wolds. Four deviations from close parallel were likely to be required due to the presence of constraints:

- To the west of Creyke Beck due to a residence, the A1079 and the A164 Jock's Lodge Road Widening Scheme;
- To the south of Walkington due to residential properties on the eastern edge of the village;
- To the south of the Sober Hill Wind Farm due to the location of wind turbines; and
- To the south of the existing line north-west of Sancton due to the location of residential properties.

11.2.5 Corridor 1 would result in a less direct and substantially longer route through the Yorkshire Wolds than Corridor 2, and therefore performed poorly both against NGET's statutory requirement to consider the most economical network and against Holford Rule 3 (other things being equal, choose the most direct line).

Corridor 2 (Section WC2a)

11.2.6 Corridor 2 provided an opportunity to parallel the existing 4ZQ 400kV overhead line through the Yorkshire Wolds and connect directly with Corridor 3 to potentially form an end-to-end close parallel solution. The existing overhead line crosses through sensitive areas of the ILA and is constrained in places by settlements and blocks of woodland, particularly to the west. Any new overhead line in this corridor would give rise to adverse landscape and visual impacts on the western scarp slope of the Yorkshire Wolds.

11.2.7 There would be no significant deviations from close parallel required in Corridor 2. However, there are more constrained areas within this preliminary corridor, particularly at Skidby and across Ellerker North Wold because of the Brantingham Dale SSSI, located north of Brantingham (as shown in **Figure 11-2**). Due to these constrained areas, a fully close parallel route to the south of the 4ZQ 400kV overhead line is unlikely.

11.2.8 There is an opportunity for a close parallel route to the north of the 4ZQ 400kV overhead line for the majority of the preliminary corridor. However, there are constraints to the north of the existing overhead line including Riplingham, Brantingham Dale SSSI and Ellerker, as shown in **Figure 11-2**. There is also an opportunity to close parallel to the south of the 4ZQ 400kV overhead line to the west of Skidby, however this is likely to require two line swap overs which adds technical complexity and would require a number of larger angle pylons. At Ellerker, if routeing to the south of the village, a third line swap over would likely be required given the proximity of the 4ZQ 400kV overhead line to the southern edge of the village. This has the potential to result in adverse landscape and visual impacts.

Figure 11-2 – Corridor 2 (within the Yorkshire Wolds) Constraints to Routeing

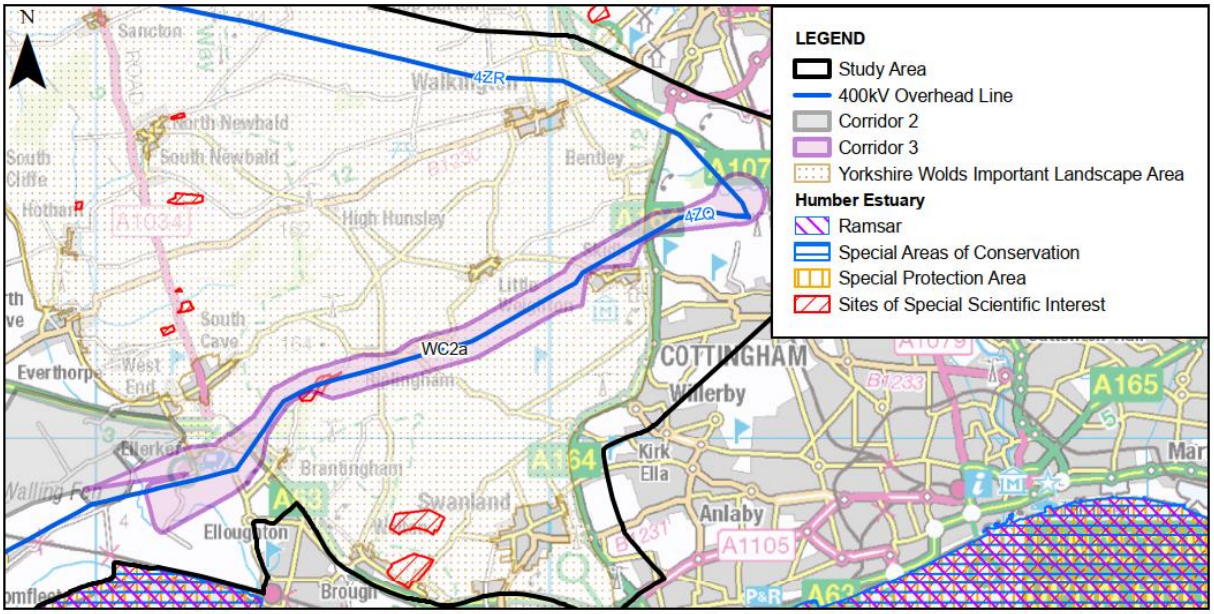


Figure 11-2 – Corridor 3 (within the Yorkshire Wolds) Constraints to Routeing

Comparative Appraisal

11.2.9 Routeing options within this area comprised the use of either Corridor 1 or Corridor 2 through the Yorkshire Wolds.

11.2.10 Both Corridor 1 and Corridor 2 provided the potential to close parallel existing 400kV overhead lines through the Yorkshire Wolds. However, both would also require deviations from close parallel to avoid key constraints. Corridor 1 would require significant deviations whereas Corridor 2 would only require smaller deviations. Due to the extent of these deviations including to avoid residential properties, developments and a wind farm, a close parallel route would not be viable for the majority of Corridor 1, whereas it would be for Corridor 2 provided the close parallel route is located to the north of the existing 4ZQ 400kV overhead line.

11.2.11 Corridor 1 routes in a north-westerly direction from Creyke Beck and would result in a less direct and substantially longer route through the Yorkshire Wolds than Corridor 2. Due to its longer length, Corridor 1 would also result in a higher cost than Corridor 2 (see **Chapter 10**).

11.2.12 Overall, it was considered that Corridor 2 performs better from an environmental, technical and cost perspective.

Summary of Decision

Defined Component Progressed

Corridor 2

11.2.13 Overall Corridor 2 was preferred through the Yorkshire Wolds primarily as it provided:

- A shorter overall length of overhead line and most direct route in line with statutory requirement to consider the most economical network and Holford Rule 3; and

- The opportunity to close parallel for the entirety of the corridor with minimal deviations to avoid settlements and constraints which would reduce landscape and visual impacts through the ILA. It was noted that at least two line swap overs would be required if a southern close parallel were followed through part of this corridor.

11.2.14 It was acknowledged that Corridor 2 was likely to result in adverse landscape and visual impacts on the western scarp slope of the Yorkshire Wolds and that this would need to be kept under review as the Project progresses.

11.2.15 The preliminary corridor provides the opportunity to continue a close parallel design across the Humberhead Levels, however it is noted that this would result in adverse visual impacts from the edge of the village of Ellerker.

Defined Component Parked

Corridor 1

11.2.16 This preliminary corridor was parked as it resulted in:

- A number of significant deviations required from close parallel to avoid settlements, proposed developments and wind turbines; and
- A less direct and longer route when compared to Corridor 2.

11.3 Step 2 – Yorkshire Wolds to River Ouse

11.3.1 Step 2 considers the following Sections and Links between the western boundary of the Yorkshire Wolds to the north of the River Ouse:

- Corridor 1 (Section C1a to C1c(s));
- Corridor 1 to Corridor 2 Links (C1-C2-Link1 and C1-C2-Link2);
- Corridor 2 (Section C2a(n), C2a(s) and C2b);
- Corridor 3 to Corridor 2 Link (C3-C2-Link5); and
- Corridor 3 (Section C3a and C3b).

11.3.2 The defined components of the preliminary corridors considered in Step 2 are shown on **Figure 11-3**.

11.3.3 Although Corridor 2 was preferred between Creyke Beck and the western boundary of the Yorkshire Wolds (Step 1), each preliminary corridor was considered in isolation for Step 2.

Figure 11-3 – Step 2 – Western Edge of the Yorkshire Wolds to North of the River Ouse

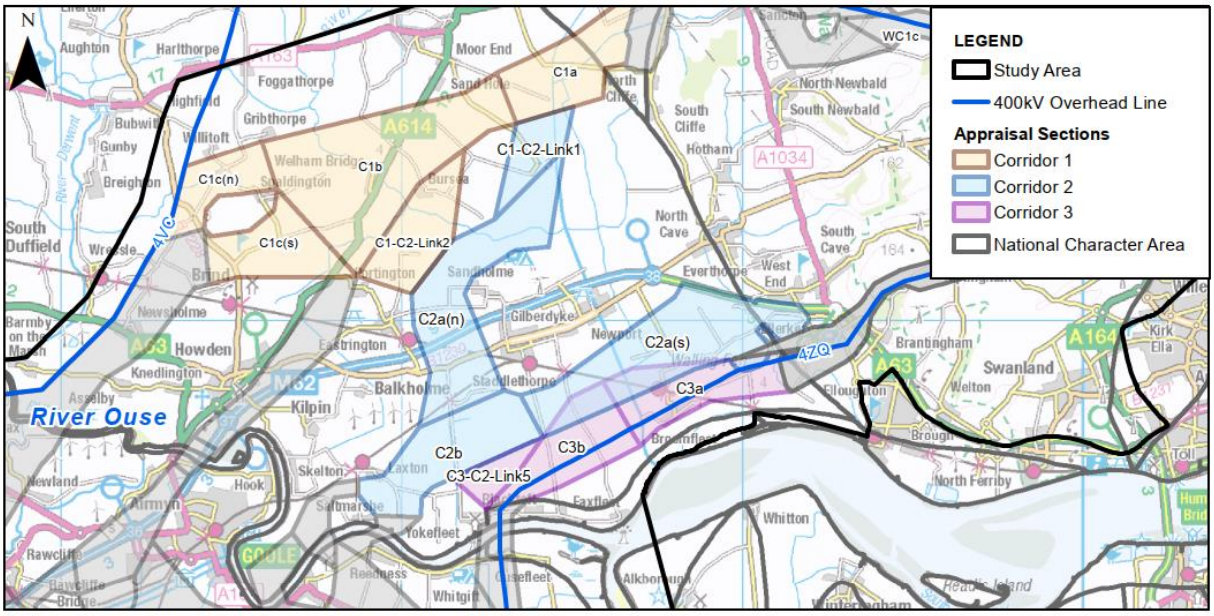


Figure 11-3 – Step 2 – Western Edge of the Yorkshire Wolds to North of the River Ouse

Corridor 1 (Section C1a to C1c(s))

11.3.4 Corridor 1 in this area deviates from close parallel between Market Weighton, where it routes westerly from the existing 4ZR 400kV overhead line, and Spaldington where this preliminary corridor re-joins the existing 4VC 400kV overhead line. This would require the introduction of a new overhead line where there are no existing overhead lines which has the potential to result in greater adverse landscape and visual impacts when compared to the close parallel option. This also performs poorly against Holford Rule 6 due to the diverging and converging overhead lines.

11.3.5 Further south between Willitoft and continuing on to Barmby on the Marsh (approximately 9km) this preliminary corridor provided a close parallel opportunity which could help to limit adverse landscape and visual impacts following the existing 4VC 400kV overhead line.

11.3.6 Corridor 1 is less direct and longer when compared to Corridor 2 and 3. This preliminary corridor therefore performed poorly both against NGET's statutory requirement to consider the most economical network and against Holford Rule 3.

Corridor 1 to Corridor 2 Link (C1-C2-Link1 and C1-C2-Link2)

11.3.7 C1-C2-Link1 and C1-C2-Link2 were considered as an opportunity to link with Corridor 2 (Section C2a(n)) and enable a more direct route south towards the River Ouse via Corridor 2 or 3. This also provided the opportunity to use Corridor 2 or 3 to cross the River Ouse.

Corridor 2 (Section C2a(n), C2a(s) and C2b)

11.3.8 Corridor 2 begins to the west of the Yorkshire Wolds NCA and would be accessible from Creyke Beck via Corridor 1 which links to Section C2a(n), or Corridor 3 which links to Section C2a(s). Similarly to Corridor 1, Corridor 2 in this section would require a new overhead line where there are no existing overhead lines and within the Humberhead

Levels NCA which is characterised by flat, low-lying open landscape with long views. This has the potential to result in adverse landscape and visual impacts.

11.3.9 Corridor 2 (Section C2a(s)) overlaps with Corridor 3 and provides an option to route further away from Broomfleet. However, it would result in a longer length of overhead line. This would be less direct and whilst not close parallel, is likely to be close enough in this very open landscape to be visible in combination with the existing overhead line from the village and other isolated properties.

Corridor 3 to Corridor 2 Link (C3-C2-Link5)

11.3.10 C3-C2-Link5 provides a connection between Section C2b and C3b and if routeing from C2b would provide an opportunity to establish a straight and direct route towards the River Ouse with minimal angles. Use of the Link would also provide a straight and direct approach into close parallel of the existing 4ZQ 400kV overhead line, to the east of Yokefleet.

Corridor 3 (Section C3a and C3b)

11.3.11 Corridor 3 provides a close parallel opportunity following the existing 4ZQ 400kV overhead line to the River Ouse. Use of Corridor 3 in this area, in addition to through the Yorkshire Wolds, would result in an end-to-end close parallel opportunity between Creyke Beck and the River Ouse crossing. Both sections C3a and C3b overlap Corridor 2 (C2a(s)) which as mentioned above provides an opportunity to route to the north of Broomfleet and the Sandtoft Roof Tiles Clay Extraction Site, located adjacent to the north of the existing 4ZQ 400kV overhead line. Broomfleet would constrain a close parallel opportunity to the south and Sandtoft Roof Tiles Clay Extraction Site would limit the opportunity to close parallel to the north in this area.

11.3.12 This preliminary corridor provides the shortest and most direct route between the Yorkshire Wolds and the River Ouse which performs well against NGET's statutory requirement to consider the most economical network and against Holford Rule 3.

Comparative Appraisal

11.3.13 Routeing options within this area comprised of either:

- Corridor 1;
- Corridor 2 accessed via Corridor 1 to Corridor 2 Link (C1-C2-Link1 or C1-C2-Link2) from the north, or via Corridor 3 and Corridor 3 to Corridor 2 Link (C3-C2-Link5) from the south; and
- Corridor 3.

11.3.14 All routeing options except Corridor 3 would require the introduction of a new overhead line into a landscape where one does not already exist. A short section of close parallel would be viable within Corridor 1 alongside the existing 4VC 400kV overhead line, however the new overhead line would need to approach from an easterly direction to the north of Spaldington and may converge with the existing overhead line at a perpendicular angle. The convergence of these two overhead lines with one from the north and one from the east would be potentially more noticeable in the landscape and technically challenging. Due to this, it was considered that overall the benefits associated with close parallel are outweighed by the challenges in this location.

11.3.15 Corridor 3 follows the existing 4ZQ 400kV overhead line and is the shortest and most direct route with the lowest cost. Corridor 2 would require a longer route, particularly if routeing via the Corridor 1 to Corridor 2 Link from the north. Corridor 1 is the least direct and longest of all of the route options and has the highest cost. However, despite being the shortest and most direct route, Corridor 3 is the closest option to the Humber Estuary designated sites. The southern start point of Corridor 2 overlaps and runs parallel to Corridor 3 in places, however due to the absence of an existing overhead line, does not benefit from a close parallel option as Corridor 3 does. Therefore, despite Corridor 2 being located further from the Humber Estuary designated sites, use of this option over Corridor 3 would require the introduction of a new overhead line where there is none currently. This may create an additional barrier to movement of species to and from the Humber Estuary designated sites.

11.3.16 Due to the opportunity to close parallel the existing 4ZQ 400kV overhead line in Corridor 3, it was considered that overall this option performed better from an environmental perspective. Corridor 3 also provided the most direct and shortest route option with the least associated cost, performing better than the other options from both a technical and cost perspective.

Summary of Decision

Defined Component Progressed

Corridor 3

11.3.17 Overall, Corridor 3 was preferred between the Yorkshire Wolds and the River Ouse, primarily as it provided:

- A shorter length in accordance with NGET statutory requirement to consider the most economical network;
- The potential to reduce adverse landscape and visual impacts by close paralleling the existing 4ZQ 400kV overhead line; and
- The potential to reduce level of bird strike risk in the vicinity of the Humber Estuary designated sites by close paralleling existing overhead line in whole or in part (potentially minimising any additional barrier to movement to functionally linked habitat).

11.3.18 Whilst not a consideration in the initial judgement, this section of Corridor 3 also links effectively with the preliminary River Ouse Crossing section of Corridor 3 and the section of Corridor 2 through the Yorkshire Wolds.

Defined Component Parked

11.3.19 The following corridors were parked at this stage:

Corridor 1

- Corridor 1 would require the introduction of a new overhead line where there is not one existing which has the potential to result in adverse landscape and visual impacts. It was also a less direct and substantially longer route than Corridor 2 and 3.

Corridor 1 to Corridor 2 Link (C1-C2-Link1 and C1-C2-Link2)

- Following removal of Corridor 1 in this area, C1-C2-Link1 and C1-C2-Link2 were also parked at this stage as it would not be viable without Corridor 1.

Corridor 2

- Section C2a(n) was parked at this stage as it would not be viable without the Corridor 1 to Corridor 2 Links; and
- Following a preference for Corridor 3 due to the close parallel opportunity it provided, Section C2a(s) and C2b were also parked at this stage.

Corridor 3 to Corridor 2 Link (C3-C2-Link5)

11.3.20 Following a preference for Corridor 3 due to the close parallel opportunity it provided, C3-C2-Link5 were also parked at this stage.

11.4 Step 3 – River Ouse Crossing

11.4.1 Step 3 considered the following corridors for the crossing of the River Ouse:

- Corridor 1 (Section C1d);
- Corridor 1 Loop (C1_C1-Loop_and C1-C1-Loop_b);
- Corridor 2 (Section C2c(w) to C2e(w)); and
- Corridor 3 (Section C3c).

11.4.2 The defined components of the preliminary corridors considered in Step 3 are shown on **Figure 11-4**.

11.4.3 The Humber Estuary designates sites go as far west as Boothferry. Corridor 1 Loop, Corridor 2 and Corridor 3 all cross the Humber Estuary designated sites. The extent of the Humber Estuary designated sites relative to the preliminary corridors is shown in **Figure 11-5**.

11.4.4 Overhead lines and pylons can present a potential collision risk to birds as they travel between feeding, roosting and nesting areas. An overhead line can present a barrier effect and lead to the displacement of species because it can alter their usual flying routes.

11.4.5 There is limited data available on bird flightpaths along the River Ouse between Corridors 1 to 3 and due to these limitations, there is the potential for significant impacts to be identified following detailed survey on any of the preliminary corridors, including the potential for an impact upon the designated sites' integrity. This risk applies across the whole of the Study Area around the Humber Estuary designated sites, and therefore all preliminary corridors. However, these risks may be considered lower for Corridor 1 and Corridor 3 due to the long-term presence of existing overhead lines in both corridors, neither of which have prompted concerns regarding historic impacts. The long-term retention of both overhead lines might also mean that any incremental risk of building a new overhead line in either preliminary corridor might be lower as birds are likely to be habituated to the presence of the existing overhead lines.

Figure 11-4 – Step 3 – River Ouse Crossing

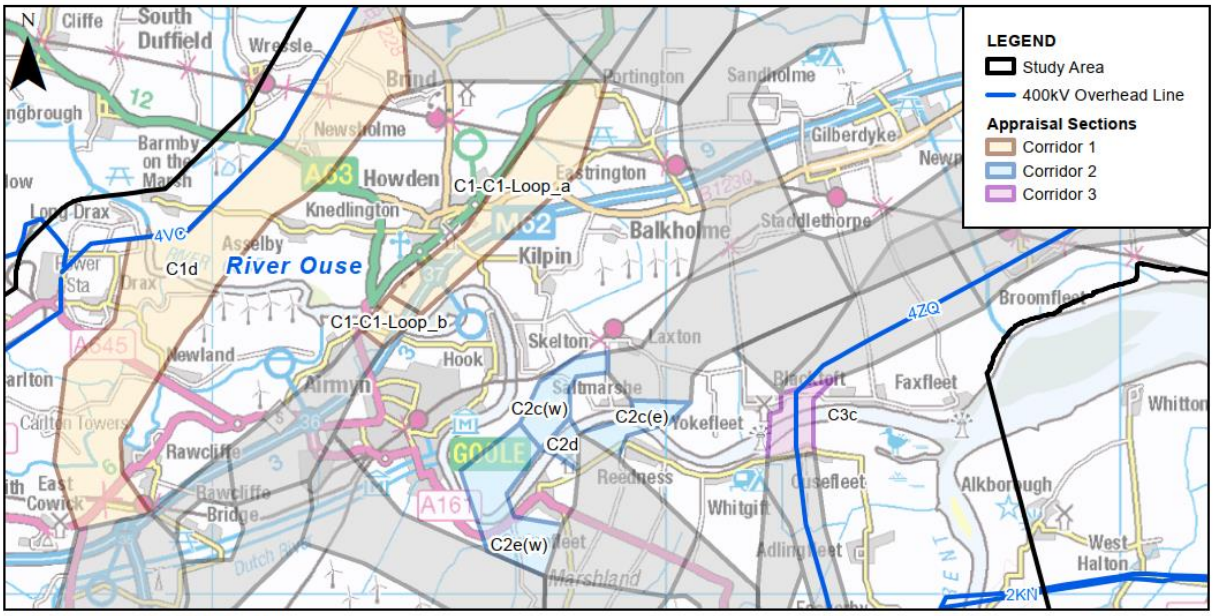


Figure 11-4 – Step 3 – River Ouse Crossing

SCALE: 1:150,000

Figure 11-5 – Humber Estuary Designated Sites

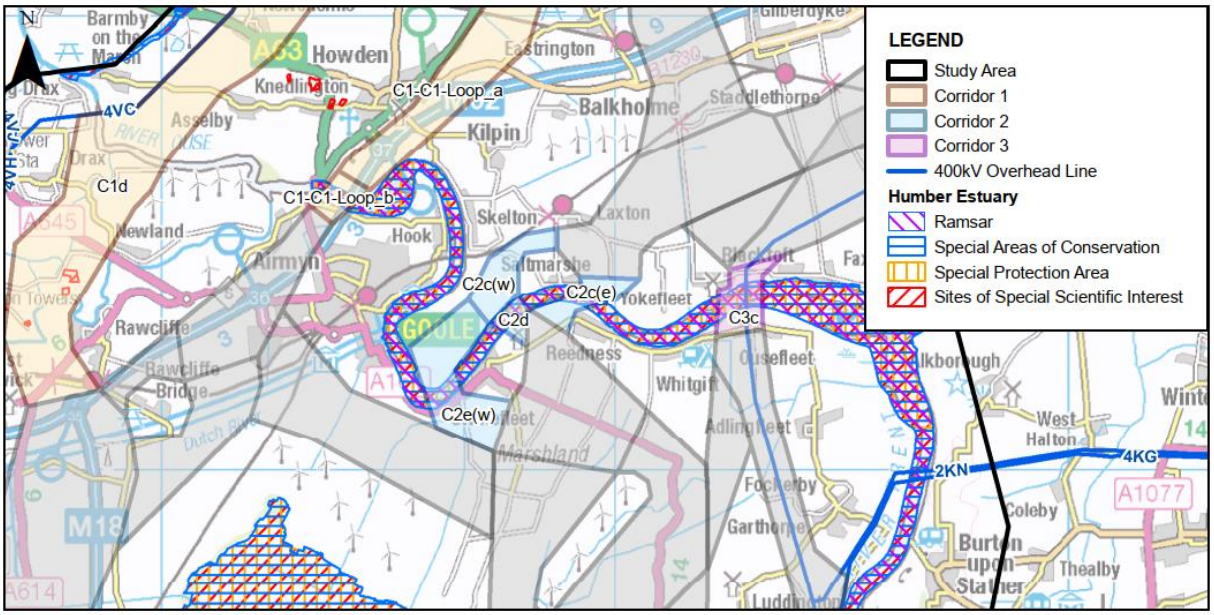


Figure 11-5 – Humber Estuary Internationally Designated Sites

SCALE: 1:150,000

11.4.6 In addition to overhead line, an underground cable crossing could be considered for any of the four potential river crossings. This would require the installation of long ducts or the construction of one or more tunnels to accommodate the eighteen transmission cables likely to be required, as these could not be laid securely on the riverbed. NGET has not reached any final conclusion with regard to the acceptability of an overhead line crossing. This decision will need to be informed by engagement with stakeholders, in particular Natural England and the RSPB, as well as by the results of detailed site surveys. However, it was noted that underground cable would result in very significant increases in cost and potentially delay the completion date for the Project. At this stage, geological data is also limited for the crossing areas and so detailed studies would be

required to confirm the technical viability of installing underground cables across the River Ouse within any of the four preliminary corridors. Further information regarding the potential impacts that would arise if installing underground cables beneath the River Ouse are provided in **Appendix A**.

Corridor 1 (Section C1d)

11.4.7 Corridor 1 crosses the River Ouse to the north-east of Drax, in proximity to an existing 400kV overhead line that has been in operation for approximately 50 years. The preliminary corridor does not pass through the Humber Estuary designated sites. Whilst this would remove any credible chance that a new overhead line within this corridor would result in the loss of qualifying habitat within the Humber Estuary designated sites, the risk that impacts could occur to qualifying species using the sites and travelling to and from the sites would remain. However, NGET is not aware of any concerns regarding birds striking the existing overhead line in this location.

11.4.8 The preliminary corridor passes between the Lower Derwent Valley SPA and the Humber Estuary SPA which both provide habitat for golden plover and ruff; qualifying species for both SPAs. It is assumed given the proximity of the sites to each other that some species may travel between the two, and in doing so cross Corridor 1. This may indirectly result in potential adverse impacts for either site, even though Corridor 1 is not within the Humber Estuary designated sites. Due to the lack of mudflats and extensive reedbeds at the crossing location of Corridor 1, there is less potential to support large groups of SPA qualifying species and breeding habitat than the other potential crossings although as it is located within a kilometre of the Lower Derwent Valley SPA and Ramsar site qualifying species may use habitats along the River Ouse at the point of this crossing. The longer length of the preliminary corridor may also result in a greater potential for environmental impacts (because it covers more area) including the potential for more functionally linked habitat to be present which may be impacted by the construction of pylons and the overhead line. An overhead line within this corridor could potentially affect the integrity of the sites.

11.4.9 Crossing the river parallel to the existing overhead line within this preliminary corridor may be challenging from an engineering perspective as a sharp change in route direction would be needed on the southern bank of the river to avoid the village of Drax. The presence of existing infrastructure and proposed developments, including EGL2, Drax Re-Power Project and the HLCP Project Preferred Route Corridor would add further technical challenges.

11.4.10 Corridor 1 is the least direct and longest option for crossing the River Ouse, conflicting with NGET's duty under Section 9 of the Electricity Act to develop an economical network.

11.4.11 For all of the above reasons this preliminary corridor is less preferred from a policy perspective.

Corridor 1 Loop (C1_C1-Loop_a and C1-C1-Loop_b)

11.4.12 The Loop for Corridor 1 offered an opportunity to cross the River Ouse at the western-most extent of the Humber Estuary designated sites and at the point the M62 also crosses the river. The presence of the M62 was considered to have its advantages and disadvantages. The Loop provide an opportunity to close parallel the existing M62 river crossing. The existing structure is raised in the wider landscape which may minimise potential landscape, visual and ecological impacts of an overhead line crossing in this

area. However, this option lies within Asselby Island, Howdens Dyke Island and Howdens Dyke Lee which comprise extensive mudflats, sandbanks and wet grassland which increases the potential for bird species to be present. It is acknowledged that the risk associated with a crossing of the Humber Estuary designated sites in this location is not known, but given the nature of the local habitats identified, there is the potential for adverse environmental impacts which could potentially affect the integrity of the sites.

11.4.13 This River Ouse crossing option is technically challenging because of the alignment of the M62 river crossing, and its alignment when approaching the river. The M62 is centrally located for much of the Corridor 1 Loop, limiting flexibility for routeing and there would be a potential requirement to cross the M62 several times, both including the approach to the river crossing and following the river crossing routeing south.

Corridor 2 (Section C2c(w) to C2e(w))

11.4.14 Corridor 2 crosses the River Ouse to the east of Goole and provides three potential crossing points (western, central, and eastern). Corridor 2 is the only river crossing where there are no existing overhead line crossings. All crossing points are located within the Humber Estuary designated sites and would require a new crossing of the River Ouse. The rural nature of the crossing points may result in challenges with construction access, particularly on the north bank. All crossing points are also located at points where the river is entering or leaving a bend and therefore has the potential to impact the movement of birds along the river, particularly if they are flying in a straight line rather than following the bends in the river. The landscape either side of the river at these crossing points is predominantly open rural landscape with fields bounded by drains. This provides ample space for construction works, but there may be potential access limitations due to the lack of road network and rural nature of the landscape. These points apply to all three of the potential crossing points, but there are specific considerations to note for each which are detailed below.

11.4.15 The western crossing crosses the river on a bend as it meanders past Swinefleet. A new overhead line in this location would result in adverse landscape impacts, introducing transmission infrastructure into an area currently unaffected by this type of development, and visual impacts due to its proximity to properties and the settlements of Swinefleet and Old Goole. This area contains dune systems, with large areas of scrub and pockets of reedbed which increase the potential for bird species to be present and increase the potential for adverse ecological impacts. The western crossing would also result in an increased length of overhead line due to its western location and would result in the biggest deviation from the main preliminary corridor. Due to these factors, this crossing option was not progressed as the proposed crossing of the River Ouse. In the absence of survey or historical data relating to the interaction between existing overhead lines and the Humber Estuary designated sites, a precautionary approach was taken in regard to the potential for impacts on the integrity of the sites. A crossing via Corridor 2 may also have the potential to impact on the setting of the Grade II* listed Saltmarshe Hall, located to the west of Saltmarshe on the northern bank of the River Ouse.

11.4.16 The central crossing performed similarly to the western crossing. It would require a new crossing on the approach to a meander of the river and is in proximity to Swinefleet, Saltmarshe and Reedness, which is likely to result in adverse landscape and visual impacts. This area contains mud banks, sand banks, reedbeds and wet grassland which increase the potential for bird species to be present and increase the potential for adverse ecological impacts. Despite its location further east than the western crossing

in this corridor, it would still result in an increased length of overhead line and notable deviation from the main preliminary corridor. Due to these factors, this crossing option was not progressed as the proposed crossing of the River Ouse.

11.4.17 The eastern crossing has similar environmental constraints to the central crossing, as it is located on the same bend in the river but is located closer to Saltmarshe and Reedness, which is likely to result in adverse visual impacts. This area contains mud banks, sand banks, reedbed and wet grassland which increase the potential for bird species to be present and increase the potential for adverse ecological impacts. However, as the eastern-most option for a river crossing within this preliminary corridor, it would result in the shortest and least complex overhead line as it is more of a direct route. It would also avoid the need to route in closer proximity to Goole and avoid the large meander to the east of Goole entirely.

11.4.18 An overhead line in this corridor would introduce infrastructure into a section of the River Ouse that currently has none, creating an entirely new hazard for birds moving along and around the river corridor. As such an overhead line in any of the three crossing locations could potentially affect the integrity of the Humber Estuary designated sites.

Corridor 3 (Section C3c)

11.4.19 Corridor 3 crosses the River Ouse at Ousefleet and provides a close parallel opportunity with an existing overhead line across the River Ouse. The 4ZQ 400kV overhead line has been in place since 1967 and crosses the Humber Estuary designated sites. The 4ZQ 400kV overhead line replaced an earlier 132kV that had crossed the River Ouse in this location since the early 1940s. The Humber Estuary SPA was designated in 1994 and extended in 2007. The line also crosses the western end of the Blacktoft Sands RSPB Nature Reserve which was established in 1973. NGET is not aware of any major concerns being raised regarding bird flight activity and disturbance to birds at the Humber Estuary designated sites or the RSPB Nature Reserve and is not aware of any significant concerns regarding birds striking the existing overhead line in this location. However, detailed bird surveys will be undertaken in this area to assess the potential for significant impacts and will inform the Project design. Corridor 3 is the closest to the mouth of the Humber Estuary and comprises mudflats, sandbanks and scattered scrub and trees which may increase the potential for bird species to be present and particularly waterfowl and waders.

11.4.20 The existing overhead line crossing comprises two large river crossing pylons with one span of overhead line. Designing the new crossing so that the conductors line up with those of the existing crossing may be a means of partially mitigating the risk of bird strike. However, as it would be unlikely that the new pylons could be precisely lined up with the existing, it would be technically challenging to ensure fully consistent overhead line spans and sags. This may result in the partial misalignment of the new overhead lines with the existing with consequent increased bird strike risk, and would require pylons of a similar or greater height than the existing with consequent potential adverse landscape and visual impacts.

11.4.21 Notwithstanding any detailed design consideration, a second overhead line crossing in this corridor could potentially affect the integrity of the Humber Estuary designated sites.

Comparative Appraisal

11.4.22 Routeing options within this area comprised the use of:

- Corridor 1;
- Corridor 1 Loop (C1_C1-Loop);
- Corridor 2; and
- Corridor 3.

11.4.23 Use of the Corridor 1 Loop or Corridor 2 would require the introduction of a new overhead line across the River Ouse where one does not already exist. Corridor 2 would require a new overhead line into an open stretch of the River Ouse, whereas the Corridor 1 Loop would not as it already includes the M62 bridge crossing of the River Ouse. The opportunity to close parallel and achieve a similar height and width of an existing crossing, rather than introduce a new crossing is preferred. It was considered that there would be more opportunity to achieve similar heights and widths of infrastructure against the existing 4ZQ 400kV overhead line in Corridor 3 rather than the M62 bridge crossing in the Corridor 1 Loop. This is because where practicable, the Project would be of similar design and dimensions to the existing overhead line, including two supporting pylons at the north and south banks of the river and a span of overhead line between the two pylons.

11.4.24 Corridor 1 was the only routeing option across the River Ouse which did not cross the Humber Estuary designated sites directly. However, it was located upstream of the sites and therefore the sites may still experience indirect impacts from species travelling along the River Ouse. Corridor 1 was also the nearest routeing option to the River Derwent designated sites and may experience impacts resulting from species travelling between the sites.

11.4.25 Due to the opportunity to close parallel the existing 4ZQ 400kV overhead line in Corridor 3 and the acknowledgment of no existing flightpath issues, it was considered that holistically this option performed better from an environmental perspective. Corridor 3 also provided the most direct and shortest route option with the least associated cost, performing better than the other options from both a technical and cost perspective.

Summary of Decision

11.4.26 It was noted that all preliminary corridors provided an opportunity to avoid construction within the designated site boundary (generally the River Ouse and it's riverbanks up to the maintained flood defences) and as a result provide the opportunity to avoid direct habitat loss within the Humber Estuary designated sites. On this basis, habitat loss was considered unlikely to be a differentiator when establishing an emerging preferred corridor across the River Ouse.

Defined Component Progressed

Corridor 3

11.4.27 Overall, Corridor 3 was preferred for the River Ouse crossing, primarily as it provided:

- Opportunity to close parallel, which offers potential benefits in relation to bird collision risk, as there are no reported issues with bird strike on the existing overhead line; and
- Shorter overall length of overhead line and most direct route in line with statutory requirement to consider the most economical network and in accordance with Holford Rule 3.

11.4.28 Given the long-term presence and operational experience of the existing overhead line within Corridor 3 and the absence of evidence suggesting that a second overhead line would affect the integrity of the Humber Estuary designated sites it is not considered appropriate to propose the use of underground cables at the River Ouse at this stage. This judgment will be subject to detailed review throughout the design development of the Project.

Defined Component Parked

11.4.29 The following were parked at this stage:

Corridor 1

- Corridor 1 Sections were constrained from a technical perspective due to existing infrastructure and proposed developments (EGL2, Drax Re-Power Project and HLCP Project Preferred Route Corridor);
- The potential for qualifying species of the Lower Derwent Valley SPA and Humber Estuary SPA to use habitats along the River Ouse, despite the corridor itself being located outside of the designated sites; and
- This crossing offers a section of close parallel opportunity; however, it would be challenging to achieve close parallel at this location due to the technical constraints.

Corridor 1 Loop

- The Corridor 1 Loop was constrained from a technical perspective due to the alignment of the M62 and location of built development which would require any new overhead line route to cross the motorway multiple times; and
- This Loop contained large pockets of potential habitat for bird species including mud banks, sand banks, reedbeds and wet grassland.

Corridor 2

- Corridor 2 would require the introduction of a new overhead line crossing of the designated sites in an open stretch of river and would be significantly constrained from an ecological, landscape and visual perspective. It would introduce infrastructure into a section of the River Ouse that currently has none, creating an entirely new hazard for birds moving along and around the river corridor.

11.5 Step 4a – River Ouse to High Marnham (Corridor 1)

11.5.1 Step 4a considers the following Sections, Links and Loop between the River Ouse and High Marnham:

- Corridor 1 (Section C1e to C1m);
- Corridor 1 Loop (C1-C1-Loop_c, C1-C1-Loop_d(n) and C1-C1-Loop_d(s)); and
- Corridor 1 to Corridor 2 Link (C1-C2-Link3 to C1-C2-Link6_a-c).

11.5.2 The defined components of the preliminary corridors considered in Step 4a are shown on **Figure 11-6**.

Figure 11-6 – Step 4a – River Ouse to High Marnham (Corridor 1)

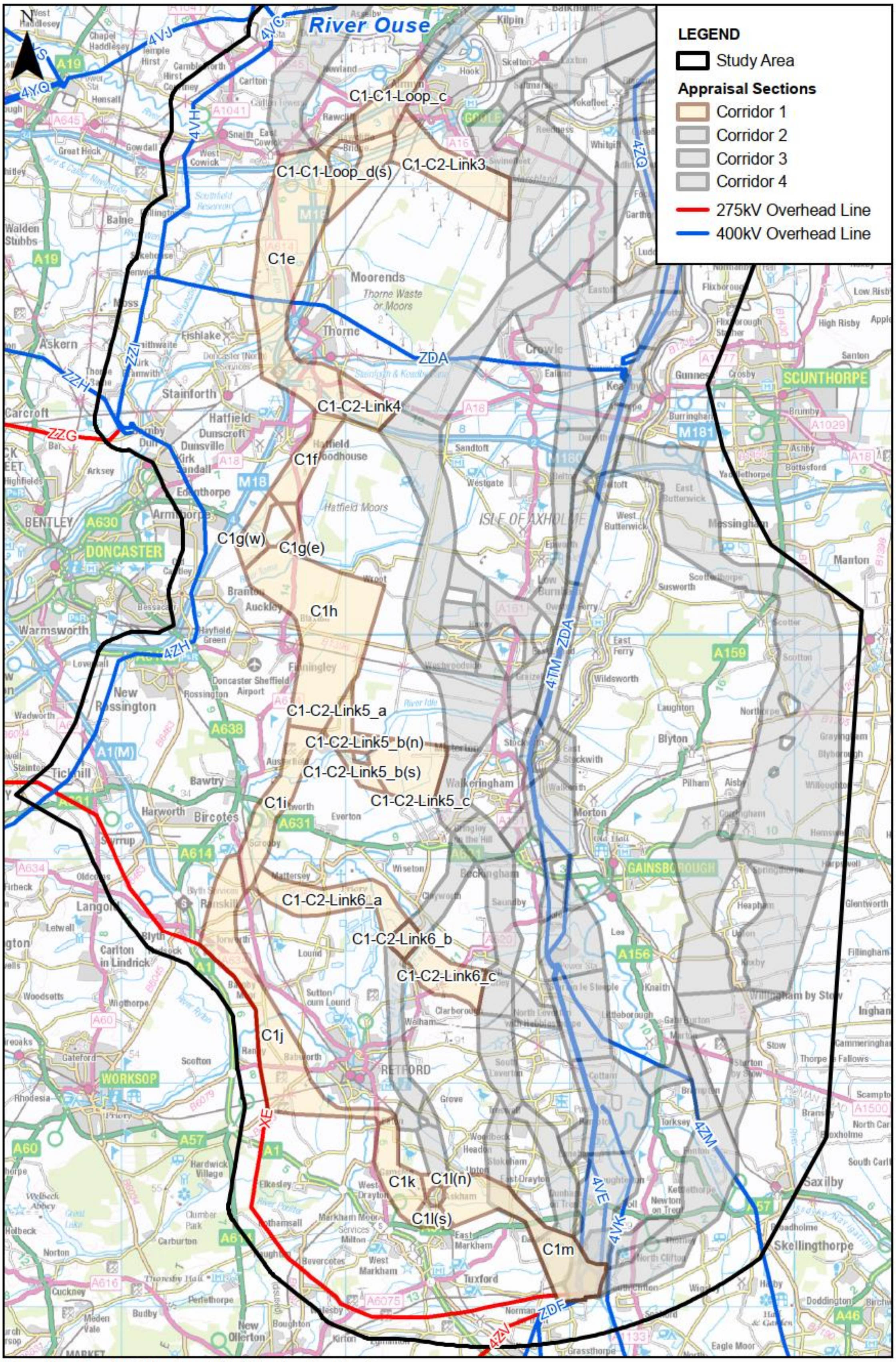


Figure 11-6 – Step 4a – River Ouse to High Marnham (Corridor 1)

SCALE: 1:270,000 0 2.5 5 7.5 10 km

Corridor 1 (Section C1e to C1m)

11.5.3 Overall Corridor 1 was a highly constrained option, with a large number of land use constraints including holiday parks, residential properties, recreational sites, landfills and scattered woodland. This added technical complexity due to the limited space for siting of pylons. Large unavoidable constraints were also present, including the housing planning allocation to the south of Retford which covered the width of the preliminary corridor in this area. The extent of the large housing planning allocation is shown in **Figure 11-7**. Constraints were also present in proximity to the preliminary corridor, including the Thorne and Hatfield Moors designated sites, Doncaster Sheffield Airport[40] and Retford (Gamston) Airport.

11.5.4 There was a limited close parallel opportunity within the southern part of Corridor 1, following the existing 275kV XE overhead line. However, the contrasting form and modest scale of this existing overhead line was considered to offer limited benefits and the close parallel opportunity was also short in distance. This opportunity was not considered sufficient to favour this preliminary corridor.

Figure 11-7 – Large Housing Allocation to the South of Retford (Corridor 1)

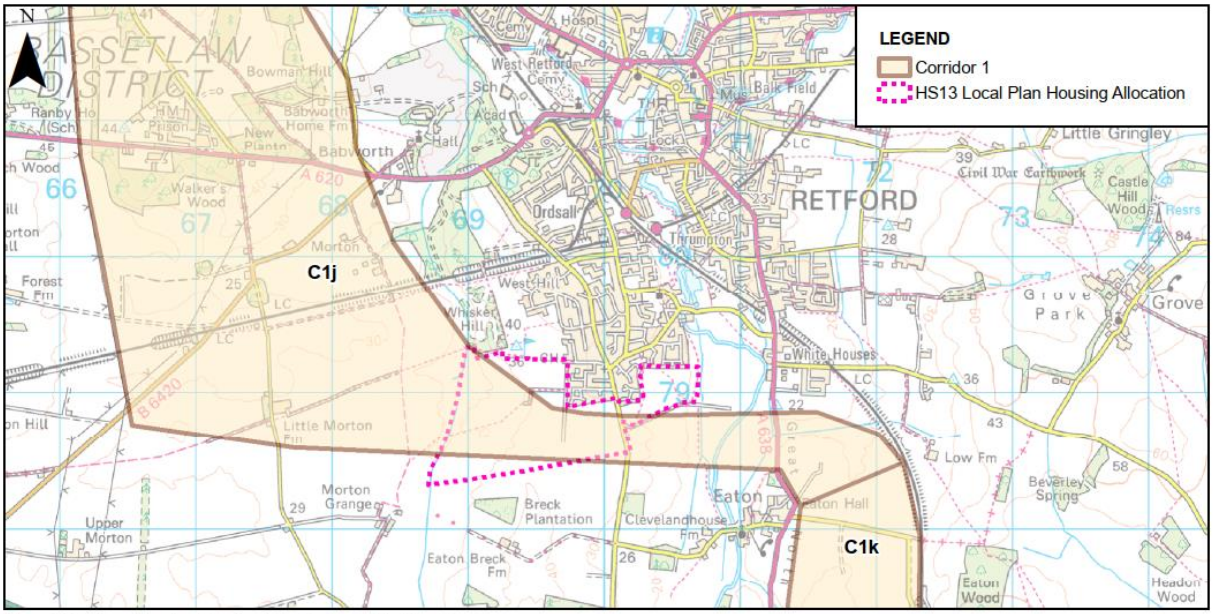


Figure 11-7 – Large Housing Allocation to the South of Retford (Corridor 1)

Corridor 1 Loop (C1-C1-Loop_c and C1-C1-Loop_d(n) and (s))

11.5.5 Routeing and siting within the Corridor 1 Loop to the south of the River Ouse continued to be similarly technically challenging as that to the north of the River Ouse due to the alignment of the M62. There would be a potential requirement to cross the M62 several times. The presence of Rawcliffe Road Industrial Estate and the Goole Interchange where the A614 meets the M62 further constrains the Corridor 1 Loop.

[40] At the time of undertaking the Options Selection, Doncaster Sheffield Airport operated as an international airport. The airport temporarily closed on the 5th November 2022. The findings of the Options Selection are not changed as a result of the temporary closure.

Corridor 1 to Corridor 2 Link (C1-C2-Link3 to C2-Link6a-c)

11.5.6 Four Links (C1-C2-Link3, C1-C2-Link4, C1-C2-Link5 and C1-C2-Link6) were considered to offer opportunities to route between Corridor 1 and Corridor 2 to offer routeing flexibility. However, there were constraints within and in proximity to these Links, and although considered, it was identified that there were no constraints that could beneficially be avoided by looping onto and off Corridor 1. For instance:

- C1-C2-Link3 connects to C1-C1-Loop_c and the M62 would still need to be crossed on the approach to this Link. This would include the area of the Goole Interchange and Rawcliffe Road Industrial Estate and would add no benefit;
- C1-C2-Link 3 and C1-C2-Link4 are also located in proximity to the Thorne and Hatfield Moors designated sites;
- Similarly, the approach to C1-C2-Link4 was constrained by the A18 and M180 road network; and
- Use of C1-C2-Link5 and C1-C2-Link6 would still require routeing in proximity to Doncaster Sheffield Airport.

Summary of Decision

11.5.7 Overall, the entire Corridor 1 between the south of the River Ouse to High Marnham was parked at this stage, primarily due to:

- The presence of a large number of land use constraints, including holiday parks, residential properties, recreational sites, landfills and scattered woodland;
- Large unavoidable constraints, including the housing planning allocation to the south of Retford;
- The presence of Thorne and Hatfield Moors designated sites and the potential for direct and indirect impacts upon the qualifying features of these sites (especially qualifying bird species) and the close proximity of the commercial airfields at Doncaster Sheffield Airport and Retford (Gamston) Airport; and
- Overall, Corridor 1 provided a longer and less direct route when compared to the other preliminary corridors, performing poorly against Holford Rule 3.

11.5.8 Following the decision to park the entire Corridor 1 and the factor that there were no constraints that could beneficially be avoided by looping onto and off Corridor 1, all Corridor 1 to Corridor 2 Links (C1-C2-Link3 to C1-C2-Link6) and the Corridor 1 Loop were also parked.

11.6 Step 4b – River Ouse to High Marnham (Corridor 4)

11.6.1 Step 4b considers the following Sections between the River Ouse and High Marnham:

- Corridor 4 (Section C4a to C4f(n) and (s)).

11.6.2 The defined components of the preliminary corridors considered in Step 4b are shown on **Figure 11-8**.

Figure 11-8 – Step 4b – River Ouse to High Marnham (Corridor 4)

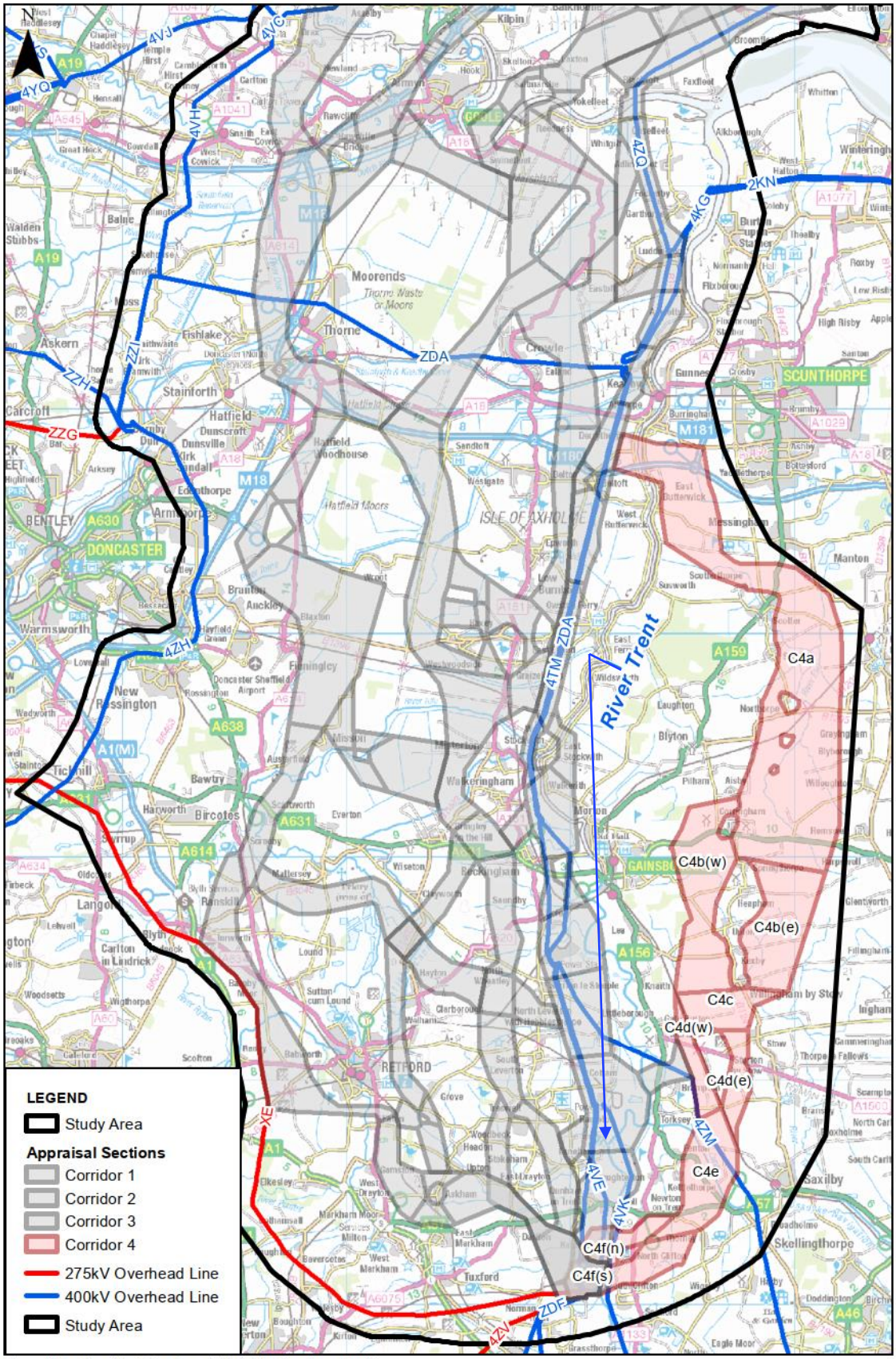


Figure 11-8 – Step 4b – River Ouse to High Marnham (Corridor 4)

Corridor 4 (Section C4a to C4f(n) and (s))

11.6.3 Corridor 4 connects to Corridor 3 north of Beltoft providing an eastern alternative to routeing south through or close to the Trent Valley on Corridor 3 or a combination of Corridors 2 and 3. The use of Corridor 4 would require routeing on the eastern side of the two existing overhead lines in Corridor 3 south of the Garthorpe area (where two of the existing lines meet). This would be technically challenging due to the requirement to cross two overhead transmission lines and four 132kV overhead distribution lines, requiring line swap overs and undergrounding, particularly near Keadby. The convergence of all these lines would introduce visual confusion in this area and have adverse impacts on landscape character.

11.6.4 Overall, the majority of this preliminary corridor is relatively unconstrained from an environmental and socio-economic perspective. Whilst it would introduce overhead transmission infrastructure into a landscape where this type of development does not currently exist, no significant landscape designations would be affected, and it would avoid the need to parallel a third line along Corridor 3.

11.6.5 However, routeing would be technically challenging. The entrance to this preliminary corridor would potentially require underground cabling with SECs, a crossing of the HLCP Project Preferred Route Corridor, avoidance of two wind turbines and a crossing of the River Trent and M180. These constraints are shown in **Figure 11-9**.

11.6.6 Further south, crossings would be required of oil and high pressure gas pipelines and 132kV and 33kV overhead lines. In the approach to High Marnham the 4ZM 400kV overhead line would need to be crossed, together with the River Trent, the 4VK and possibly the existing 4VE 400kV overhead lines. All of the 400kV line crossings would likely require underground cabling, adding to cost and complexity and requiring the construction of at least three, and possibly five, permanent compounds. In addition, crossing of several 33kV and 132kV overhead lines in the south of the corridor will cause visual confusion in these areas.

Figure 11-9 – Example Technical Challenges associated with Corridor 4

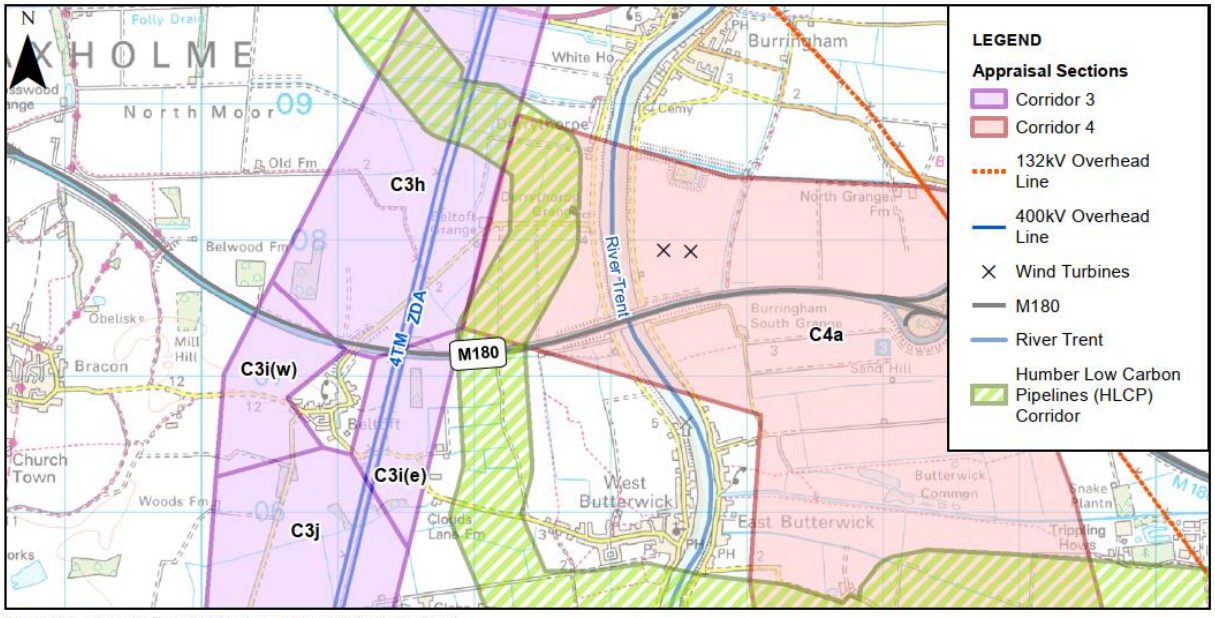


Figure 11-9 – Example Technical Challenges associated with Corridor 4

11.6.7 The local entry into High Marnham from the east is itself challenging from an environmental and technical perspective. Due to the eastern approach into High Marnham and the alignment of the existing 4VK and 4VE 400kV overhead lines within the area, the new route would likely require an underground cable entry into High Marnham. This would likely comprise an underground cable crossing of the River Trent requiring the installation of eighteen ducts and cables. North Clifton is present to the east of the River Trent and the required transition from overhead line to underground cable would be located in proximity to the village which comprises residential properties and farms, listed buildings and a primary school.

11.6.8 The technical complexity of connecting into Corridor 4 at the northern end and connecting from the corridor into High Marnham at the southern end would add significant additional costs and programme risk.

Summary of Decision

11.6.9 Overall, the entirety of Corridor 4 was parked at this stage, primarily due to:

- Being significantly more technically challenging than Corridor 2 and 3, due to the number of existing overhead lines which would require a line swap over or undergrounding and the presence of existing utility pipelines, the motorway and railway crossings, wind turbines and residential properties limiting gaps for routeing;
- Slightly longer length of corridor compared with Corridor 2 and 3, but potentially three challenging underground cabling sections including an underground cable crossing of the River Trent; and
- Potential for later project completion compared with Corridors 2 and 3 due to the level of technical constraints.

11.6.10 It was noted that Corridor 4 is largely unconstrained from an environmental and socio-economic perspective and would avoid increasing the number of overhead lines in or close to the Trent valley. However, the technical challenges meant that this Corridor was not preferred when compared to Corridor 2 and Corridor 3.

11.7 Step 4c –River Ouse to Luddington

11.7.1 Step 4c considers the following remaining Sections and Links:

- Corridor 2 (Section C2e(e), C2f(e) and (w));
- Corridor 3 (Section C3d); and
- Corridor 3 to Corridor 2 Link (C3-C2-Link1).

11.7.2 These sections provide four possible paths between the River Ouse Crossing locations in Corridors 2 and 3 and the Eastoft and Luddington area

11.7.3 The defined components of the preliminary corridors considered in Step 4c are shown on **Figure 11-10**.

Figure 11-10 – Step 4c – River Ouse to Luddington

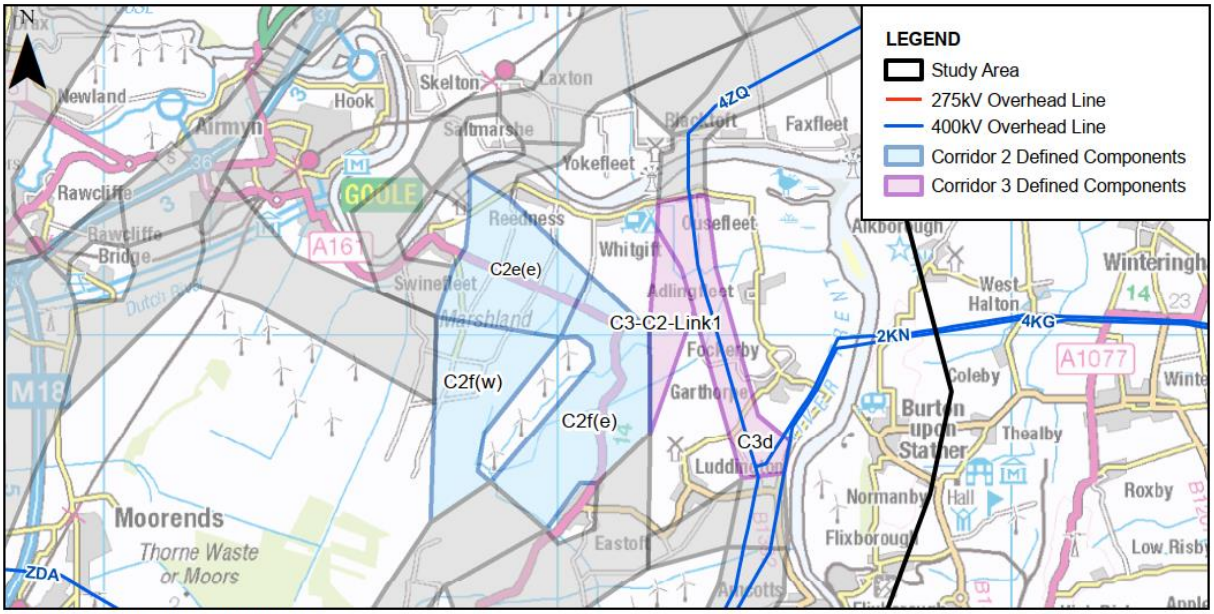


Figure 11-10 – Step 4c – River Ouse to Luddington

SCALE: 1:150,000

0 1 2 3 4 5 km

Corridor 2 (Section C2e(e), C2f(e) and (w))

11.7.4 Corridor 2 in this area would be accessed by either one of the three Corridor 2 River Ouse crossings, C1-C2-Link3 or C3-C2-Link1. Similar to the area north of the River Ouse, the landscape in this area is predominantly open and rural with fields bounded by drains. This would provide ample space for construction works, but there may be potential access limitations due to the poor local road network and rural nature of the landscape.

11.7.5 The settlements of Swinefleet, Reedness and Little Reedness are close to Corridor 2 and a new overhead line in this location would result in the potential for adverse landscape and visual impacts. The Twin Rivers windfarm to the north of Eastoft also presents a constraint in this area.

Corridor 3 (Section C3d)

11.7.6 Corridor 3 continues to follow the existing 4ZQ 400kV overhead line immediately south of the River Ouse and would provide the opportunity to maintain close parallel near the Humber Estuary designated sites. Corridor 3 is located further east than Corridor 2 and therefore is located further away from the Thorne and Hatfield Moors designated sites thereby reducing the potential for adverse ecological impacts. It is however closer to the River Trent section of the Humber Estuary designated sites.

11.7.7 The existing 4ZQ 400kV overhead line runs as a single line to Luddington before two other existing 400kV overhead line converge from the east and continue to Keadby as a broadly parallel pair of lines. As is the case immediately north of the river running close parallel to a single existing 400 kV overhead line on Corridor 3 may intensify the environmental impacts locally but would limit the area affected by new infrastructure. There are few constraints along the route of the existing 400kV overhead line, and therefore paralleling without any deviation from the existing route may be feasible.

Corridor 3 to Corridor 2 Link (C3-C2-Link1)

11.7.8 C3-C2-Link1 connects Section C3d with Section C2f(e) and would provide the means to deviate from a close parallel option in Corridor 3 to the north-west of Garthorpe. Use of this Link would avoid the introduction of an additional new overhead line in the area to the south of Garthorpe and Luddington, which is congested due to existing diverging and converging overhead lines.

Comparative Appraisal

11.7.9 Routeing options within this area comprised the use of:

- Corridor 2;
- Corridor 3; and
- Corridor 2 via the Corridor 3 to Corridor 2 Link1 (C3-C2-Link1).

11.7.10 Corridor 2 could be accessed from three routeing options across the River Ouse and therefore Section C2e(e) had a large area providing good routeing flexibility. However, Corridor 2 would require the introduction of a new overhead line into a predominantly rural landscape where an overhead line does not already exist, and would introduce further vertical features into a landscape already influenced by nearby wind turbines. Corridor 3 between the River Ouse and Luddington follows the existing 4ZQ 400kV overhead line and offers less routeing flexibility but would provide a close parallel opportunity. Use of the Corridor 3 to Corridor 2 Link1 would result in a divergence away from the existing 4ZQ 400kV overhead line which would be potentially more noticeable in the landscape, but would provide an opportunity to avoid the congested area of overhead lines near Luddington.

11.7.11 There would be an opportunity to avoid the congested area of overhead lines near Luddington by routeing on the western side of the existing 4ZQ 400kV overhead line in Corridor 3. Therefore, due to the close parallel opportunity in Corridor 3, it was considered that overall this option performed better from an environmental perspective. Corridor 3 also provided the most direct and shortest route option with the least associated cost, performing better than the other options from both a technical and cost perspective.

Summary of Decision

Defined Component Progressed

Corridor 3

11.7.12 Overall, Corridor 3 Section C3d were preferred, primarily due to:

- The opportunity to close parallel the single existing 4ZQ 400kV overhead line which is expected to limit the significance of adverse landscape and visual impacts in comparison with Corridor 2 in this section; and
- Corridor 3, whilst being closer to the River Trent section of the Humber Estuary designated sites, maintains a close parallel alignment in the area near to the designated sites, which is expected to minimise potential collision risk for bird species; and

- It is located further east of the Thorne and Hatfield Moors designated sites than the other preliminary corridors in this area.

Defined Components Parked

11.7.13 The following corridor components were parked at this stage:

Corridor 2

- This component of Corridor 2 was parked primarily because this would require the introduction of a new overhead line in a predominantly rural landscape which has the potential to result in greater adverse landscape compared with a parallel option in Corridor 3. There would also be adverse impacts upon views from isolated residential properties which are widely scattered through both C2f sections.

Corridor 3 to Corridor 2 Link (C3-C2-Link1)

- The C3-C2-Link1 was parked because it led into the less preferred component of Corridor 2. Utilising this more northerly link would also increase the length of the route located in areas presently unaffected by transmission lines when compared with a route utilising the more southerly C3-C2 Link 2. Here adverse landscape and visual impacts might be lower due to the opportunities to follow an established transmission route.

11.8 Step 4d – Luddington to the River Idle

11.8.1 Step 4d considers the following Sections and Loop between Luddington and the River Idle:

- Corridor 2 (Section C2g to C2i(e)-(w));
- Corridor 3 to Corridor 2 Link (C3-C2-Link2);
- Corridor 2 to Corridor 3 Loop (C2-C3-Loop_a-d); and
- Corridor 3 (C3f to C3k).

11.8.2 This is a relatively long section of the route and the components considered offer three discrete paths for any new line. The first passes the western side of the villages of Crowle and Ealand and the west of the higher ground of the Isle of Axholme. The second path is to the east of Crowle and Ealand, and runs east of the high ground of the Isle of Axholme. This path crosses high ground (30m) immediately east of the small town of Epworth. The third path follows the close parallel route represented by Corridor 3, immediately to the west of the villages of Keadby and Althorpe and avoiding most of the Isle of Axholme (though crossing high ground west of Owston Ferry).

11.8.3 Keadby Windfarm, Keadby Power Station, the historic landscape and features of the Isle of Axholme, including its slightly elevated terrain, and the Thorne and Hatfield designated sites were important considerations in this area.

11.8.4 The defined components of the preliminary corridors considered in Step 4d are shown on **Figure 11-11**.

Figure 11-11 – Step 4d – Luddington to the River Idle

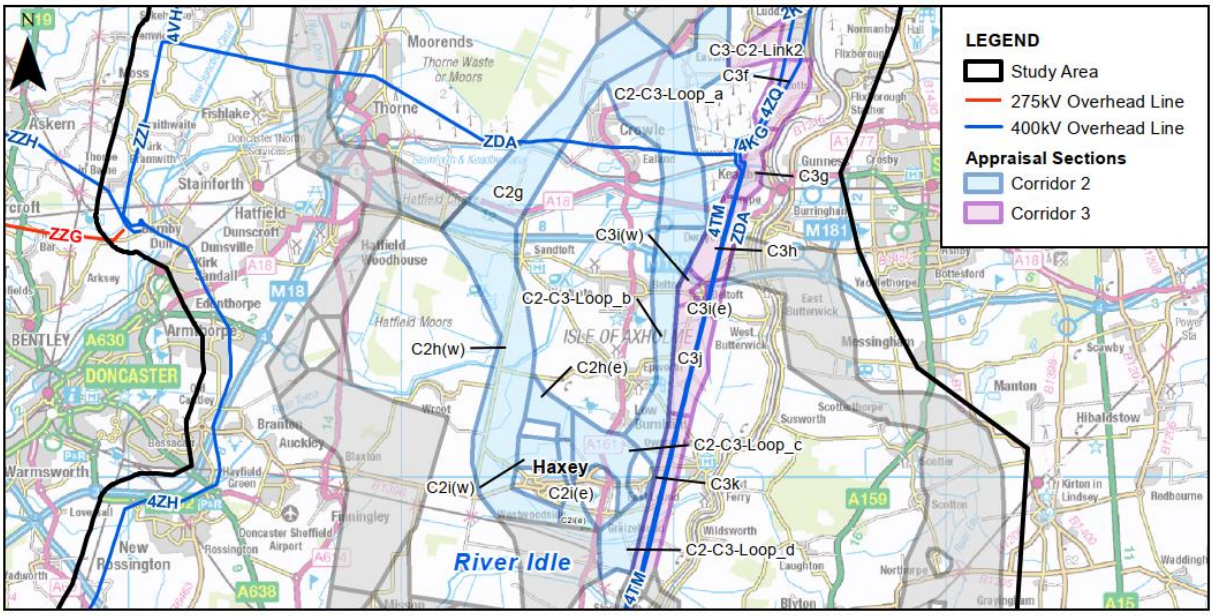


Figure 11-11 – Step 4d – Luddington to the River Idle

SCALE: 1:250,000

0 2.5 5 7.5 10 km

Corridor 2 (Section C2g to C2i(e) and (w))

11.8.5 This component of Corridor 2 is the western preliminary corridor option between Luddington and Epworth and deviates to the west to avoid Crowle, Sandtoft Airfield, Belton and Epworth. Corridor 2 also avoids Thorne and Hatfield designated sites but is adjacent to the boundary of the sites. Due to its avoidance of constraints, this preliminary corridor is less direct than the other preliminary corridor options in this area. It is considered that a new overhead line would be sufficiently separate from the existing overhead lines in the Trent Valley to ensure that no cumulative impacts would arise (in line with Rule 6 of the Holford Rules), however, it would result in a longer route.

11.8.6 Adopting this component of Corridor 2 would be technically challenging due to the presence of peaty soils in the area where the corridor crosses the existing 400kV ZDA overhead line. A section of the ZDA overhead line would need to be placed underground west of Crowle through potentially difficult ground conditions to facilitate the crossing with any new overhead line.

11.8.7 From an environmental and socio-economic perspective, several constraints were considered including the Thorne and Hatfield Moors designated sites, commercial flight operations at Sandtoft Airfield and a large mineral plan allocation safeguarding aggregate reserves north west of Westwoodside. In addition, the overhead line would introduce tall vertical features into the landscape which could result in adverse cumulative interactions with the wind farm to the north of Eastoft. Isolated residential properties and commercial businesses were also present. Corridor 2 remains closer to settlements including Westwoodside and Haxey when compared with the Corridor 2 to Corridor 3 Loop. It also crosses the highest ground on the Isle of Axholme (41m) between Haxey and Upperthorpe.

Corridor 3 to Corridor 2 Link (C3-C2-Link2)

11.8.8 C3-C2-Link2 connects Section C3e with C2-C3-Loop_a to the south of Luddington. Use of this Link would likely result in Luddington experiencing potential adverse landscape

and visual impacts. However, it would also provide the opportunity to close parallel the existing 4ZQ 400kV overhead line to Luddington and then diverge from close parallel west towards the Loop. This would avoid the need for line swap overs and avoid the introduction of a triple close parallel overhead line between Luddington and Keadby, as two existing overhead lines already converge in this area, and the area is already constrained by the presence of the Keadby Wind Farm.

Corridor 2 to Corridor 3 Loop (C2-C3-Loop_a-d)

11.8.9 The Loop begins to the south of Eastoft and is accessed via Corridor 2 or the C3-C2-Link2. It follows Corridor 3 south and deviates to the west to avoid Keadby Windfarm and Keadby Power Station, avoiding the existing overhead lines in the Trent Valley to avoid cumulative impacts in the Keadby area. As the Loop is adjacent to Corridor 3 which has two existing close parallel overhead lines, development of a new overhead line which is not close parallel within this area is likely to be visible within the same landscape. There is the potential for adverse landscape and visual impacts on settlements including Beltoft and Epworth. However, the use of this Loop would minimise any routeing over the ridge of higher ground at the southern end of the Isle of Axholme which is an elevated landscape in this area.

11.8.10 The Loop does also have technical challenges associated with crossings of the road and rail network, high pressure gas pipelines and an existing 132kV overhead line. The crossing of the 132kV overhead line will cause less visual confusion than introducing another overhead line alongside the two existing lines in Corridor 3, and having to cross four overhead lines within proximity to one another around Keadby Power Station. It also allows more flexibility in routeing around Keady Wind Farm.

Corridor 3 (Section C3f to C3k)

11.8.11 Corridor 3 follows the two existing close parallel overhead lines to the north and south of Keadby Power Station which constrain the preliminary corridor from an environmental and technical perspective. It is likely that the existing overhead lines to the north of Keadby Power Station would need to be crossed with a new overhead line and then crossed back again south of Keadby Power Station, introducing several line swap overs. This has the potential to introduce a wirescape into this area, contributing to visual confusion.

11.8.12 Keadby Windfarm is also present adjacent to the west of Section C3f and C3g and was considered as a major constraint for routeing when defining the preliminary corridors when considered in combination with the existing overhead lines and the River Trent. Corridor 3 was defined to take into account the required stand-off distances to the wind turbines, however opportunities to route to the east of the wind farm are limited. This resulted in the creation of constrained areas to the east of Keadby Power Station, especially considering the existing overhead lines and proposed developments in this location, as shown in **Figure 11-12**.

11.8.13 To the south of Keadby, Corridor 3 continues to follow the two existing close parallel overhead lines and the introduction of a third overhead line would be environmentally and technically challenging in places. For instance, the preliminary corridor narrows around Beltoft and a new overhead line in this area would likely result in potential adverse landscape and visual impacts and the potential for wirescape. Furthermore, properties at High Melwood and Low Melwood may limit opportunities to parallel, as would Low Hall Farm near East Lound.

11.8.14 Utilising Corridor 3 and the close parallel opportunity within the area around Epworth would avoid routeing in close proximity to Haxey Airfield, Haxey and Westwoodside which would also have likely adverse landscape and visual impacts.

Figure 11-12 – Keadby Windfarm Constrained Area – Corridor 3

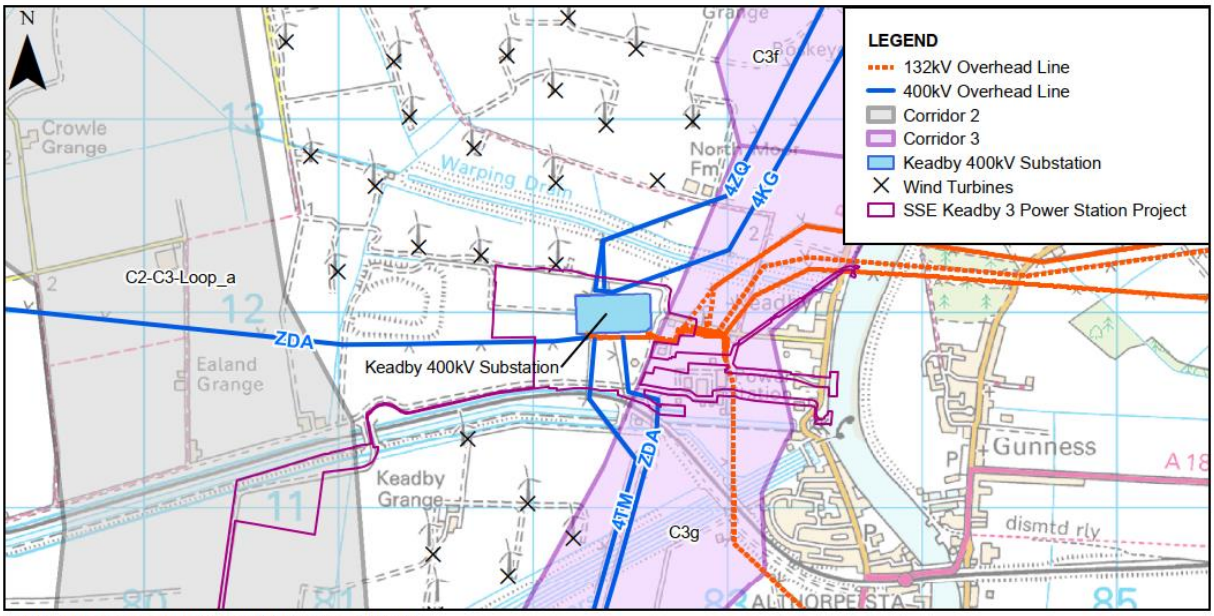


Figure 11-12 – Keadby Windfarm Constrained Area – Corridor 3

Comparative Appraisal

11.8.15 Routeing options within this area comprised the use of:

- Corridor 2;
- Corridor 2 to Corridor 3 Loop (C2-C3-Loop) via Corridor 2 or the Corridor 3 to Corridor 2 Link (C3-C2-Link2); and
- Corridor 3.

11.8.16 Routeing options around Keadby, Isle of Axholme and Haxey led the discussions in this area due to the environmental and technical constraints present.

Keadby

11.8.17 Corridor 3 is the closest preliminary corridor to Keadby and is the most technically challenging of the routeing options due to the existing overhead line network, Keadby Power Station and Keadby Windfarm. Introducing a new overhead line in this area would likely result in adverse landscape and visual impacts, due to the presence of converging and diverging overhead lines, and interaction with other tall development (e.g. wind turbines). This would be further restricted by the presence of Keadby Windfarm with an offset required from the eastern-most wind turbines. Keadby Power Station also intersects Corridor 3 and restricts routeing in this area. Alternatively, the use of Corridor 2 or the Corridor 2 to Corridor 3 Loop in this area would avoid Keadby and the network of existing overhead lines, and would be of sufficient distance from the existing overhead lines to minimise cumulative interactions with the two sets of overhead lines.

11.8.18 Both Corridor 2 and the Corridor 2 to Corridor 3 Loop cross the existing ZDA 400kV overhead line routeing west from Keadby. Both would also require the introduction of a new overhead line into a predominantly rural landscape which passes close to the settlements including Crowle, Ealand and Beltoft. The use of Corridor 2 would also result in the potential for adverse environmental impacts as it runs parallel to the Thorne and Hatfield Moors designated sites.

11.8.19 It was considered that overall, the Corridor 2 to Corridor 3 Loop performed better from an environmental and technical perspective, due to the opportunity to avoid the Thorne and Hatfield Moors designated sites, as well as the congested area of overhead lines, power stations and wind turbines around Keadby.

Isle of Axholme

11.8.20 The Isle of Axholme, an Area of Special Historic Landscape Interest, covers the Corridor 2 to Corridor 3 Loop and Corridor 3 in the area around Epworth. Corridor 2 avoids the Isle of Axholme but routes parallel to the Thorne and Hatfield Moors designated sites and would require a new overhead line where there is not one already existing. The Corridor 2 to Corridor 3 Loop routes directly to the east of Epworth and would require a route through the Isle of Axholme. The use of Corridor 3 would also require a route through the Isle of Axholme, but would provide a close parallel option alongside the existing close parallel overhead lines.

11.8.21 The use of Corridor 3 would require less routeing through the Isle of Axholme. Due to the existing close parallel overhead line and width of the preliminary corridor, there would be environmental and technical challenges associated with routeing particularly in the Beltoft area. The Corridor 2 to Corridor 3 Loop would require more routeing through the Isle of Axholme, but due to its connection with Corridor 3 which widens the preliminary corridor, it provides greater routeing flexibility. It can also maintain some distance between the parallel overhead lines to reduce cumulative interactions, particularly at Beltoft. Due to this opportunity, it was considered that the Corridor 2 to Corridor 3 Loop performed better from an environmental and technical perspective.

Haxey

11.8.22 The settlement of Haxey is within the southern extent of the Isle of Axholme and is within a highly constrained area due to the nearby settlements of Westwoodside, Upperthorpe and East Lound. It is also located on the highest terrain in the area. Corridor 2 routes to the west and north of the settlements providing three different routeing options. However, a new overhead line in Corridor 2 could lead to potential encircling of these settlements due to the presence of the existing close parallel overhead line to the east of these settlements. The Corridor 2 to Corridor 3 Loop is the closest preliminary corridor to Haxey, routeing around the settlement to the north and east. Use of the Corridor 2 to Corridor 3 Loop would require the new overhead line to route in close proximity to Haxey and East Lound, in an area of preliminary corridor which is approximately 330m in width. Alternatively, the combination of Corridor 2 to Corridor 3 Loop and Corridor 3 could be utilised to provide a greater offset distance to the cluster of settlements. However, due to the existing close parallel overhead lines in Corridor 3, a new overhead line, even in close parallel would route within 600m of East Lound resulting in potential adverse environmental impacts.

11.8.23 The combination of Corridor 2 to Corridor 3 Loop and Corridor 3 performed better environmentally and technically than the use of Corridor 2 alone, or Corridor 2 to Corridor 3 Loop alone. This was due to the opportunity to close parallel the existing

overhead lines in Corridor 3, the increased width of preliminary corridor which improves routeing flexibility and the avoidance of having to route between settlements.

Summary of Decision

Defined Component Progressed

Corridor 3 to Corridor 2 Link (C3-C2-Link2)

- The use of C3-C2-Link2 would avoid the need to introduce a triple close parallel route to Keadby, where the existing overhead lines already converge and diverge.

11.8.24 It was noted that utilising Corridor 3 and the close parallel option would result in a marginal increase in overall length when compared to the use of the slightly more direct, C3-C3-Link2 and C2-C3-Loop_a components.

Corridor 2 to Corridor 3 Loop (C2-C3-Loop_a, b and d)

11.8.25 Overall, the Corridor 2 to 3 Loop (C2-C3-Loop_a, b and d) were preferred, in combination with Section C3i(w), C3j and C3k primarily as it provided:

- A route to the west avoiding Keadby Windfarm, Keadby Power Station and the existing overhead lines north of Keadby (C2-C3-Loop_a);
- Greater routeing flexibility around Beltoft where Corridor 3 was constrained by existing overhead lines (C2-C3-Loop_b). Routeing through Section C2-C3-Loop_b, C3k and C2-C3-Loop_d also prevents East Lound being enclosed by overhead lines to the east and west. Section C3i(w) was also progressed to avoid the need for sharp angles if routeing back into Corridor 3 to close parallel the existing overhead lines; and
- The use of C2-C3-Loop_d would provide an alternative to routeing through Corridor 3 further south, which would be highly constrained by existing overhead lines and properties as the preliminary corridor narrows around East Stockwith and West Stockwith. The use of C2-C3-Loop_d would avoid the need to triple parallel to the west of East Stockwith, or completely enclose East Stockwith with an additional overhead line to the east (see Step 4e).

Corridor 3

- Section C3j and C3k were preferred as they provided a close parallel opportunity and avoidance of Epworth, East Lound and Haxey (including Haxey Airfield). There is greater routeing flexibility when these Sections are combined with C2-C3-Loop_b.

Defined Component Parked

11.8.26 The following corridor options were parked at this stage:

Corridor 2

- Corridor 2 as it is a longer and less direct route. Several constraints were also within and adjacent to the preliminary corridor including the Thorne and Hatfield Moors designated sites, Sandtoft Airfield and a large mineral local plan allocation.

Corridor 2 to Corridor 3 Loop (C2-C3-Loop_c)

- Corridor 2 to Corridor 3 Loop (C2-C3-Loop_c) due to its proximity to Haxey and Haxey Airfield which constrain routeing flexibility in this area. Routeing through C2-C3-Loop_c would also enclose East Lound with overhead lines to the east and west.

Corridor 3

- Corridor 3 Sections (C3f, C3g, C3h and C3i(e)) due to the presence of Keadby Windfarm, Keadby Power Station, the existing overhead lines and the River Trent. These would significantly constrain routeing flexibility within this area and would likely result in wirescape and visual confusion in the Trent Valley.

11.9 Step 4e – River Idle to High Marnham

11.9.1 Step 4e considers the following Sections and Links between the River Idle (Epworth) and High Marnham:

- Corridor 2 (Section C2j to C2q);
- Corridor 2 to Corridor 3 Link (C2-C3-Link);
- Corridor 2 to Corridor 1 Link (C2-C1-Link_a to C2-C1-Link_e);
- Corridor 3 (Section C3l(w) to C3r); and
- Corridor 3 to Corridor 2 Link (C3-C2-Link3 and C3-C2-Link4).

11.9.2 The defined components of the preliminary corridors considered in Step 4e are shown on **Figure 11-13.**

Figure 11-13 – Step 4e – River Idle (Epworth) to High Marnham

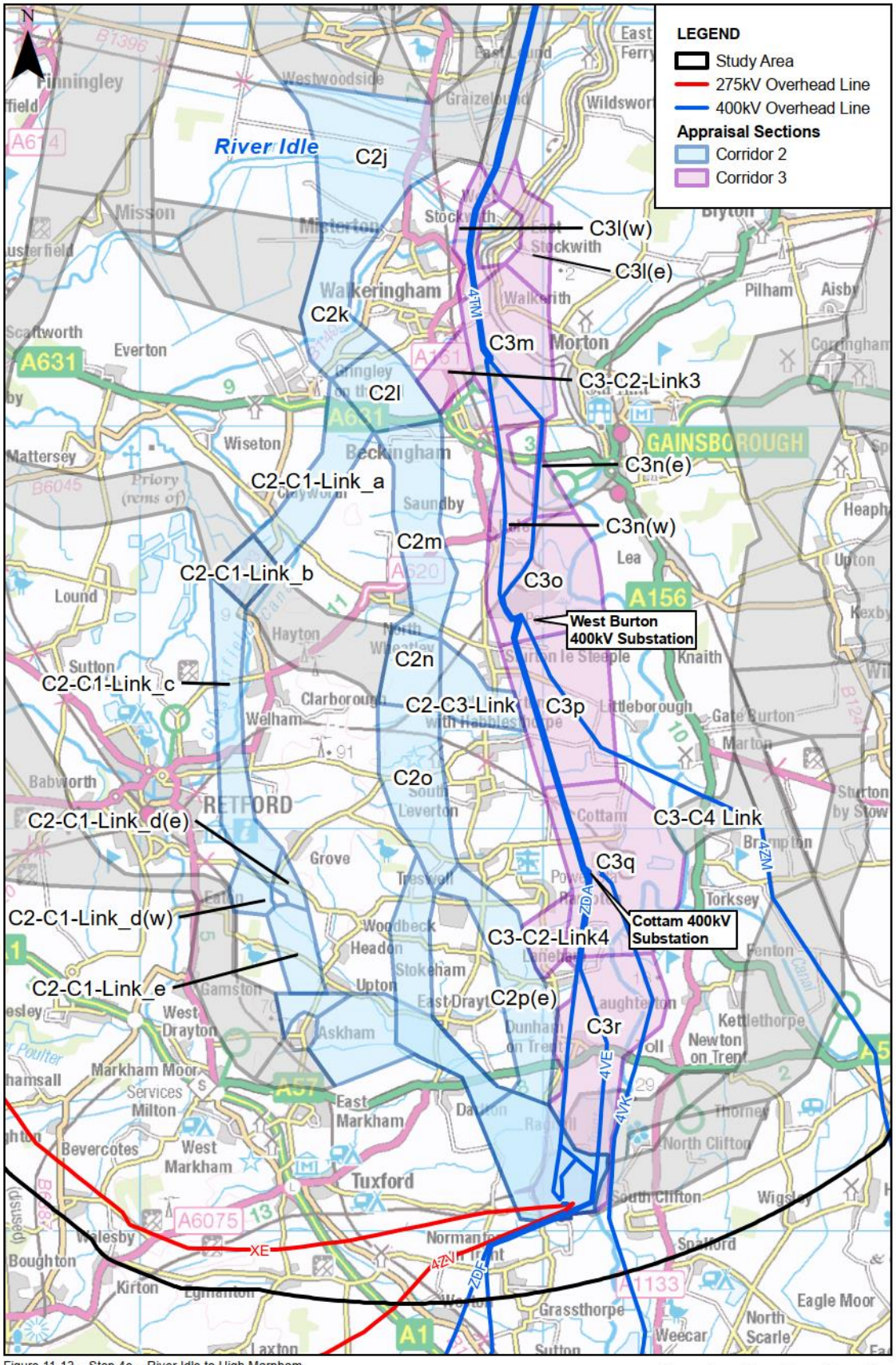


Figure 11-13 – Step 4e – River Idle to High Marnham

SCALE:1:150,000

0 1 2 3 4 5 km

Corridor 2 (Section C2j to C2q)

11.9.3 Corridor 2 provides an alternative to introducing a third close parallel alignment along the existing overhead lines in Corridor 3 and in Corridor 1 where there are also discrete sections of existing overhead line. This section of Corridor 2 would adhere to Rule 6 of the Holford Rules in keeping new overhead lines noticeably distant from existing overhead lines and avoiding converging routes.

11.9.4 The preliminary corridor deviates to avoid settlements and constraints including Misterton, North Wheatley and South Wheatley and West Burton Airstrip. At Treswell, the preliminary corridor is in proximity to Treswell Wood SSSI and LNR and the private airstrips west of Treswell.

11.9.5 South of Treswell the preliminary corridor splits into an eastern (C2p-(e)) and western leg (C2p(w)) to avoid Rampton Secure Hospital, Stokeham and East Drayton. There was no strong technical preference between these two options, however the western option was preferred from an environmental perspective. The western leg is located on slightly higher land, while the eastern option drops towards the floodplain of the River Trent. It is situated in closer proximity to the close parallel alignment of the ZDA and 4VE 400kV overhead lines, leading to greater likelihood of creating a wirescape and visual confusion from three overhead lines. Given the presence of three existing overhead transmission lines in this section of the Trent Valley there was considered to be greater potential for significant cumulative landscape and visual impacts, especially on the settlements of Laneham and Ragnall, which would be enclosed to the east and west by overhead lines in close proximity.

11.9.6 The settlements of East Drayton and Darlton lie adjacent to the western option of Corridor 2. There is the potential for adverse impacts on the setting of the Grade II* listed Church of St Giles at Darlton and also adverse landscape and visual impacts for those on the edge of the settlements of East Drayton and Darlton.

Corridor 2 to Corridor 3 Link (C2-C3-Link)

11.9.7 The option of using this Link to route between Corridor 2 and Corridor 3 would avoid the constrained area around West Burton Power Station, Beckingham Marshes RSPB Nature Reserve and the existing converging and diverging overhead lines in Corridor 3. However, it was noted that routeing into Corridor 3 via this Link would result in converging overhead routes, the need for multiple angle pylons and a triple close parallel alignment. It would also have likely adverse landscape and visual impacts on the settlements of Fenton, Sturton le Steeple and North Leverton with Habblesthorpe. Properties on the eastern edge of Sturton le Steeple would provide further constraints to routeing parallel to the existing overhead lines.

Corridor 2 to Corridor 1 Link (C2-C1-Link_a to C2-C1-Link_e)

11.9.8 The use of this Link between Gringley on the Hill and Askham was considered as an alternative to utilising Corridor 2 in isolation. This option provided benefits from a landscape and visual perspective as it avoided the Trent Valley and the potential cumulative interactions with existing overhead lines. However, there would be potential for landscape and visual impacts on settlements along the Link, particularly due to the presence of the higher ground to the east of Retford. Routeing would be constrained by settlements to the north-east of Retford and between Askham and Upton, which is on higher land and would likely result in greater visual prominence of the overhead line. In addition, routeing would potentially impact upon users of the Chesterfield Canal /

Cuckoo Way recreational path. This option would also result in an additional length of overhead line and implications for programme.

Corridor 3 (Section C3l(w) and (e) to C3r)

11.9.9 Corridor 3 follows the existing overhead lines through the Trent Valley. These existing lines include two close parallel overhead lines, although these diverge in places, and they are joined by a third overhead line south of West Burton. The existing density and complexity of overhead lines throughout this corridor would inevitably lead to adverse cumulative landscape and visual impacts, should the new overhead line be routed along this corridor.

11.9.10 Corridor 3 narrows at several points including at West Stockwith where the western split of the preliminary corridor is constrained by the River Idle, Chesterfield Canal, River Trent, Misterton and West Stockwith and the existing close parallel 4TM and ZDA 400kV overhead lines. An alternative option would be to route through the eastern split of the preliminary corridor at this point, however, this would deviate from close parallel, require a crossing of the River Trent and would result in encirclement of the villages of West and East Stockwith. To the north-east of Beckingham, the 4TM and ZDA 400kV overhead lines diverge and a line swap over would likely be required.

11.9.11 Achieving the benefits associated with close parallel between Beckingham and West Burton is likely to be challenging and has a high potential of becoming considered a wirescape due to the separation distances between the existing 4TM and ZDA 400kV overhead lines which at most is approximately 1.1km. The benefits of separation within the landscape would not be realised at this small distance. The preliminary corridor narrows again at Beckingham Marshes RSPB Nature Reserve, which the existing ZDA 400kV overhead line routes through and there would be a strong preference to avoid adding an additional overhead line through the Reserve. Avoidance of this Reserve would require an overhead line alongside the 4TM 400kV overhead which runs along the outskirts of Beckingham.

11.9.12 The 4TM and ZDA 400kV overhead lines converge again at West Burton which is a constrained area due to the existing electricity transmission infrastructure and the presence of proposed developments associated with the redevelopment of West Burton Power Station. It is likely that at least one line swap over would be required in the area to the north of West Burton. To the south of West Burton, there are three existing overhead lines within the preliminary corridor. A close parallel alignment of the ZDA 400kV and 4VE 400kV overhead lines run southwards to Cottam and the 4ZM 400kV overhead line continues southwards to North Leverton before routeing east out of Corridor 3. Due to the flat topography within this area, the introduction of a fourth overhead line would likely result in adverse environmental impacts and be noticeable in the landscape from a long distance. This is likely to result in a wirescape and would not be compliant with Rule 4, to choose tree and hill screening as a background in preference to sky and Rule 6 of the Holford Rules, to keep overhead lines as far apart to avoid wirescape.

11.9.13 A similar layout of overhead lines can be found to the south of Cottam where the two overhead lines comprising the ZDA and 4VE 400kV overhead lines run in close parallel to Laneham before diverging and running in a slightly separated parallel alignment (approximately 950m to High Marnham). A third overhead line comprising the 4VK 400kV overhead line runs to the east of this parallel alignment to High Marnham. Introducing a new, fourth, overhead line into this section of preliminary corridor would be challenging due to the separation distance between the existing overhead lines and

constraints including Dunham-on-Trent, Ragnall and the River Trent. The introduction of a fourth overhead line would also likely result in adverse environmental impacts and a wirescape.

Corridor 3 to Corridor 2 Link (C3-C2-Link3 and C3-C2-Link4)

11.9.14 The use of C3-C2-Link3 would avoid the need to route through or adjacent to Beckingham Marshes RSPB Nature Reserve and avoid the constrained area around West Burton Power Station. It would also avoid potentially introducing a parallel overhead line to the east of Beckingham. However, the Link is in close proximity to the settlements of Walkeringham to the north and Beckingham in the south which would potentially result in adverse landscape and visual impacts on these settlements.

11.9.15 The use of C3-C2-Link4 would provide an opportunity to avoid the converging and diverging existing overhead lines on the approach to High Marnham. However, the Link is located to the south-west of Cottam Power Station which is a highly constrained area with existing overhead lines and therefore entry into the Link would be challenging.

11.9.16 It was considered that use of these Links would result in converging routes, the need for multiple angle pylons and a triple close parallel alignment.

Comparative Appraisal

11.9.17 Routeing options within this area comprised the use of:

- Corridor 2;
- Corridor 2 to Corridor 1 Link (C2-C1-Link) via Corridor 2;
- Corridor 2 via the Corridor 3 to Corridor 2 Link (C3-C2-Link3 or C3-C2-Link4);
- Corridor 3; and
- Corridor 2 and Corridor 3 via the Corridor 2 to Corridor 3 Link (C2-C3-Link).

11.9.18 Corridor 3 follows the existing network of overhead lines along the Trent Valley in this area and is highly constrained in the area around Beckingham, Cottam, West Burton and High Marnham. This is due to a combination of existing development, the River Trent and the existing overhead lines which converge and diverge throughout the preliminary corridor. Corridor 2 in comparison is relatively unconstrained and has no existing overhead lines, but is in close proximity to settlements which are located adjacent to Corridor 2. The Corridor 2 to Corridor 1 Link performs similarly to Corridor 2, as it is relatively unconstrained when compared to Corridor 3, however it is also in close proximity to settlements including Retford.

11.9.19 Corridor 3 would provide the shortest and most direct route; however, it performs less well than Corridor 2 when considering environmental and technical aspects. Several deviations from close parallel would be required for Corridor 3 and in combination with the existing overhead lines, have the potential to result in adverse landscape and visual impacts. Therefore, the benefits of close parallel are outweighed by the environmental and technical challenges.

11.9.20 Corridor 2 and the Corridor 2 to Corridor 1 Link performed similarly in terms of environmental and technical aspects, but use of the Corridor 2 to Corridor 1 Link would require a greater length of overhead line and a higher associated cost. The Corridor 2 to Corridor 1 Link is also smaller in width and would limit routeing flexibility, particularly to

the east of Retford where a new overhead line has the potential to result in adverse landscape and visual impacts.

11.9.21 Overall, Corridor 2 performed better in terms of environmental and technical aspects, providing routeing flexibility and a direct route between the River Idle and High Marnham.

Summary of Decision

Defined Component Progressed

Corridor 2

11.9.22 Overall, Sections C2j to C2q were preferred primarily as it provided an:

- Opportunity to keep new overhead lines noticeably distant from existing overhead lines and avoid converging routes, particularly with in the Trent Valley; and
- Avoid introducing a new overhead line into the highly constrained areas around West Burton and Cottam.

11.9.23 Where close parallel cannot be achieved, it is preferred that overhead lines should be kept completely separate for the purposes of reducing landscape and visual impacts.

Defined Component Parked

11.9.24 The following were parked at this stage:

Corridor 2 to Corridor 3 Link (C2-C3-Link)

- The use of this Link would result in converging routes, the need for multiple angle pylons and a triple close parallel alignment. It would also have likely adverse landscape and visual impacts on nearby settlements.

Corridor 3 to Corridor 2 Link (C3-C2-Link3 and C3-C2-Link4)

- The use of this Link would result in converging routes, the need for multiple angle pylons and a triple close parallel alignment. It would also have likely adverse landscape and visual impacts on nearby settlements.

Corridor 2 to Corridor 1 Link (C2-C1-Link_a to C2-C1-Link_e)

- Use of these Links would potentially result in landscape and visual impacts on settlements, particularly due to the presence of the higher ground to the east of Retford. The use of this Link would also result in an additional length of overhead line and implications for programme.

Corridor 3

- Highly constrained areas in this preliminary corridor. These include the area around East Stockwith and West Stockwith, Beckingham, West Burton and Cottam which are further constrained by the presence of two existing close parallel overhead lines. Introducing a new overhead line into Corridor 3 would likely result in wirescape and cumulative landscape and visual impacts, due to the existing converging and diverging overhead lines in the preliminary corridor.

11.10 Step 5 – End-to-end Solution

11.10.1 For the Project, four preliminary overhead line corridors were identified and appraised. The four preliminary corridors were divided in sections, links and loops for appraisal and the identification of an emerging preferred corridor. Following the appraisal of the sections, links and loops in isolation an end-to end solution review was then undertaken between Creyke Beck and High Marnham. This review considered each progressed section, link or loop of the preliminary corridor in the context of the wider end-to-end solution and ensured that the reasoning and justification for progressing one part of the emerging preferred corridor did not incorrectly impact on the decision made for the next section, link or loop of the corridor. The wider end-to-end solution review also incorporated cost performance, reported in **Chapter 10**. The review did not cause any amendments to the preferred emerging corridor.

11.10.2 To summarise the emerging preferred corridor consists of:

- A new overhead line closely parallel to the existing 4ZQ 400kV overhead line from the edge of the Yorkshire Wolds to near Luddington (Lincolnshire) including crossing the River Ouse alongside the existing overhead line river crossing;
- A new overhead line from Luddington to near Beltoft, looping west around Keadby Windfarm to pass east of Ealand and then parallel or close parallel to the two existing 400kV overhead lines south to near the crossing of the Warping Drain, south-east of Haxey; and
- A new overhead line from there looping west to pass west of Misterton, then south, passing west of the line of villages along the edge of the Trent valley (Wallingham, Beckingham, Sturton le Steeple, North and South Leverton, Tresswell and Woodbeck) to pass west of East Drayton then approach High Marnham from the north-east.

11.10.3 The emerging preferred corridor is shown in **Figure 11-14**.

11.10.4 Overall, the conclusion was drawn that routeing the new overhead line closely parallel to existing 400kV network would minimise the overall environmental impacts – concentrating impacts in areas already impacted rather than spreading them more widely. The main exceptions to this are at Keadby with the technical constraints around the Keadby Windfarm and south of Haxey, identifying a new corridor three to four kilometres west of the existing 400kV overhead lines in the Trent Valley where the increasing numbers of existing lines form a broad and complex network.

11.10.5 The emerging preferred corridor broadly looks to close parallel with existing electricity transmission infrastructure, where possible. Close paralleling would minimise overall environmental and socio-economic impacts, whilst avoiding areas of highest engineering challenge. The deviations from close parallel avoid the congested Trent Valley and reduce the potential for adverse cumulative impacts with the existing converging and diverging overhead lines. The deviations make little difference to the overall length of the emerging preferred corridor which is close to the shortest practicable given the constraints posed by the Humber Estuary. Overall, the emerging preferred corridor is considered to offer the optimum balance between environmental, technical, cost and socio-economic considerations.

Figure 11-14 – End-to-End Emerging Preferred Corridor

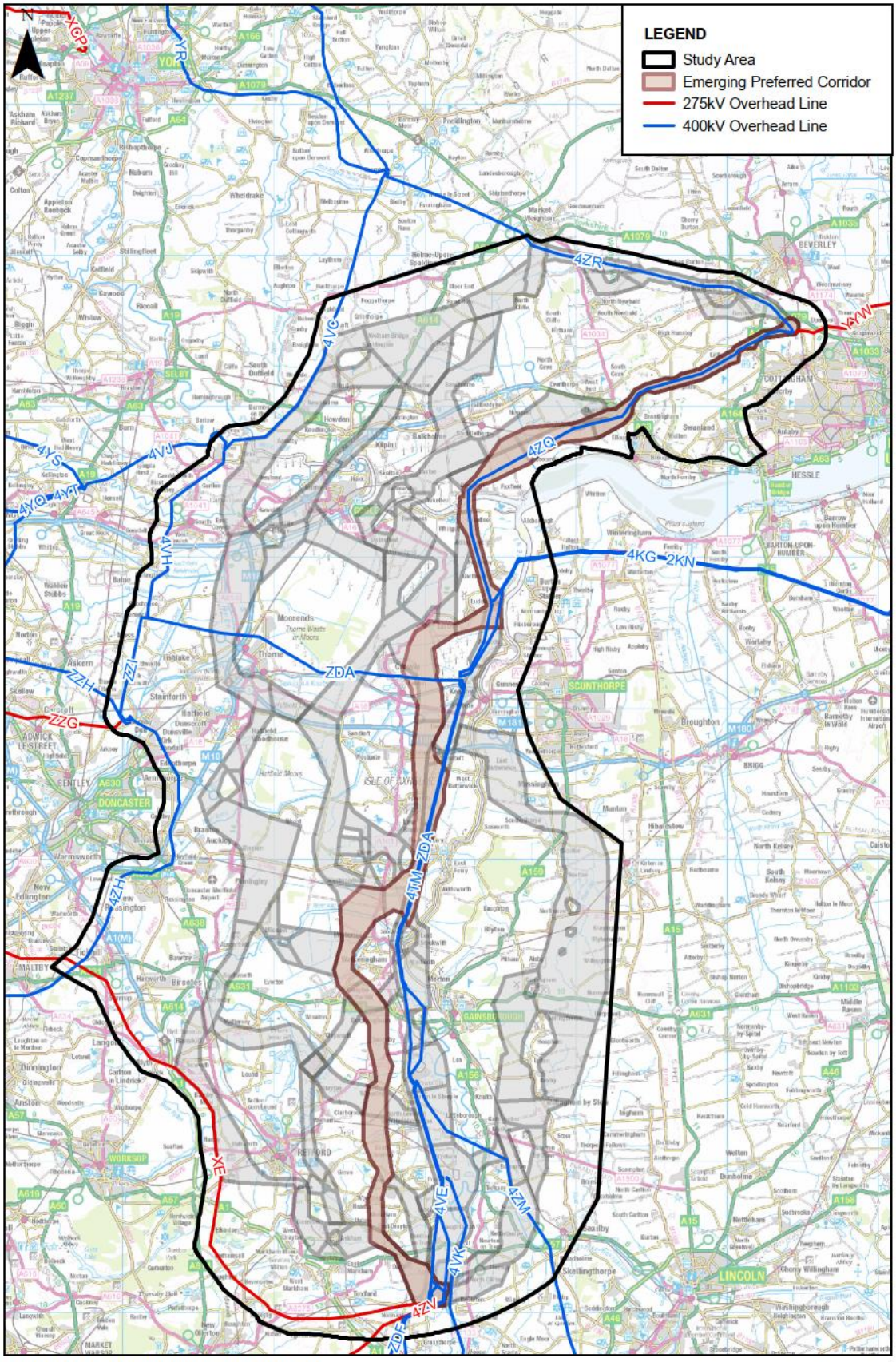


Figure 11-14 – End-to-End Emerging Preferred Corridor

12. Development of the Graduated Swathe

12. Development of the Graduated Swathe

12.1 Introduction

12.1.1 Following the selection of the emerging preferred corridor, a preliminary design exercise was undertaken to identify where it might be more appropriate to site the Project within the corridor. This took into account the Holford Rules, having regard to local sites and features. These include features such as known residential properties, larger woodlands and existing infrastructure. The outcome of this exercise is shown by the use of a 'graduated swathe' – coloured shading of varying intensity to indicate areas more likely (darker colour) and less likely (lighter colour) to be the location of the proposed infrastructure. Detailed plans showing the location of the proposed graduated swathe are included in **Appendix C**.

12.1.2 The graduated swathe is both preliminary and indicative. It is intended as a tool for non-statutory consultation and engagement with communities and other stakeholders, including landowners. The feedback from non-statutory consultation will inform the further development of the Project.

12.1.3 Within the area covered by the graduated swathe there are areas where there is greater flexibility for routeing and areas where there is less flexibility. This is reflected in the way the width of the darker parts of the graduated swathe varies: some areas of the emerging preferred corridor where the darker shading covers a broader area (greater flexibility) and in other areas where the darker shading is more focused (lesser flexibility).

12.1.4 In some sections of the corridor, the swathe forms two or more distinct paths through the emerging preferred corridor, defined by local sites and features that may constrain the routeing of a new overhead line. In other places the graduated swathe follows a single path with the width varying dependent upon local sites and features and design principles such as the preference to follow more direct routes where opportunities exist.

12.1.5 The outcomes of the analysis depicted in the graduated swathe may be subject to change as the design and consenting process continues, more information becomes available, and the views of stakeholders are considered. It does not rule out development within other parts of the emerging preferred corridor if necessary, or indeed outside of the emerging preferred corridor, based on consultation feedback received, the findings of detailed surveys and subsequent design development.

12.1.6 As discussed in **Chapter 3**, detailed localised routeing of the new overhead line will have due regard to the guidelines set out in the 'Holford Rules' and other principles of good design. In order to limit the number of bulkier angle pylons and develop a more coherent design solution opportunities will be sought to develop straight sections of route wherever practicable. Accordingly, any detailed design proposal will be a response to local environmental, technical and socio-economic considerations and will seek to follow the holistic principles of good design.

12.2 Developing the Graduated Swathe

12.2.1 The development of the graduated swathe was informed by the location of sites and features within and beyond the corridor, which were identified from mapping and visits to the emerging preferred corridor, similar to those that informed the options appraisal, as described in **Chapter 5**. The emerging preferred corridor was appraised to identify areas that may be more or less sensitive to the introduction of the Project infrastructure, then preliminary designs were developed to identify where a new overhead line might most appropriately be routed, designing in accordance with the Holford Rules whilst taking into account environmental features and technical requirements. This was informed by opportunities, such as identifying where it was possible to run consistently close parallel to existing overhead lines, as well as detailed consideration of features and the locations of residential properties within the emerging preferred corridor. Where the options appraisal identified potential opportunities to develop close parallel alignments this opportunity has been reflected in the graduated swathe.

12.2.2 In order to effectively portray the graduated swathe between Creyke Beck and High Marnham Substations, a number of additional features have been included, as described in the following sections.

Substation Zones

12.2.3 The start and end points of the graduated swathe link into routeing zones which connect to the new substation zones at both Creyke Beck and High Marnham and the Creyke Beck substation extension zone. The routeing zones are outlined in blue, the new substation search areas are outlined in orange and the Creyke Beck substation extension zone is outlined in green in **Figure 12-1** (Creyke Beck) and **Figure 12-2** (High Marnham).

12.2.4 The graduated swathe does not cover the substations because the development of these is not within the scope of this Project, as explained in **Chapter 4**. However, they are shown because they will form the start and end points of the Project. The graduated swathe does not cover the routeing zone into High Marnham, because the likely position of the new overhead line cannot be determined until the substation position is fixed. This will be an iterative process whereby the location and design of the substation will determine the positions of the end of the overhead line connection, whilst at the same time the potential impacts of different options for the final section of overhead line will be taken into account in the process of determining the substation location. A graduated swathe has been developed for the routeing zone into Creyke Beck as that substation project is further along in the process of determining the substation location, as explained in **Section 2.5**.

Figure 12-1 – Potential Routeing, New Substation Zone and Substation Extension Zone at Creyke Beck

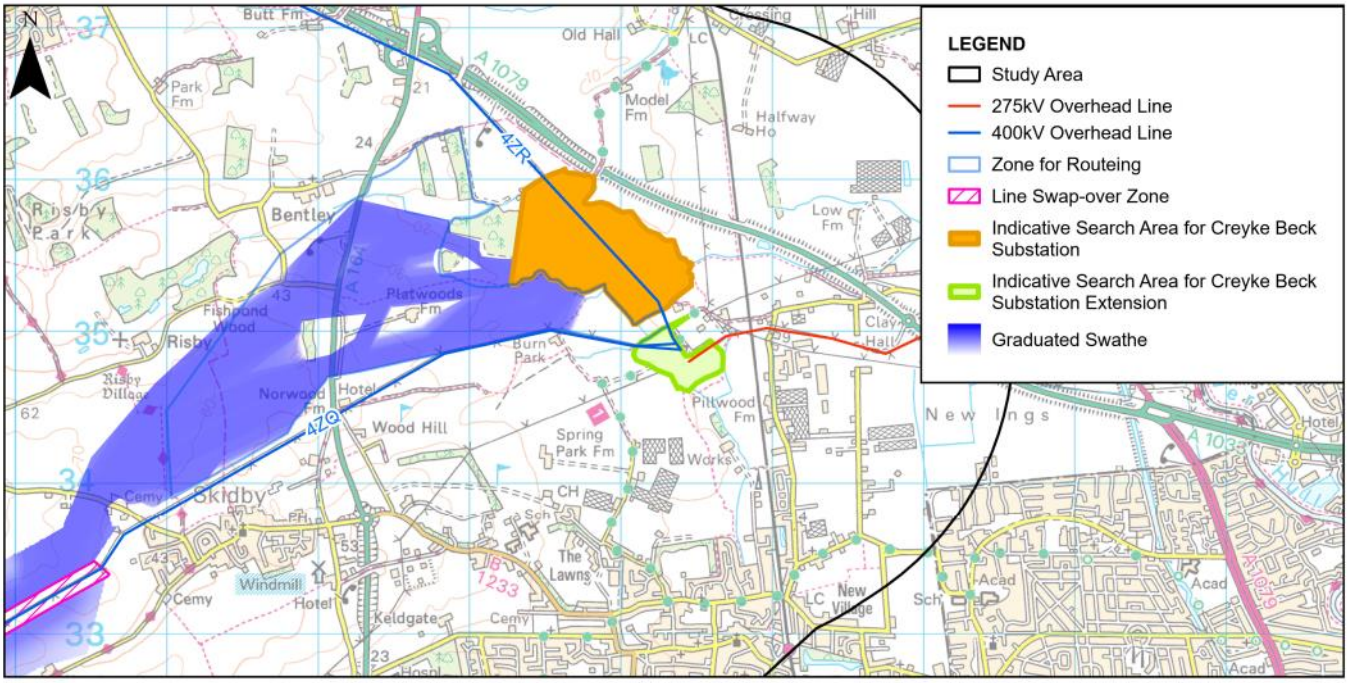


Figure 12-1 – Potential Routeing, New Substation Zone and Substation Extension Zone at Creyke Beck

SCALE: 1:50,000

Figure 12-2 – Potential Routeing and New Substation Zone at High Marnham

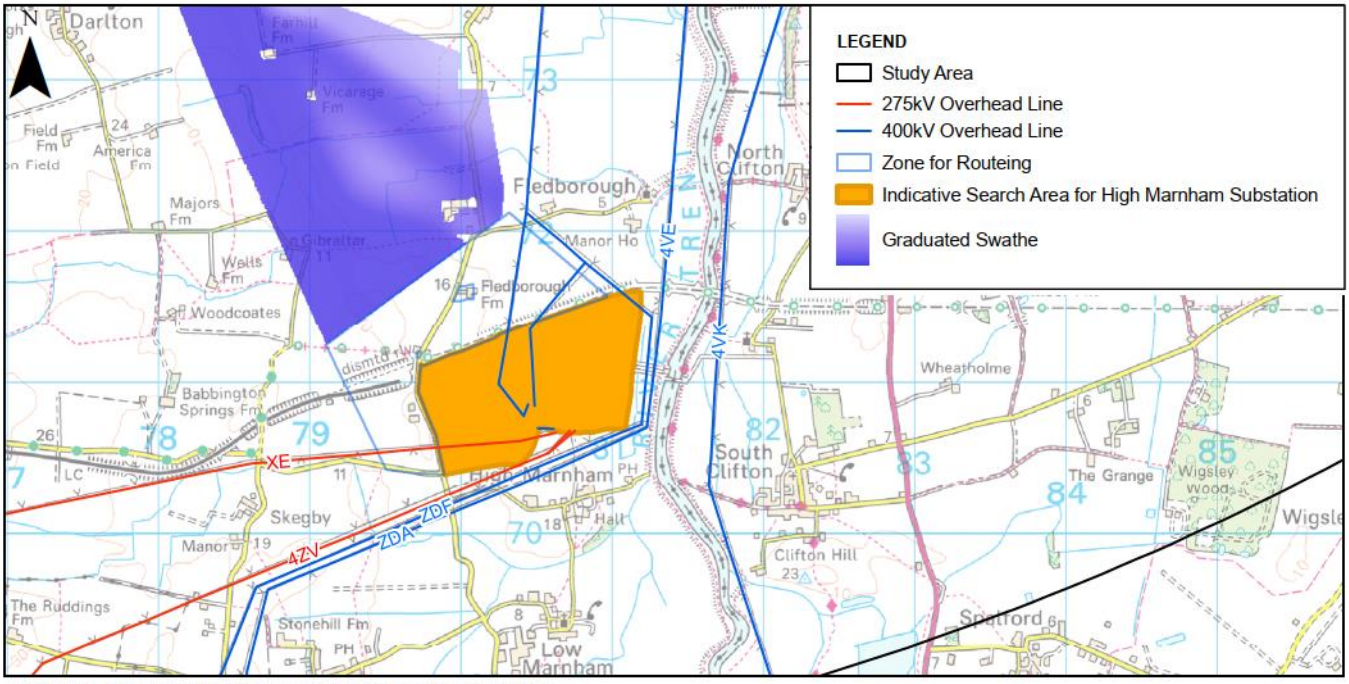


Figure 12-2 - Potential Routeing and New Substation Zone at High Marnham

SCALE: 1:50,000

Close Parallel

12.2.5 The graduated swathe has generally been drawn to show a strong preference for close parallel with darker shading used in the areas of the emerging preferred corridor where this opportunity exists, unless a deviation from close parallel is required from either an engineering, environmental or socio-economic perspective. This approach aims to minimise the overall impact of the Project as discussed in **Chapter 11**.

12.2.6 There is no shading shown for the graduated swathe adjacent to the existing overhead line. This is because it is not technically feasible to build a new overhead line in close proximity to an existing overhead line. To allow safe construction and maintenance there needs to be a minimum stand-off distance of 65m from a single overhead line and a minimum stand-off of 130m from a pair of existing close parallel overhead lines. This has been incorporated into the graduated swathe as a 130m corridor along the sections where there is a single existing overhead line (65m either side) and a 130m corridor to the west of the existing close parallel overhead lines between Beltoft and Gunthorpe.

12.2.7 Following detailed consideration of the environmental, socio-economic and/or technical constraints adjacent to the existing overhead lines, it was found that it is not feasible to adopt a close parallel route in every location that these opportunities have been taken forward without crossing the existing overhead line. In order to avoid a constraint or to enable a shorter and more direct path to be taken there may be a need to cross the existing overhead line and route on the other side. This is referred to as a line swap over. The potential areas where a line swap over may be required are shown as pink hatched areas on the existing overhead line (see **Figure 12-3** as an example). These areas have informed the level of shading shown on the graduated swathe, with darker shading generally shown adjacent to these areas so as not to limit the location of the line swap over.

12.2.8 Whilst it could be possible to swap over the new and existing by utilising a short section of underground cable, this would require two permanent SECs as described in **Chapter 2** and would add significant cost. Therefore, any line swap over is likely to be achieved buy reconfiguring the existing route using overhead line as also described in **Chapter 2**. However, should it be found that the use of underground cables was appropriate in one or more sections of the new line on environmental, socio-economic or technical grounds then any such section of cable could also be used to achieve a line swap over, if required, at little or no additional cost.

12.2.9 To reduce the technical difficulties associated with crossing an existing overhead line, it may be necessary to underground a section of existing overhead line and route the new overhead line over the undergrounded section. This applies for the crossing of the existing ZDA 400kV overhead line to the west of Keadby, and the area where this may occur is shown with a purple hatching on the graduated swathe (see **Figure 12-4**). There would also be the need to site two SECs within these undergrounding areas at the transition from overhead line to underground cable.

Figure 12-3 – Example of Line Swap Over Areas

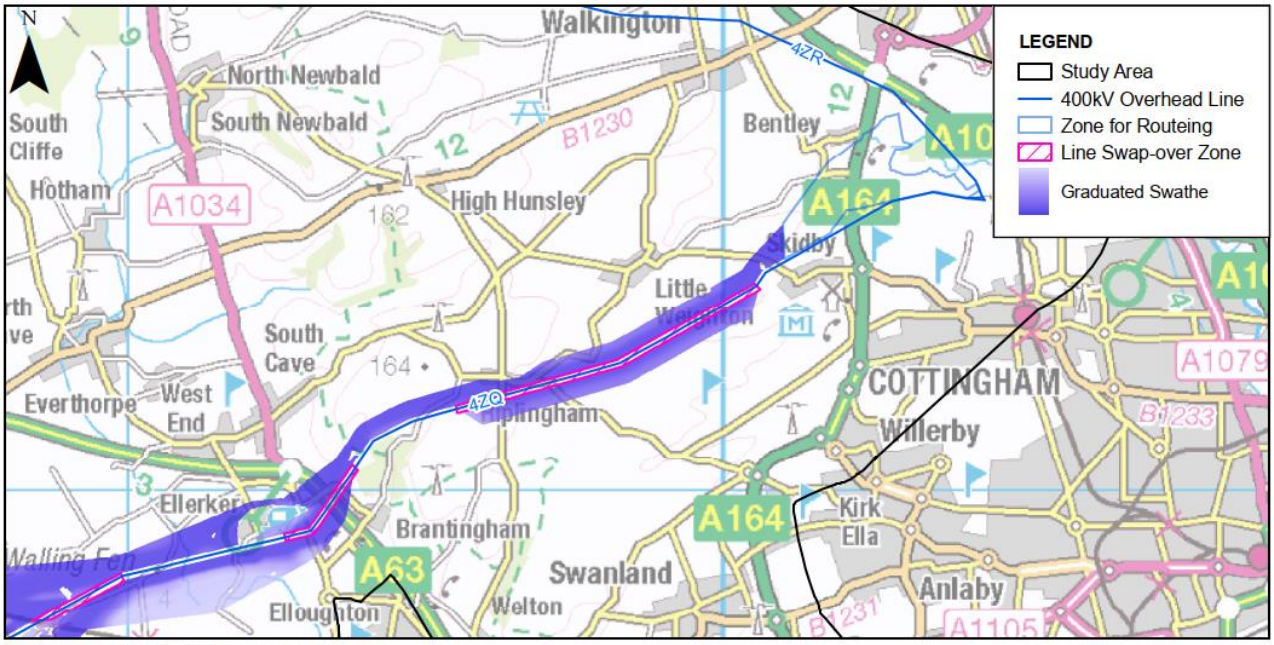


Figure 12-3 – Example of Line Swap-over Areas

Figure 12-4 – Keadby Potential Undergrounding Area

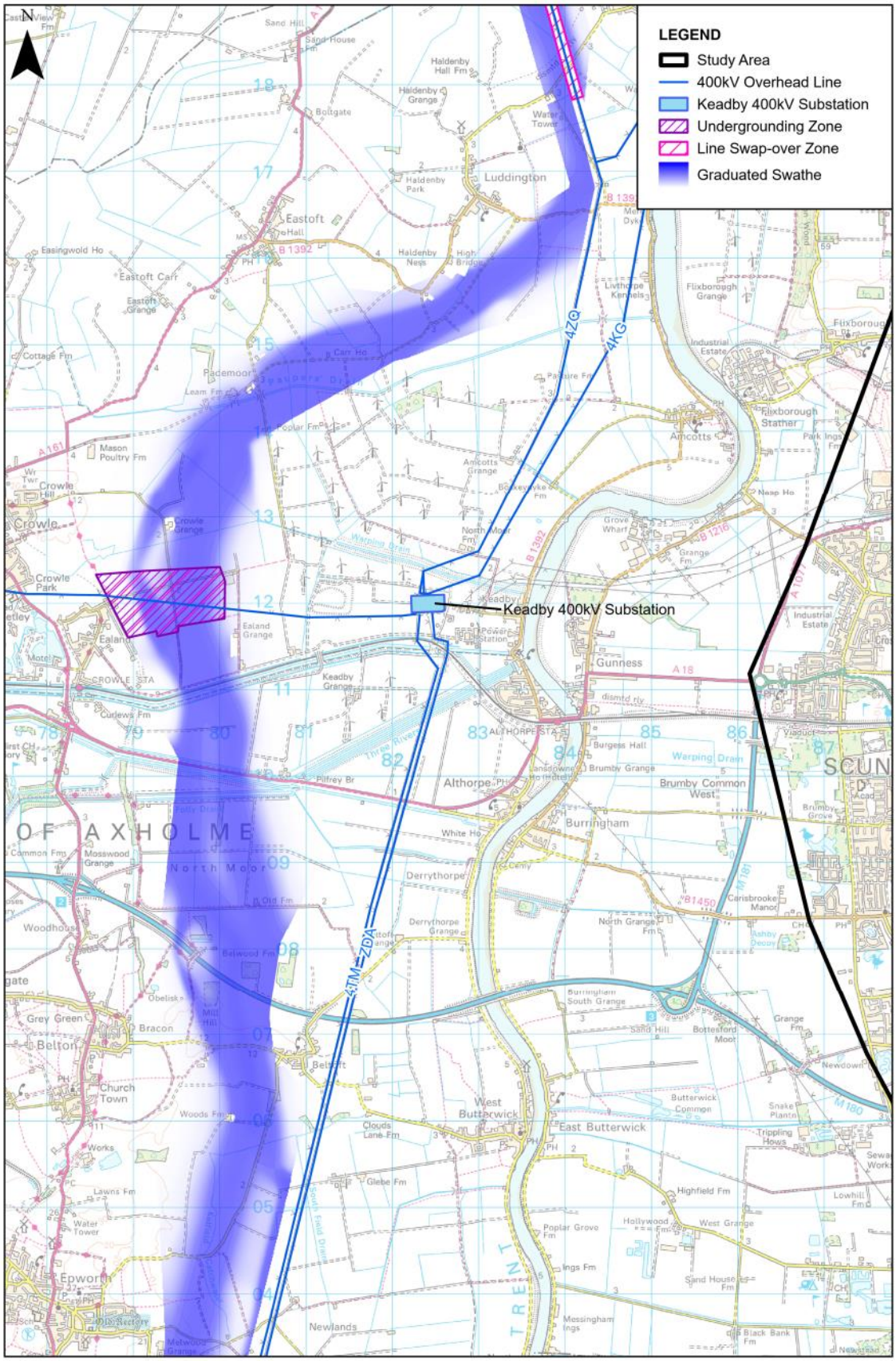


Figure 12-4 – Keadby Potential Undergrounding Area within the Graduated Swathe

SCALE: 1:70,000

Avoidance of Properties

12.2.10 Known residential properties and their curtilages, and larger settlements have been cut-out of the graduated swathe. However, there are locations where there are several cut-outs grouped which limits routeing flexibility and as a result, darker shading is presented adjacent to properties within these areas. Where these occur, there is the potential that a route could be considered that would oversail the possible curtilage of a residential property. This would only be considered where such a route would result in a significantly better overall design outcome and in discussion with the potentially affected resident and landowner.

Corridor Deviations

12.2.11 When developing the graduated swathe, the boundary of the emerging preferred corridor informed the outer edges of the graduated swathe. However, it was not used as a rigid outer limit. The majority of the graduated swathe is within this emerging preferred corridor boundary, however, there are instances where the swathe extends beyond the emerging preferred corridor boundary. These were added to reduce potential environmental and socio-economic impacts and technical constraints, by indicating more flexibility for routeing, to allow the siting of infrastructure at a greater distance from constraints.

12.2.12 The first example of this was included to avoid the village of Broomfleet. This southern path was included within the graduated swathe because it would enable a shorter path, compared to the north of Broomfleet, where there is a need to route around Sandtoft Roof Tiles Clay Extraction Site. This deviation is shown in **Figure 12-5**. The second example of this was to provide greater routeing flexibility and ensure avoidance of Rampton Hospital and East Drayton, as shown in **Figure 12-6.** In these instances, it is considered that the wider corridor now shown retains and increases the range of design opportunities available within the related corridor sections that were originally appraised. Consequently, these minor changes do not alter the conclusions reached when identifying the emerging preferred corridor.

Figure 12-5 – Deviation to the South of Broomfleet

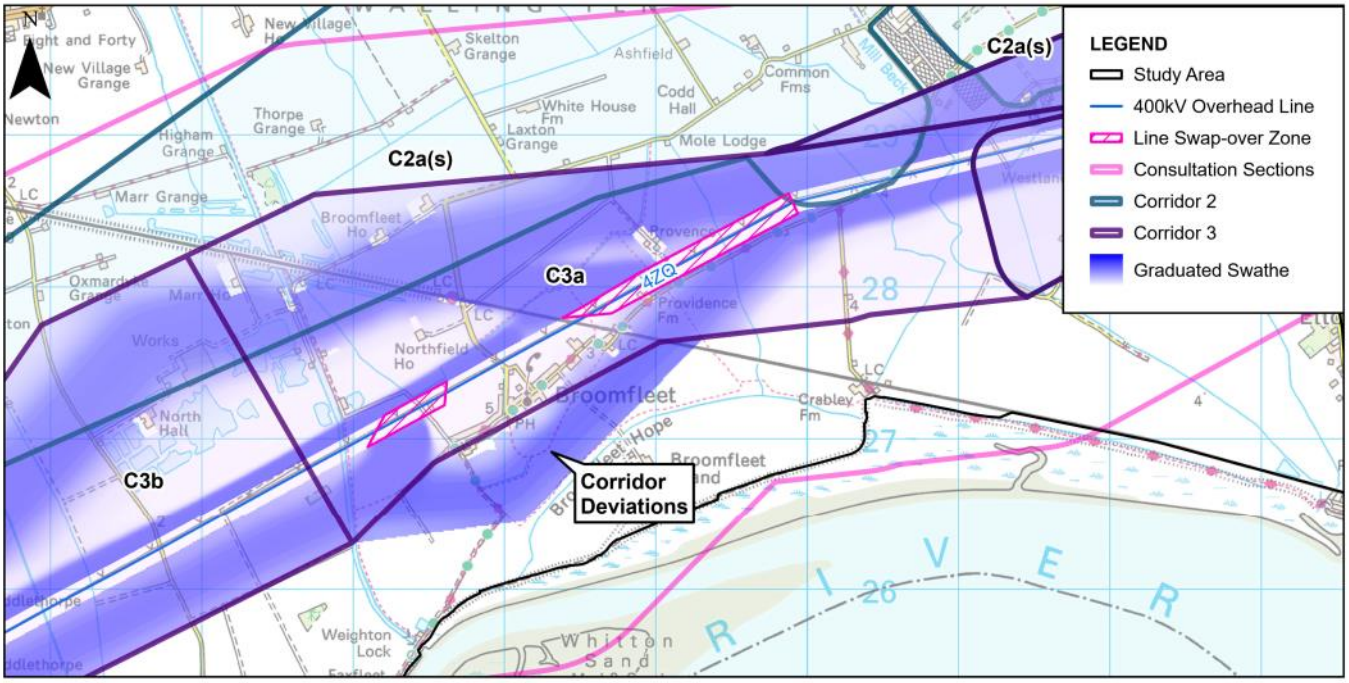


Figure 12-5 – Deviation to the South of Broomfleet

SCALE: 1:50,000

Figure 12-6 – Deviation to avoid Rampton Hospital and East Drayton

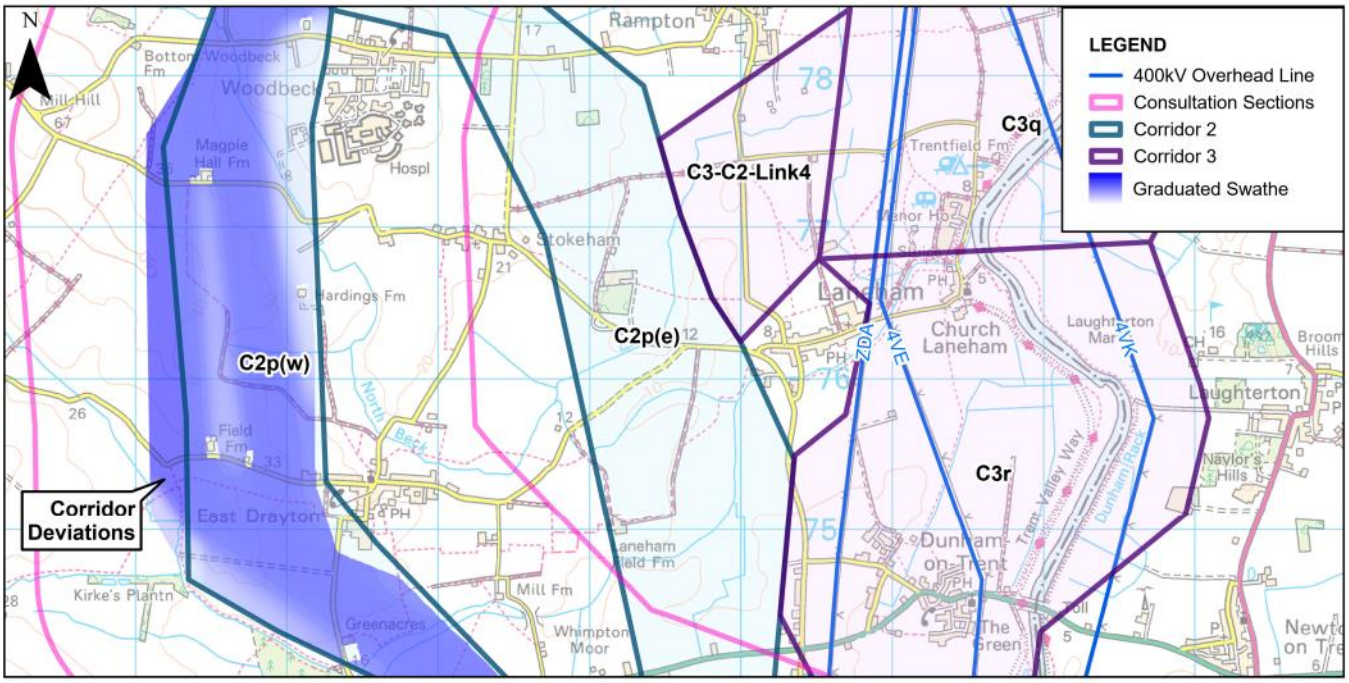


Figure 12-6 – Deviation to avoid Rampton Hospital and East Drayton

SCALE: 1:50,000

12.3 Description of the Graduated Swathe

12.3.1 For the purposes of consultation the graduated swathe has been split into eleven separate sections. These have been largely defined by geographical features and are intended to help reporting and consultation. The eleven sections are listed below and shown on **Figure 12-7**.

- Section 1: Creyke Beck – Skidby;
- Section 2: Skidby – A63 dual carriageway;
- Section 3: A63 dual carriageway – River Ouse Crossing;
- Section 4: River Ouse Crossing;
- Section 5: River Ouse Crossing – Luddington;
- Section 6: Luddington – M180 motorway;
- Section 7: M180 – Graizelound;
- Section 8: Graizelound – Chesterfield Canal;
- Section 9: Chesterfield Canal – A620 east of North Wheatley;
- Section 10: A620 east of North Wheatley – Fledborough; and
- Section 11: Fledborough - High Marnham.

12.3.2 A summary of the graduated swathe by sections is provided below and more detailed plans are included in **Appendix C**.

Figure 12-7 – Graduated Swathe Sections

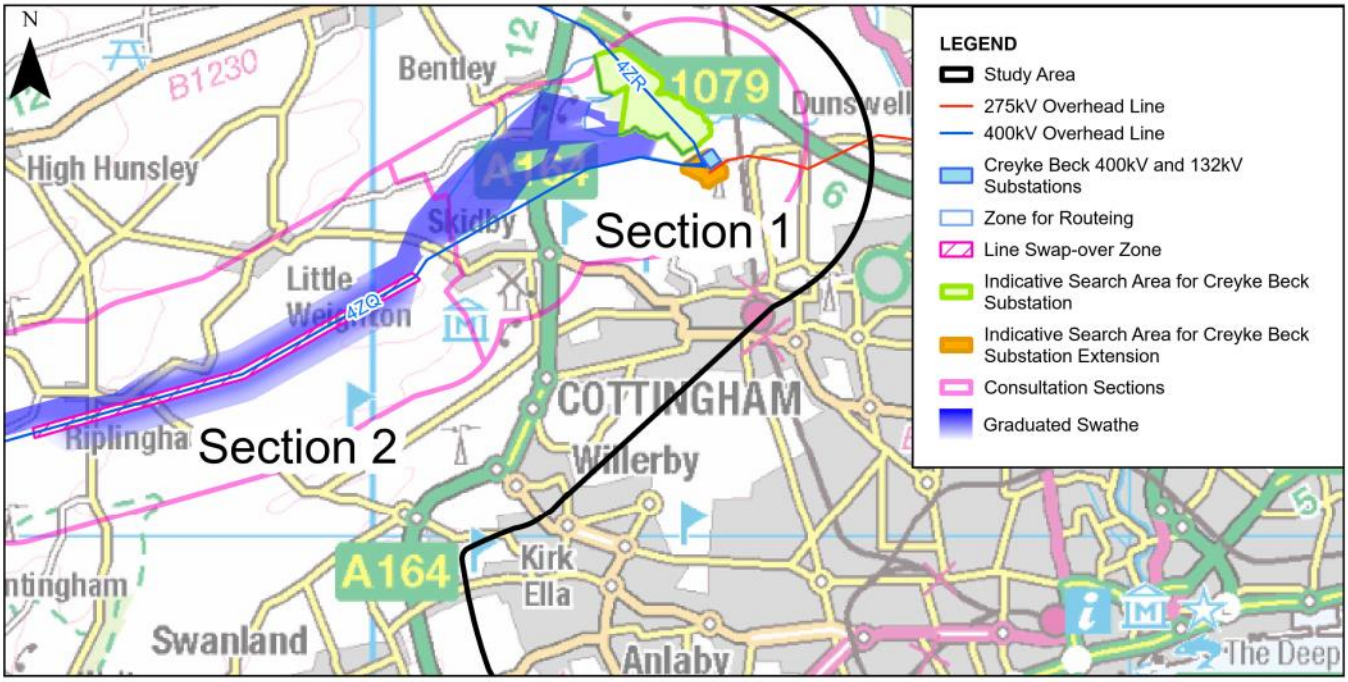


Figure 12-7 – Graduated Swathe Sections – Creyke Beck to River Ouse (Sheet 1)

SCALE: 1:100,000

0 0.75 1.5 2.25 3 3.75 4.5 5.25 km

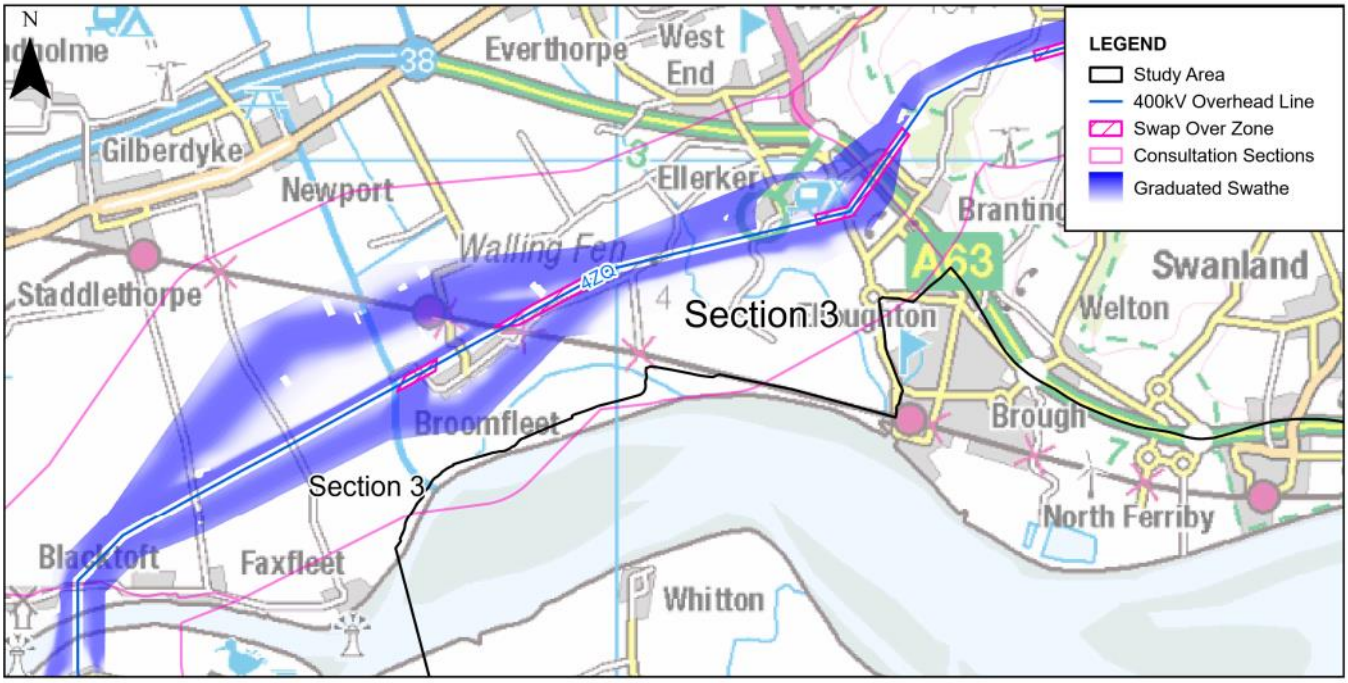


Figure 12-7 – Graduated Swathe Sections – River Ouse to Keadby (Sheet 2)

SCALE: 1:100,000

0 0.75 1.5 2.25 3 3.75 4.5 5.25 km

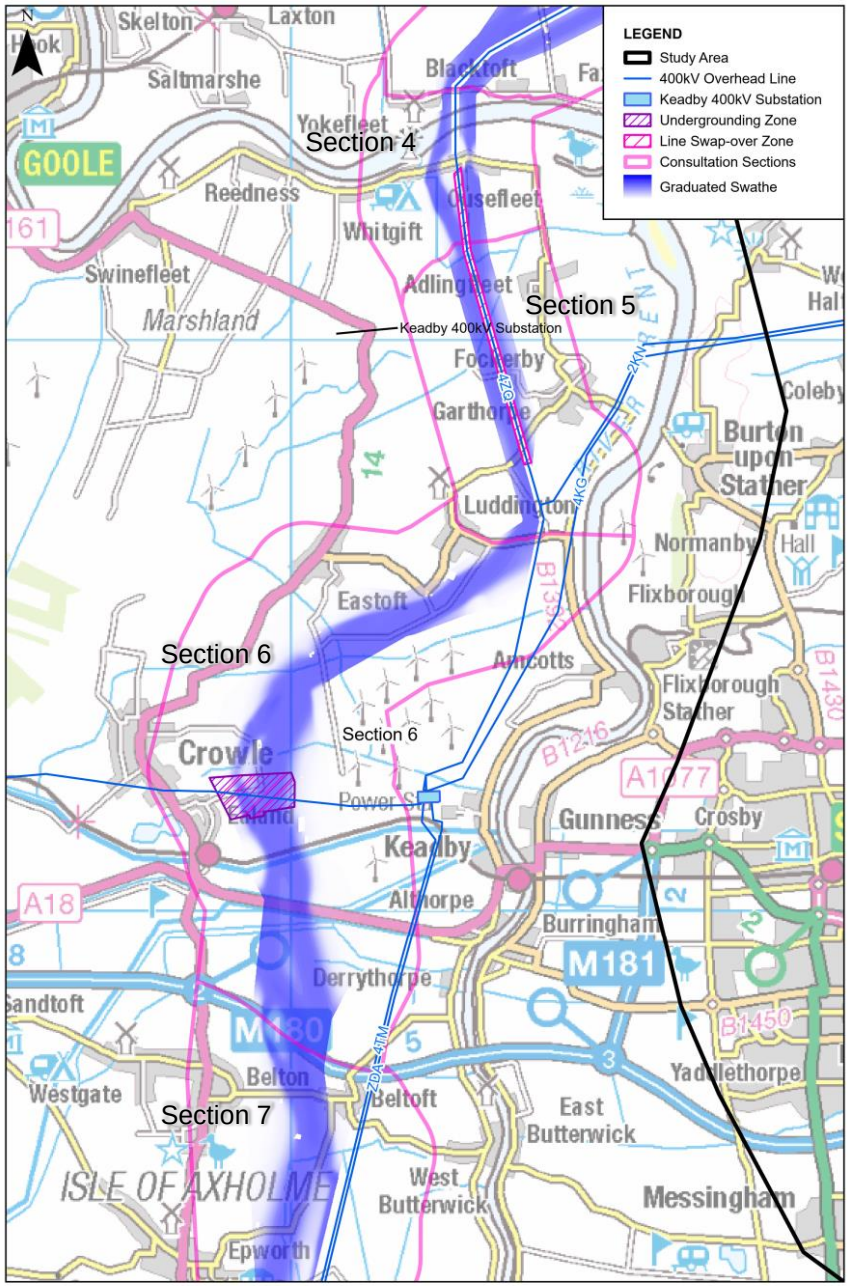


Figure 12-7 – Graduated Swathe Sections – Luddington to Graizelound (Sheet 3)

SCALE: 1:100,000

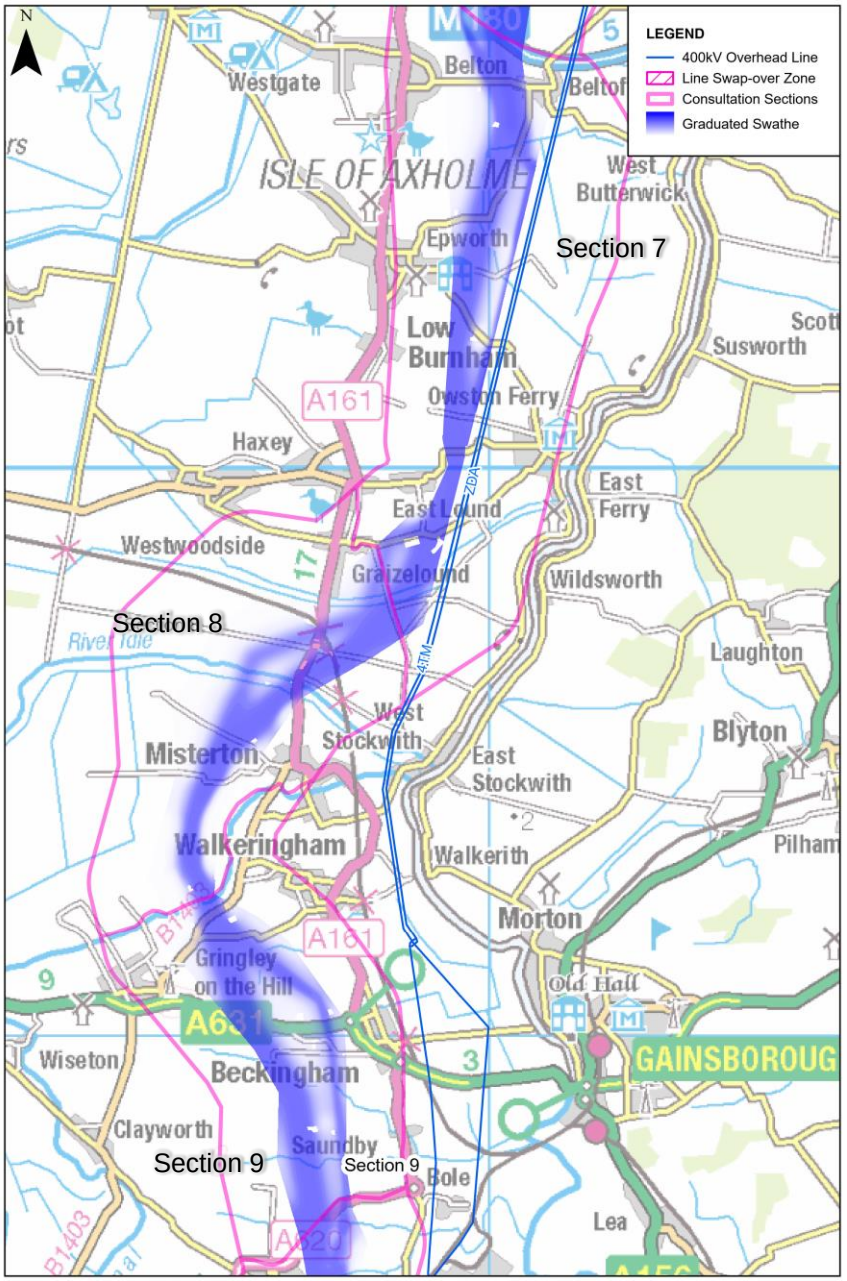


Figure 12-7 – Graduated Swathe Sections – Graizelound to North Wheatley (Sheet 4)

SCALE: 1:100,000

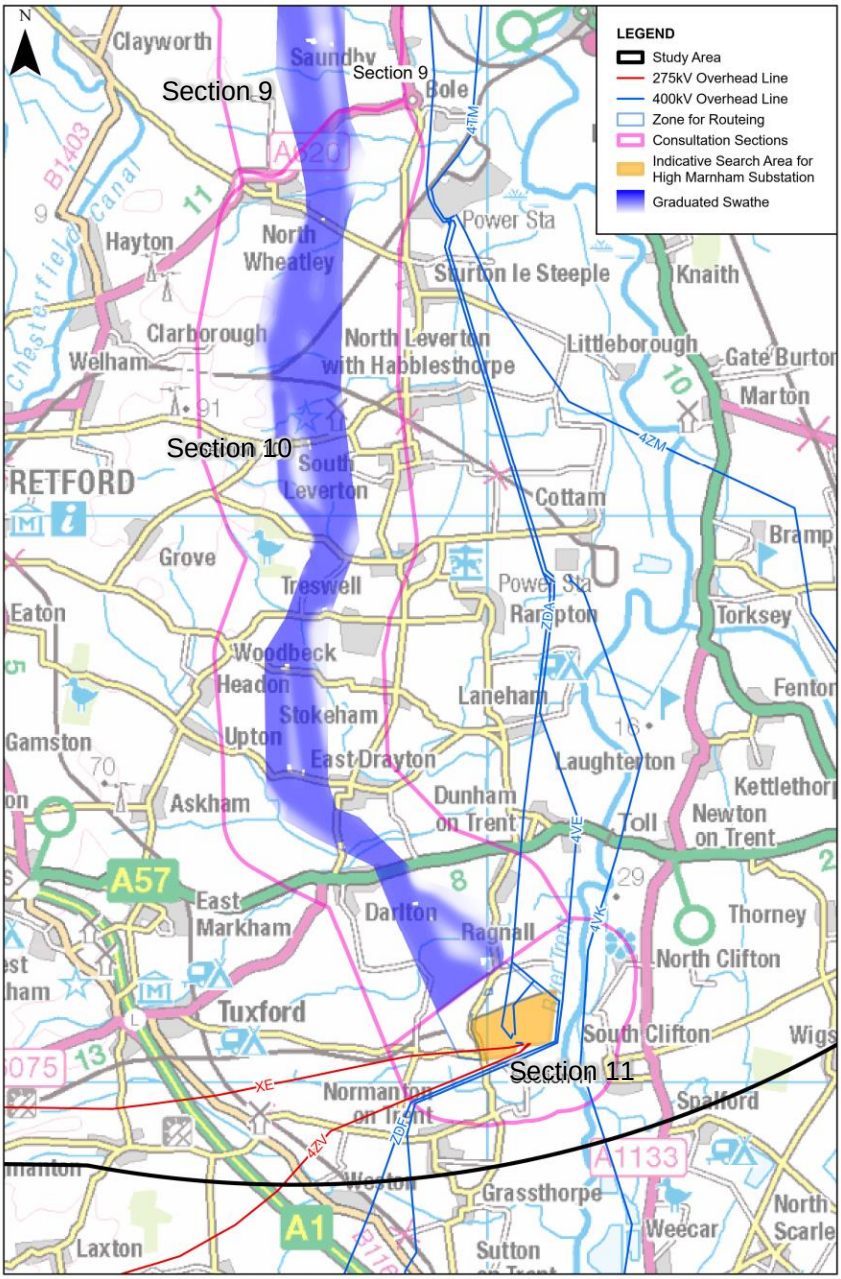


Figure 12-7 – Graduated Swathe Sections – North Wheatley to High Marnham (Sheet 5)

Section 1: Creyke Beck – Skidby

12.3.3 This section of the preliminary preferred corridor runs from the connection point at the new Creyke Beck Substation to a point immediately north of the village of Skidby, within the Yorkshire Wolds ILA. This is shown in **Figure 12-8** below and on Sheet 1 of **Appendix C**.

Figure 12-8 – Section 1 (Creyke Beck – Skidby)

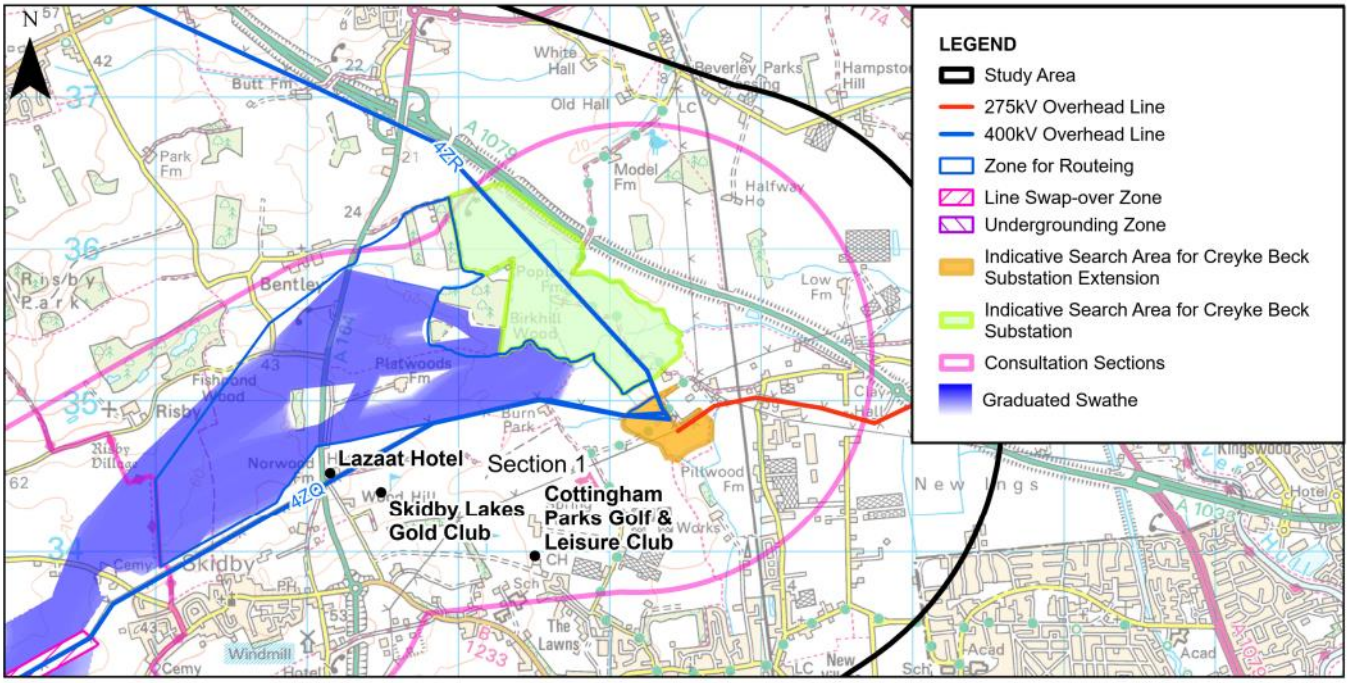


Figure 12-8 – Section 1 (Creyke Beck – Skidby)

Section 1: Northern Path

12.3.4 Immediately west of the search area for the new Creyke Beck substation, as shown coloured orange on **Figure 12-8**, the northern path of the swathe routes between two blocks of ancient woodland at Birkhill Wood. The swathe continues and provides two options to cross the A164 either north of Dunflat Road to the south of the settlement of Bentley or south of Dunflat Road to the north of Platwood Farm. The swathe then continues to the South of Risby Hall Registered Park and Garden converging with the central and southern paths of the swathe in the open fields to the north of the village of Skidby.

12.3.5 Utilising the northern path through this section would introduce technical complexity and environmental constraints with a pinch point for routeing between blocks of ancient woodland which make achieving sufficient stand-off distances difficult. This also potentially introduces a number of angles which may impact on visual amenity for the settlement of Bentley and property at Birkhill Farm although woodland blocks may provide some limited visual screening. This path routes along higher ground and is separated from the existing overhead line potentially resulting in wirescape looking over the open fields towards the village of Skidby. This swathe is the closest to the Risby Hall Registered Park and Garden and scheduled monument in the section. In addition, the northern path crosses the greatest area of the planned Creyke Beck Solar Farm development, which has planning permission approved.

Section 1: Central Path

12.3.6 The central path routes around 500m to the north of the existing 4ZQ overhead line south of Birkhill Wood loosely paralleling the Jillywood Lane Local Wildlife Site and continues to the north of Platwood Farm and Drove Road Local Wildlife Site before converging with the northern and southern paths through the open fields to the north of the village of Skidby.

12.3.7 There is a link between the central and southern swathes in this section to the west of Platwood farm. This provides an opportunity to route to the south of the small woodland block at Platwoods Bar Plantation and avoid multiple crossings of the Jillywood Lane Local Wildlife Site.

12.3.8 A central path through this section may be preferred from a technical perspective as it keeps a greater distance from the high pressure gas pipelines and other 33kV overhead transmission lines and overall has a shorter route length. From an environmental perspective the central path is further away from the settlement of Bentley in the north as well as the Lazaat Hotel and Cottingham Park Golf Club in the south, however it crosses the Jillywood Lane Local Wildlife site and vegetation removal may be required to achieve the required clearance to the conductors.

Section 1: Southern Path

12.3.9 The southern path close parallels to the north of the existing 4ZQ overhead line for a short section before diverting away to the north of the Lazaat Hotel and Cottingham Park Golf Club, crossing the Drove Road LWS east of the A164 trunk road before converging with the Northern and central paths of the graduated swathe through the open fields to the north of the village of Skidby.

12.3.10 The southern swathe provides an opportunity to close parallel the existing line and keeps transmission infrastructure together along the lower elevation land, however it will place overhead lines on both sides of the Lazaat Hotel as well as properties further west in this section along Little Weighton Road. This route is furthest away from the Risby Hall Registered Park and Garden and scheduled monument and has the potential to minimise the impact upon the Creyke Beck Solar Farm development site. However, the swathe is closer to the Skidby and Cottingham Conservation Areas. This swathe is in close proximity to an existing high pressure gas pipelines which may limit the siting of the new overhead line.

Section 2: Skidby – A63 Dual Carriageway

12.3.11 This section of the preliminary preferred corridor runs from a point immediately north of the village of Skidby to the A63 dual carriageway on the western edge of the Yorkshire Wolds ILA. The area lies beyond the Provisional Candidate Area identified by Natural England for possible designation as an AONB but lies within the locally designated Yorkshire Wolds ILA. This is shown in **Figure 12-9** below and on Sheet 1 and Sheet 2 of **Appendix C**.

Figure 12-9 – Section 2 (Skidby – A63 Dual Carriageway)

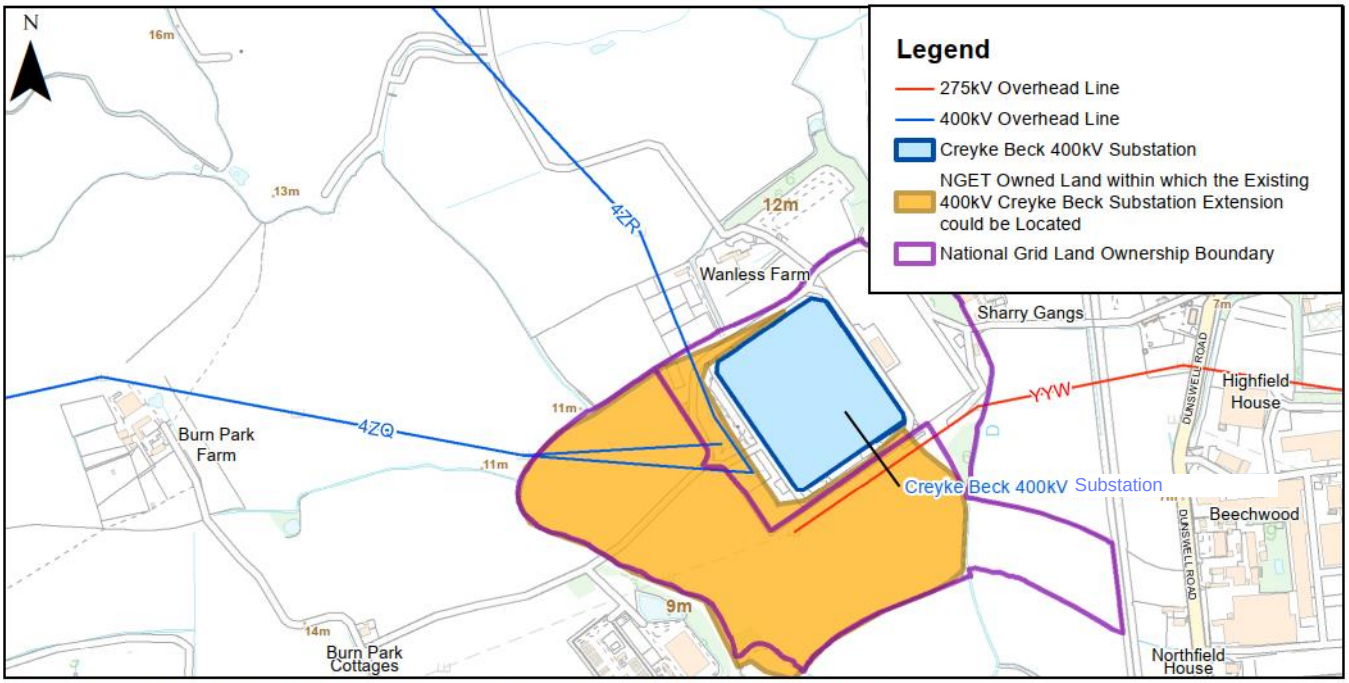


Figure 2-9 – Area of NGET Owned Land within which the Existing 400kV Creyke Beck Substation Extension could be Located

Section 2: Northern Path

12.3.12 North of Skidby the graduated swathe is shown on the northern side of the existing overhead line; the far side of the existing line when viewed from the village. The graduated swathe then continues on the northern side of the existing overhead line in parallel. In this section of the emerging preferred corridor, there are technical and environmental constraints to routeing. It is therefore considered that there may be merit in keeping the new and existing lines closer together to reduce the landscape and visual impacts and avoid the creation of a wirescape. Further west in this section the distance between the new and existing overhead lines may increase so as not to directly impact sites and features such as Brantingham Dale SSSI and individual residential properties.

Section 2: Southern Path

12.3.13 Southwest of Skidby (and south of Little Weighton), there is a section of the graduated swathe shown to the south of the existing overhead line. Following this southern path would require two line swap overs for a maximum distance of approximately 5km. The area within which line swap overs may be achieved is shown hatched pink between the northern and southern paths of the graduated swathe in **Figure 12-9** above. The southern swathe does not continue further west largely to avoid impacting the substantive area of mature woodland in Brantingham Dale SSSI and to avoid the steep topography.

12.3.14 A southern alignment in this section of the emerging preferred corridor would add to the technical complexity and cost of the new overhead line and is unlikely to be preferred. Environmentally there may be both advantages and disadvantages if the new overhead line were to be constructed within this southern swathe. A belt of mature woodland might be avoided to the southeast of Rowley Manor but more prominent angle pylons may be required. Visual impacts from some properties (including Rowley Manor Hotel and the Grade II* listed Church of St Peter) might reduce with greater distance but other

properties might experience increased visual impacts. Farming operations are likely to be affected similarly by either swathe.

12.3.15 Before crossing the A63 dual carriageway, the graduated swathe again follows two discrete paths; one leading to the north of the village of Ellerker, and the other to the south. In order to follow the southern path, a line swap would be required. The area within which this swap over may occur is shown hatched on **Figure 12-9** above, beginning to the northwest of the village of Brantingham and extending westwards.

Section 3: A63 Dual Carriageway – River Ouse Crossing

12.3.16 This section of the emerging preferred corridor runs from the A63 dual carriageway, on the western edge of the Yorkshire Wolds ILA to Blacktoft Lane, a minor road close to the north bank of the River Ouse, as shown in **Figure 12-10** below and on Sheet 3 and Sheet 4 of **Appendix C**.

12.3.17 This section of the emerging preferred corridor crosses the flat, low-lying and intensively drained Humberhead Levels.

Figure 12-10 – Section 3 (A63 Dual Carriageway – River Ouse Crossing)

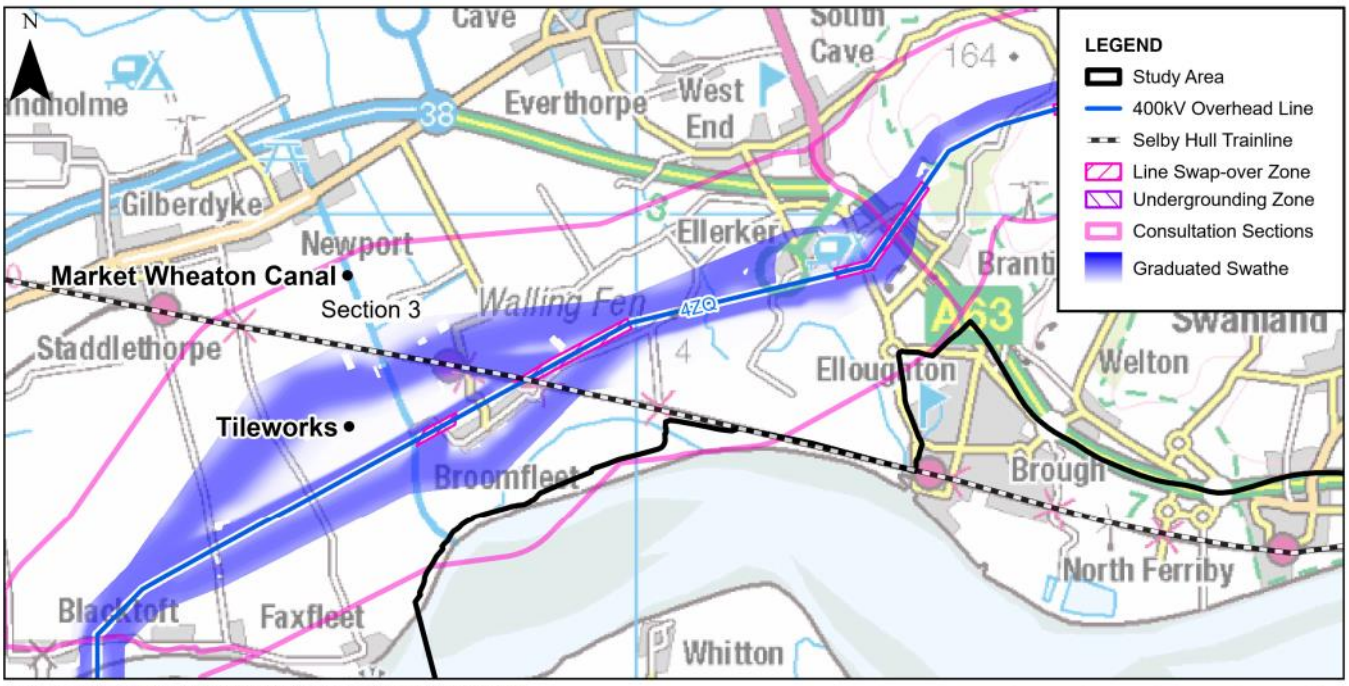


Figure 12-10 – Section 3 (A63 Dual Carriageway – River Ouse Crossing)

12.3.18 Of particular note in this section of the emerging preferred corridor is:

- The presence of the existing 400kV overhead line;
- The location of the two villages of Ellerker (immediately west of the A63) and Broomfleet; and
- The mineral workings associated with Wienerberger's Broomfleet Tile Factory.

12.3.19 All have influenced the definition of the various paths for the graduated swathe in this section.

12.3.20 Another consideration is the potential impacts upon bird species using the nearby Humber Estuary designated sites. The risk of impacts may be reduced by closely following the route of the existing overhead line, minimising the risk of birds striking the new line. For further information on bird strikes please see **Chapter 11**.

12.3.21 Following a path close to the existing line may also help reduce the landscape and visual impacts of the new overhead line in this location but would increase technical complexity and increase capital costs if line swap overs are required.

12.3.22 There are three paths shown across the graduated swathe within this section (a northern, central and southern paths). There are opportunities to combine different paths within the section which, at detailed design, will provide opportunities to develop several different alignments. Any new overhead line will need to cross both the Selby – Hull railway line and the Market Weighton Canal in this section of the corridor.

12.3.23 The northern and central paths would lead into a crossing of the River Ouse to the west of the existing 400kv overhead line. Following the southern path would lead to a crossing of the River Ouse to the east of the existing 400kV overhead line.

Section 3: Central Path

12.3.24 The central path is located to the north of the village of Ellerker; a designated Conservation Area and passes across the undeveloped land between the village and Hunsdale Business Park. The path then continues westwards to the south of Millbeck Nursery, avoiding residential properties on Ings Lane.

12.3.25 West of Ellerker the path provides opportunities to closely parallel the existing overhead electricity transmission line, on the far side of the existing line when viewed from the village of Broomfleet. The path then crosses the Market Weighton Canal. At this point opportunities exist to potentially switch the new electricity transmission line to the south of the existing overhead line, onto a southern path (see overleaf).

12.3.26 Alternatively, continuing westwards, the central path crosses an area of active mineral extraction south of the Sandtoft Tile Factory. From here the path continues westwards, crossing Staddlethorpe Broad Lane before turning south westwards. Again, opportunities exist in the Staddlethorpe area to swap over any new transmission route from the northern side of the existing overhead transmission line to the south side of the line, onto the southern path.

12.3.27 Continuing along the central path leads into Section 4 of the emerging preferred corridor to west of the existing overhead line and the east of Yokefleet Hall and the village of Yokefleet.

Section 3: Northern Path

12.3.28 The northern path diverges from the central path to the north of the Selby-Hull railway line. Dependent upon where this path diverges from the central path, the graduated swathe could accommodate a new overhead line either to the north or south of the isolated property to the north of Broomfleet.

12.3.29 From this point, the northern path diverges from the existing overhead line and crosses the rail line, avoiding direct impacts upon isolated residential properties. The northern path passes to the north of the Sandtoft Tile Factory, potentially reducing impacts upon operations at the site.

12.3.30 The path then heads in a south westerly direction, re-joining the central path of the graduated swathe to the west of Staddlethorpe.

12.3.31 The northern path is located furthest from the village of Broomfleet and the River Humber, but has the least opportunity to run in close parallel the existing overhead line, resulting in the potential for wider landscape and visual impacts.

Section 3: Southern Path

12.3.32 Following the southern path would require a line swap over to the south and east of the village of Ellerker, which is a designated Conservation Area. Properties on the southern edge of the village have extensive views to the existing overhead line. Any new overhead line following the southern path would be to the south of the existing overhead line. The southern path of the graduated swathe is broadly parallel to the existing overhead line until the edge of the village of Broomfleet, where the location of residential properties means that the southern path is shown to the south of the village, deviating away from being close parallel to the existing overhead line. This would bring the new overhead line closer to the Humber Estuary designated sites.

12.3.33 The southern path then moves back to a position parallel to the existing overhead line whilst providing an opportunity to avoid the consented minerals workings south of the Sandtoft Tile Factory. The graduated swathe along the southern path then avoids isolated residential properties in the Staddlethorpe area before approaching the River Ouse to the east of the existing overhead line.

Combined Paths

12.3.34 Three possible line swap over zones are shown: to the north-east and west of Broomfleet and to the northwest of Blacktoft, as shown on Sheet 3 and Sheet 4 of **Appendix C**. Moving to or from the eastern end of the central and northern paths to the southern path, would be practicable in the northeast line swap over area northeast of Broomfleet, north of the railway line. Alternatively, this same line swap over area would allow the path to cross from the southern path to the central or northern paths.

12.3.35 The line swap over area west of the village of Broomfleet would allow the path to move from the eastern section of the central path onto the southern path.

12.3.36 In this section of the corridor these combinations may, for example, allow a close parallel path to be developed on the far side of the existing overhead line when viewed from Ellerker and Broomfleet, or allow a close parallel alignment south of Ellerker whilst also taking a wider deviation to the north of Broomfleet and the Sandtoft Tile Factory.

12.3.37 The line swap over area northwest of Blacktoft would allow the path to move from either the northern or central path onto an eastern path. Alternatively, a line swap over here would allow the path to move from the southern path onto a western path in Section 4.

12.3.38 However, the introduction of any line swap overs as part of the detailed design would add to the technical complexity and capital cost of the new overhead line and is unlikely to be preferred.

Section 4: River Ouse Crossing

12.3.39 This section of the emerging preferred corridor is bounded to the north by Blacktoft Lane, a minor road close to the north bank of the River Ouse. The section extends south as far as the public bridleway between Hoggard Lane and the A161 King's

Causeway, as shown in **Figure 12-11** below and on Sheet 4 and Sheet 5 of **Appendix C**. This is a short 2.5km section of the preliminary preferred corridor but importantly is the section of the corridor that crosses the River Ouse and directly interacts with the Humber Estuary designated sites.

Figure 12-11 – Section 4 (River Ouse Crossing)

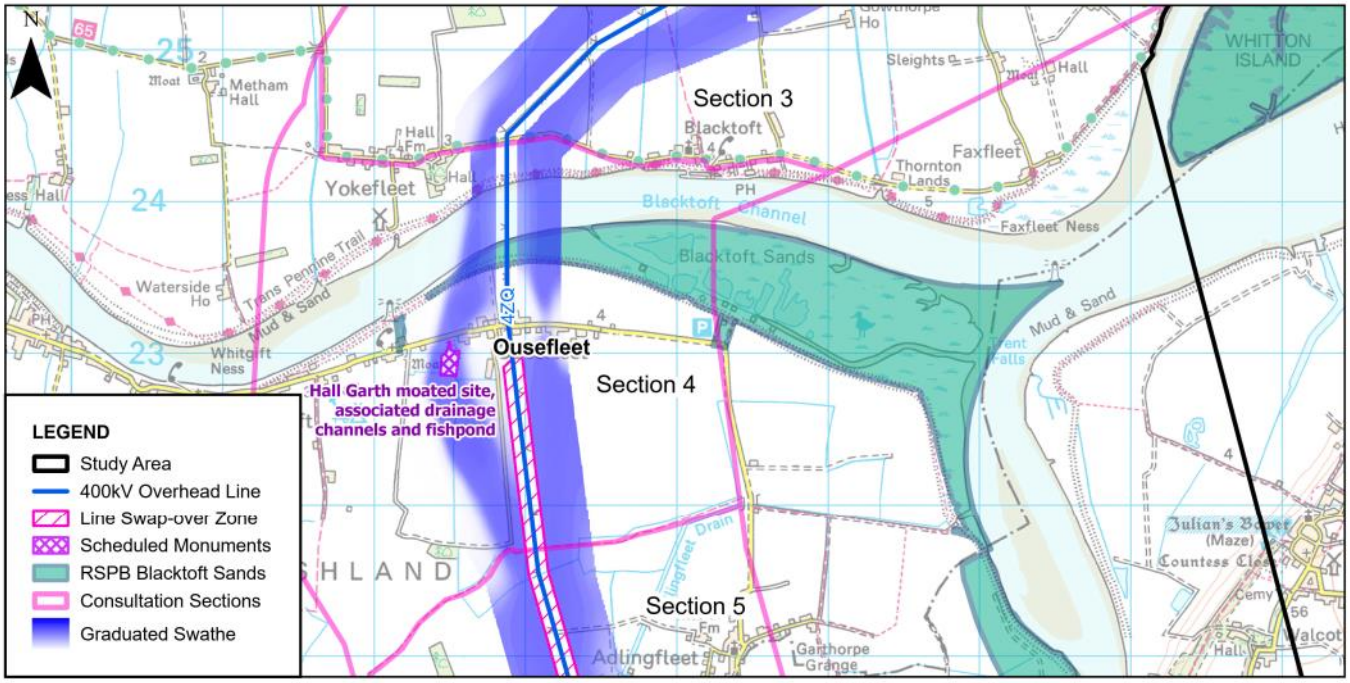


Figure 12-11 – Section 4 (River Ouse Crossing)

12.3.40 The existing overhead line crosses the western-most extent of the Blacktoft Sands RSPB Nature Reserve. The emerging preferred corridor extends to the east and west of the existing overhead line. The corridor crosses part of the Reserve's grazing marsh but avoids the Reserve's main intertidal reedbed.

12.3.41 It is anticipated that no permanent structures would need to be constructed within the international designated sites, reducing the likelihood of permanent habitat loss within the sites. Similarly, it should be technically practicable to avoid permanent structures, such as pylons, on the undefended side of the existing flood defences.

12.3.42 The emerging preferred corridor avoids the small hamlets of Yokefleet and Blacktoft on the north bank of the River Ouse but crosses the scattered linear hamlet of Ousefleet on the south bank.

12.3.43 This section of the graduated swathe contains two alternative paths; one to the west and one to the east of the existing overhead line. A line swap over may be required to the northwest of Blacktoft, dependent upon the relationship of the preferred path in Section 3 and the chosen path across the River Ouse.

12.3.44 The distance between any new overhead line and the existing overhead line would need to be greater across the River Ouse in comparison with other sections of the

emerging preferred corridor. This is due to the taller pylons required to ensure that conductor wires do not interfere with the passage of vessels using the Port of Goole[41].

Section 4: Eastern Path

12.3.45 The eastern path of the graduated swathe runs in close parallel to the existing overhead line crossing of the river, narrowing to pass between residential properties at Ousefleet. This path crosses a slightly wider part of the Blacktoft Sands RSPB Nature Reserve. It is considered unlikely that any permanent structure would need to be constructed within the Blacktoft Sands RSPB Nature Reserve[42]. Due to the close parallel nature of the eastern path, early design work suggests that this path could offer opportunities to closely match the profile and heights of the existing overhead line over the River Ouse. The degree to which this might minimise or avoid impacts upon birds using the Reserve and the Humber Estuary designated sites will be considered as part of any Appropriate Assessment under the Habitat Regulations.

Section 4: Western Path

12.3.46 The western path of the graduated swathe runs broadly parallel to the existing line, but deviates slightly westwards at Ousefleet, south of the river, to offer opportunities to avoid any new overhead line oversailing residential properties and to avoid construction activities within the Hall Garth Moated Site, a Scheduled Monument.

Combined Paths

12.3.47 There are opportunities to move between the eastern path to the western path and vice versa towards the southern end of this section of the emerging preferred corridor, as indicated by the line swap over areas shown on **Figure 12-11**. This line swap over area extends southwards into Section 5 of the emerging preferred corridor meaning that any line swap over could also be achieved beyond this section. The new overhead line will ultimately need to be routed to the west of the existing line as the emerging preferred corridor deviates away from the existing overhead line to avoid constraints to routeing in the Keadby area, as discussed in **Chapter 11**.

12.3.48 Therefore, crossing the River Ouse to the east of the existing line is expected to require a line swap over south of Ousefleet, as the emerging preferred corridor deviates westwards away from the existing overhead line in Section 6.

Underground Cabling

12.3.49 Given NGET's operational experience with the existing overhead crossing of the River Ouse it is considered that there is currently insufficient evidence to conclude that a second overhead line crossing of the River Ouse within the emerging preferred corridor would not be appropriate. Detailed surveys will be undertaken to provide the level of evidence needed to inform an Appropriate Assessment under the Habitat Regulations.

12.3.50 As with any section of the emerging preferred corridor, it may be technically possible to install underground cables rather than an overhead line. This would require the installation of long ducts or the construction of one or more tunnels to accommodate the

---

41 To ensure safe passage the two existing pylons either side of the river are around 115m high.

42 The existing pylon on the south bank predates the Reserve and was included within the Reserve boundary when the Reserve was first established.

eighteen transmission cables likely to be required, as these could not be laid securely on the riverbed. However, it was noted that the use of underground cables would result in very significant increases in cost, potentially delay the completion date for the Project and introduce significant technical and operational complexity (as summarised in **Appendix A**).

Section 5: River Ouse Crossing – Luddington

12.3.51 This section of the emerging preferred corridor is bounded to the north by the public bridleway between Hoggard Lane, north of Adlingfleet, and the A161 King's Causeway. The section extends south as far as the B1392 Meredyke Lane, which runs between the village of Luddington and the River Trent, as shown in **Figure 12-12** below and on Sheet 5 and Sheet 6 of **Appendix C**.

12.3.52 This section of the emerging preferred corridor continues across the flat, open, and low-lying area of the Humberhead Levels. The graduated swathe extends parallel to and either side of the existing overhead line in this area, as far as a point east of the village of Luddington, where the existing line connects with a second overhead line from the east. This connection between the existing lines (referred to as the 'Garthorpe Tee') presents an obstruction to an eastern close parallel path.

12.3.53 This section of the corridor shows a potential line swap over areas within which a new overhead line could cross from a western path onto an eastern path and vice versa.

Section 5: Eastern Path

12.3.54 The eastern and western paths have relatively similar considerations in environmental and socio-economic terms. However, the eastern path would bring any new overhead line marginally closer to the villages of Adlingfleet, Fockerby and Garthorpe to the east. In addition, following an eastern path would require a swap over of the lines at some point within this section of the emerging preferred corridor. Any such swap over is likely to require the use of up to four slightly bulkier angle pylons, which might be avoided if following a western path (although overall the same number of pylons is probable).

Section 5: Western Path

12.3.55 A western path through this section of the emerging preferred corridor is relatively unconstrained and therefore a path closely parallel to the existing overhead line has been identified. A close parallel alignment may limit local landscape and visual impacts from the new overhead line. A pair of residential properties and the Water Tower east of the village of Luddington provide local constraints that could somewhat limit alignment options within this path.

12.3.56 Due to the need to swap the routes onto the west at the southern end of this section there is likely to be a technical preference to adopt the western path, especially if crossing the River Ouse on the western path in Section 4.

Figure 12-12 – Section 5 (River Ouse Crossing – Luddington)

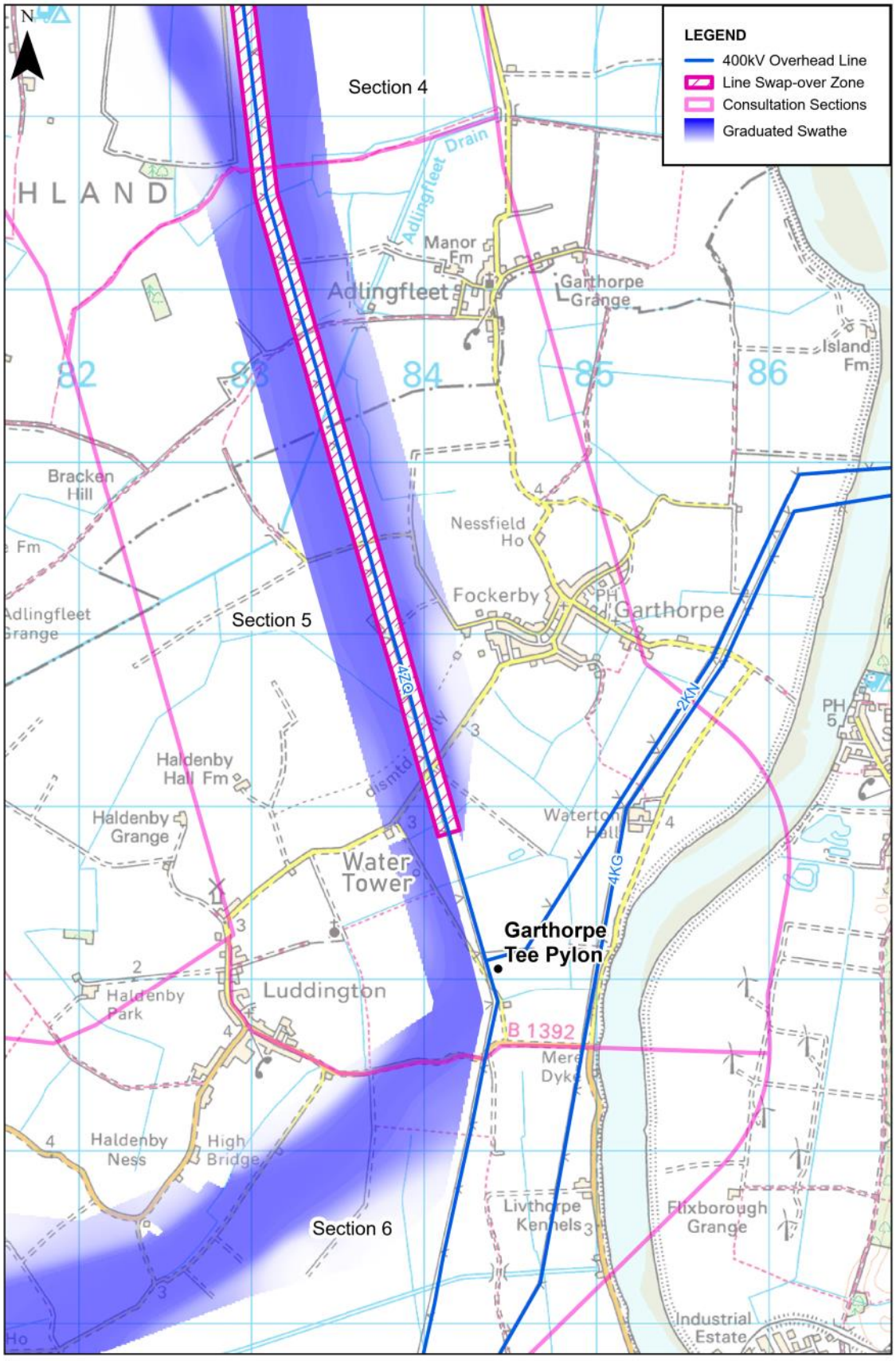


Figure 12-12 – Section 5 (River Ouse Crossing – Luddington)

SCALE:1:35,000

0 1 2 3 4 5 km

Section 6: Luddington – M180 Motorway

12.3.57 This section of the preliminary preferred corridor is bounded to the north by the B1392 Meredyke Lane, which runs between the village of Luddington and the River Trent and the M180 motorway to the south, as shown in **Figure 12-13** below and on Sheet 6 and Sheet 7 of **Appendix C**.

12.3.58 This section of the corridor continues across the flat, open, and low-lying area of the Humberhead Levels. The graduated swathe departs from the route of the existing overhead lines to the east of Luddington, and then is located to the north and West of the operational Keadby Windfarm. Therefore, in this section of the merging preferred corridor the overhead line would not generally be viewed in the context of existing pylons.

Section 6: Single Graduated swathe south of Eastoft

12.3.59 Within the section of the emerging preferred corridor south of Eastoft the graduated swathe is generally around 1km in width. Although a wide graduated swathe has been defined which follows a more direct path within the corridor to lessen overall route length there are limited local constraints that would preclude routeing elsewhere within the wider corridor.

Section 6: Eastern and Western paths from east of Crowle

12.3.60 East of Crowle the swathe breaks into two discrete paths; to the east and west of the property at Crowle Grange, before recombining to the west of Ealand Grange. Opportunities to route to the east of Ealand Grange are restricted by the routes of existing and proposed buried pipelines. Local land-use and impacts upon views from isolated residential properties may help inform ongoing design considerations in this section.

12.3.61 Approximately 1km south of Crowle Grange the emerging preferred corridor intersects the route of the existing 400kV overhead line from Keadby Substation. The hatched area in **Figure 12-13** above indicates an approximate area within which at least one span of the existing line would be replaced with underground cables to allow the new and existing transmission routes to cross. Adopting a more westerly path in this area would bring the new overhead line and underground cabling works somewhat closer to the village of Ealand than would the adoption of a more easterly path.

12.3.62 Southeast of Ealand the generally less constrained landscape allows a wider graduated swathe to be defined, providing opportunities for the new overhead line to follow one of several paths. South of the A18 trunk road the swathe gain breaks into two discrete paths to avoid the North Moor Farm Anaerobic Digestion Plant and has also been defined so as to offer opportunities to route around the blocks of established woodland on either side of the M180 motorway.

Figure 12-13 – Section 6 (Luddington – M180 Motorway)

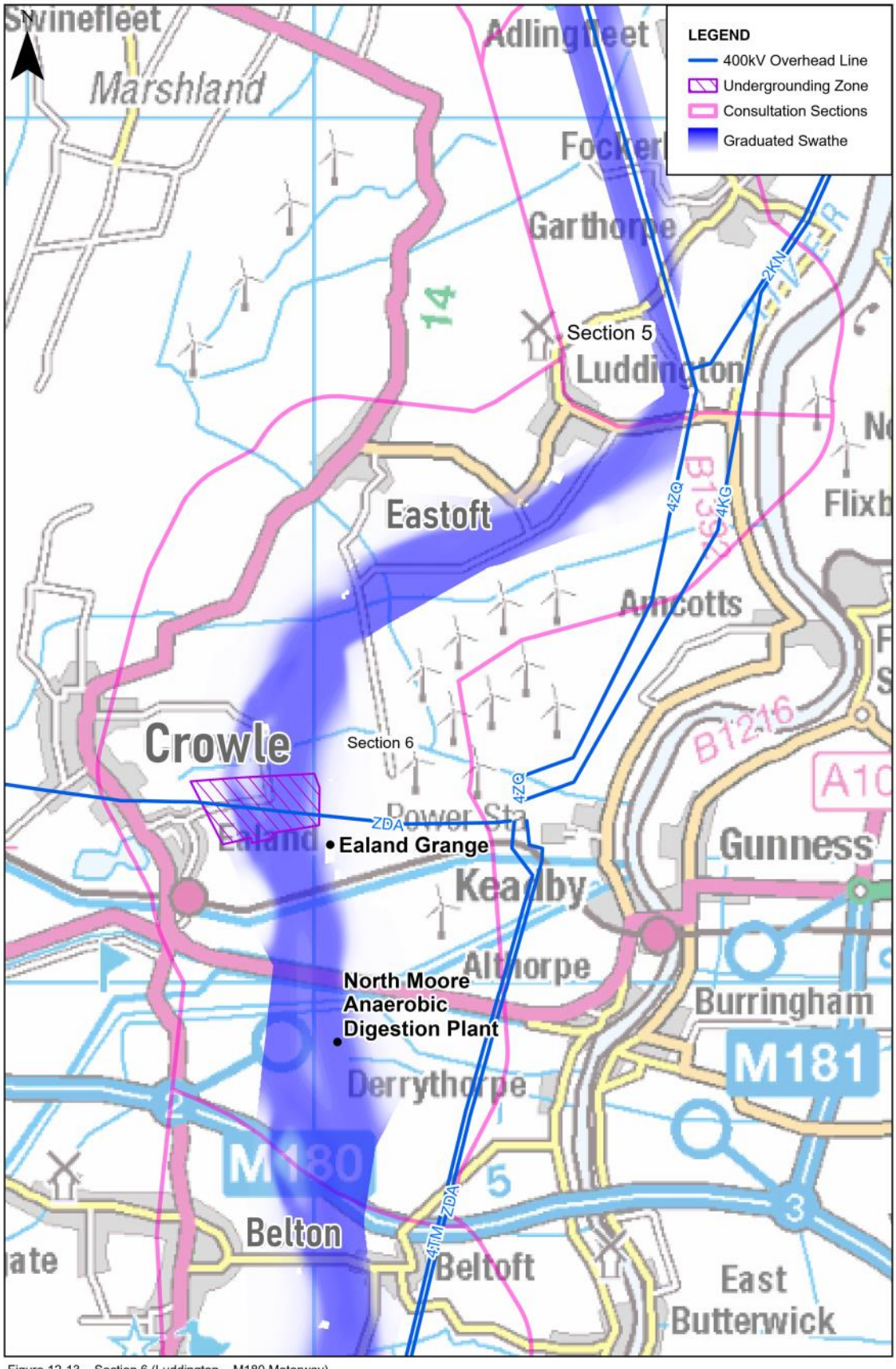


Figure 12-13 – Section 6 (Luddington – M180 Motorway)

SCALE:1:70,000

0 1 2 3 4 5 km

Section 7: M180 Motorway – Graizelound

12.3.63 This section of the preliminary preferred corridor is bounded to the north by the M180 motorway and to the south by Stockwith Road / Owston Road; the minor 'c' road between the villages of Graizelound and West Stockwith, as shown in **Figure 12-14** below and on Sheet 8 and Sheet 9 of **Appendix C**.

12.3.64 Of particular note in this section of the emerging preferred corridor is the largest area of high ground within the Isle of Axholme area; which rises above the generally open and flat landscape of the Humberhead Levels. The towns of Epworth and Haxey, together with the villages of Belton, Beltoft, East Lound and Owston Ferry are located on this higher ground.

12.3.65 South of the M180 motorway the emerging preferred corridor moves back to parallel the route of two existing overhead transmission lines that run south from Keadby, following the eastern flank of the higher ground.

Section 7: Eastern and Western paths south of Beltoft

12.3.66 At the northern end of this section the new and existing routes converge south of Beltoft. Isolated residential properties have defined two discrete paths for the swathe in this area. The path further to the east is as close to, and parallel with, the existing lines as possible. In the case of all but one property this would mean any new line would be located on the same side of properties as the two existing lines, helping to reduce impacts upon the character of views.

12.3.67 An alternative path is shown within the swathe further to the west, on slightly higher ground. This would be somewhat simpler to construct and operate and might also increase distance from residential properties. However, any new line within this path of the swathe may be more visible in the wider landscape, would bring the new route somewhat close to the eastern edge of Epworth and introduce pylons into currently unaffected views westwards from properties at High Melwood.

Section 7: Swathe in the East Lound / Owston Ferry area

12.3.68 In the southern part of this section of the corridor the graduated swathe combines into a single, narrower path, being constrained by the village of East Lound, properties on East Lound Road and the existing overhead lines, before again widening to separate paths to avoid individual residential properties to the east and south of Graizelound.

Figure 12-14 – Section 7 (M180 Motorway – Graizelound)

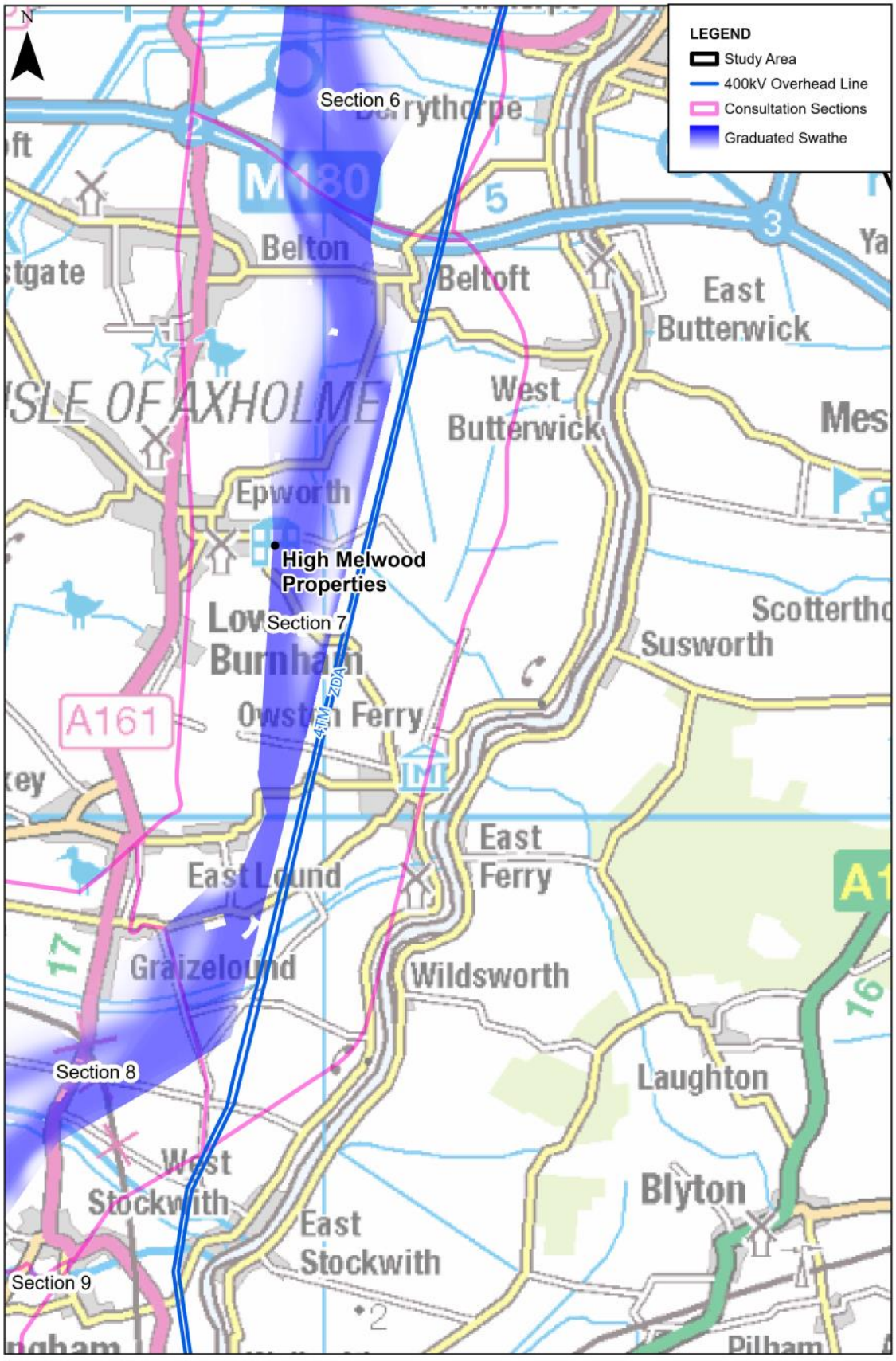


Figure 12-14 – Section 7 (M180 Motorway – Graizelound)

SCALE: 1:75,000

Section 8: Graizelound – Chesterfield Canal

12.3.69 This section of the preliminary preferred corridor is bounded to the north by the minor Stockwith Road / Owston Road between the villages of Graizelound and West Stockwith and to the south by the Chesterfield Canal, as shown in **Figure 12-15** below and on Sheet 9 and Sheet 10 of **Appendix C**.

12.3.70 This section of the emerging preferred corridor is generally flat and low lying, comprising the valley of the River Idle at the southern end of the Isle of Axholme. The area is generally sparsely populated with the one main settlement being the village of Misterton. This section of the preliminary preferred corridor is crossed north to south by the A161 main road and by the Doncaster – Lincoln railway line.

12.3.71 Given the relatively low numbers of local constraints to the routeing of an overhead line in this section of the merging preferred corridor the corridor itself is generally quite wide. However, the graduated swathe shown follows a more easterly path within the corridor, shortening overall route distance and hence the number of pylons likely to be required whilst also avoiding the settlement of Misterton (and Walkeringham further to the south).

Section 8: Alternative Paths at Haxey Gate

12.3.72 The swathe does split into two paths to avoid isolated properties along the A161. The more north-westerly path crosses more remote farmland but would somewhat increase overall route length. The more south easterly path would be more direct but closer to the leisure businesses at Haxey Quays and Haxey Gate.

12.3.73 South of the River Idle the two local paths merge to form a single swathe west of Misterton. The swathe then crosses the navigable Chesterfield Canal SSSI immediately west of the former Walkeringham Brick Works, narrowing to avoid isolated properties to the east and west.

Figure 12-15 – Section 8 (Graizelound – Chesterfield Canal)

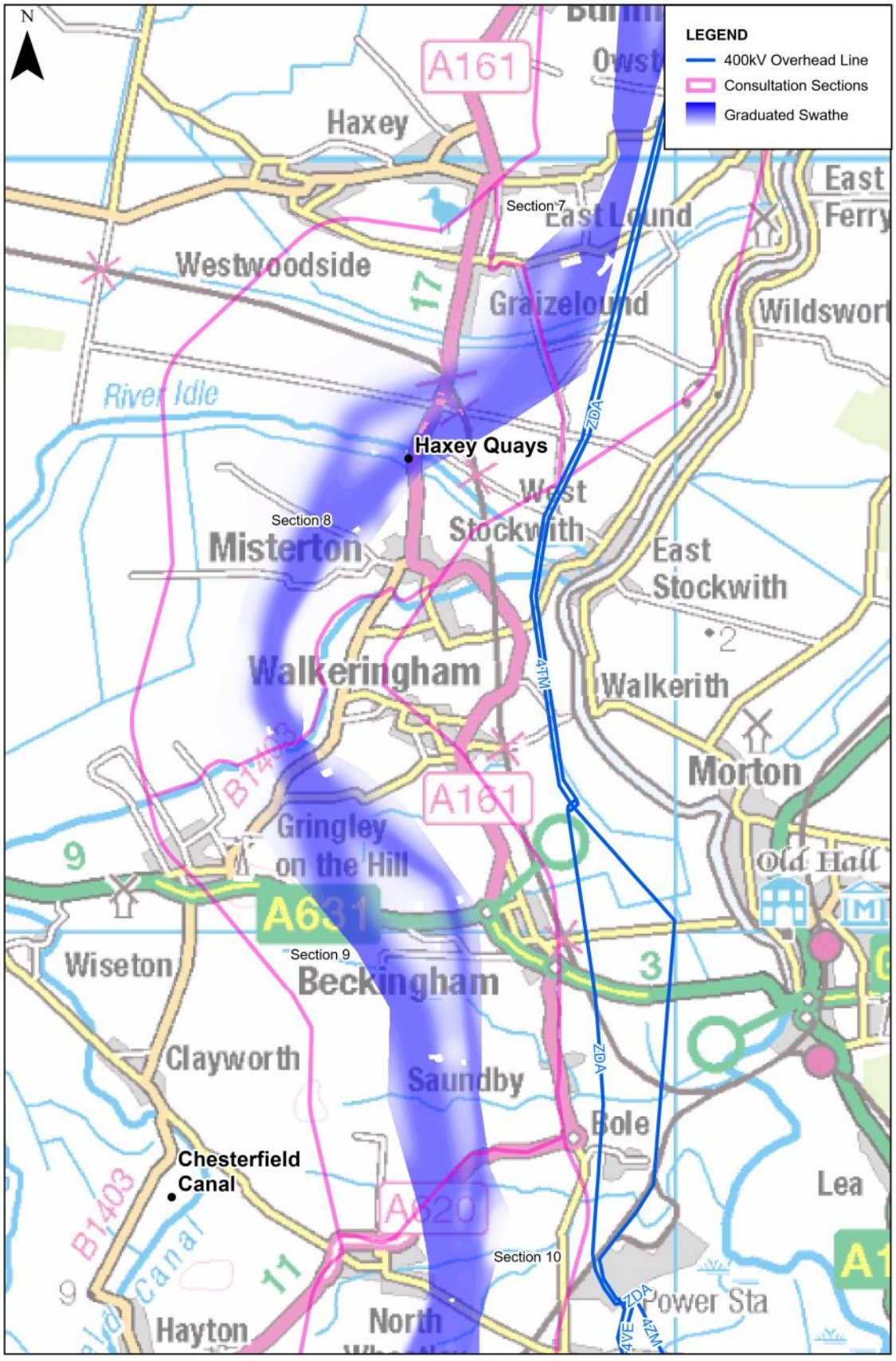


Figure 12-15 – Section 8 (Graizelound – Chesterfield Canal)

SCALE: 1:78,125

0 1 2 3 4 5 km

Section 9: Chesterfield Canal – A620

12.3.74 This section of the preliminary preferred corridor is bounded to the north by the Chesterfield Canal and to the south by the A620 Gainsborough Road, north-east of the village of North Wheatley, as shown in **Figure 12-16** below and on Sheet 10 and Sheet 11 of **Appendix C**.

12.3.75 The main settlements are Walkeringham and Beckingham to the west of the emerging preferred corridor, and Gringley on the Hill and North Wheatley to the west of the corridor. The A631 trunk road to Gainsborough crosses the corridor from west to east. South of the Chesterfield Canal the ground rises to an area of gently rolling farmland located between the washlands of the River Idle to the west and the flood plain of the River Trent to the east.

12.3.76 The graduated swathe is generally central to the corridor but splits into two discrete paths to avoid isolated properties, most notably those on the A631, and woodland blocks, especially the woodland at Saundby Park.

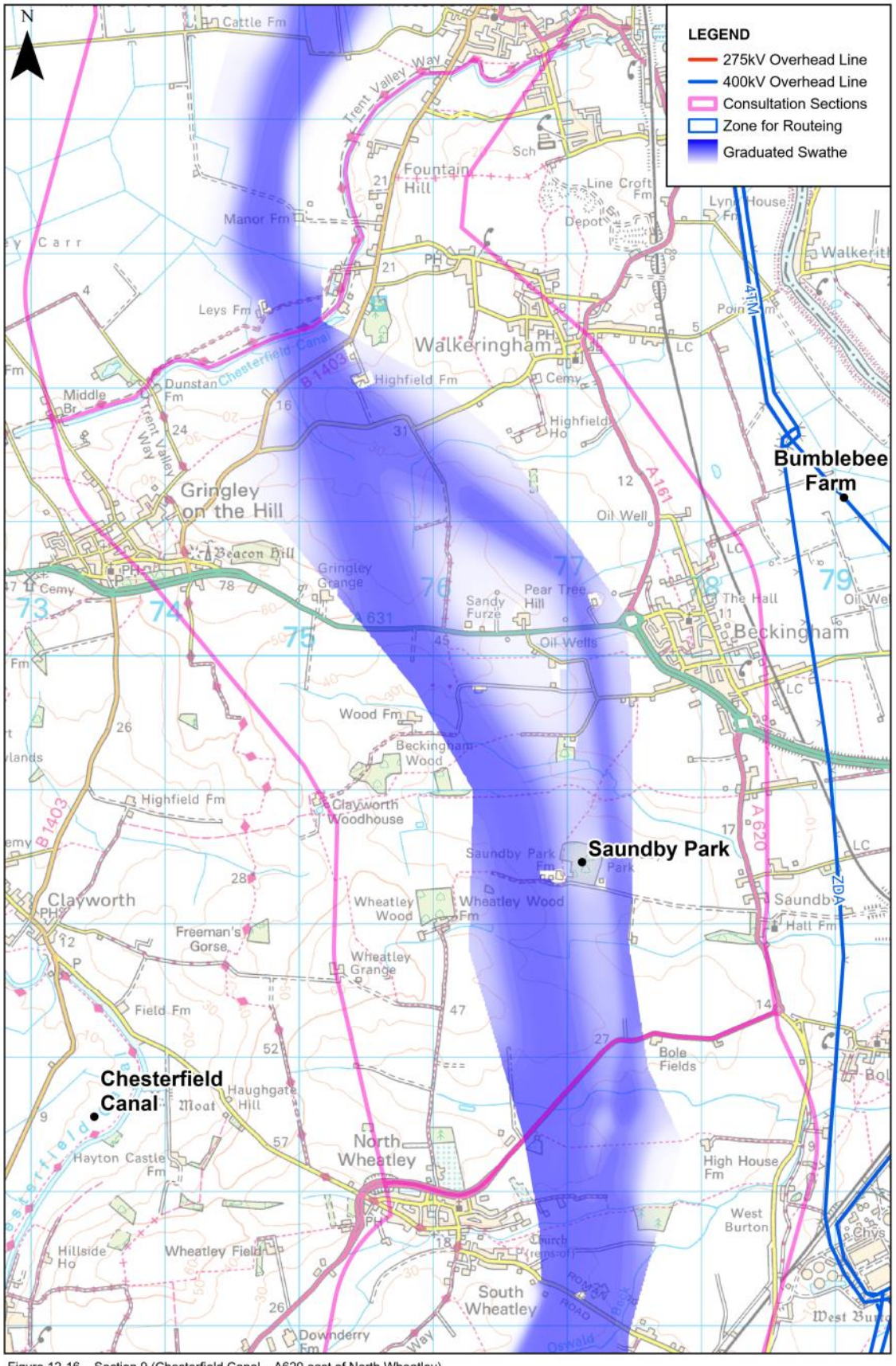
Section 9: Western Path

12.3.77 The more westerly path would occupy slightly higher ground and bring any new line slightly closer to the village of Gringley on the Hill whilst avoiding blocks of ancient woodland. This path skirts the extensive polytunnels at Wheatley Wood Farm to the west and the proposed Bumble Farm solar farm development (west of Saundby) to the east.

Section 9: Eastern Path

12.3.78 The more easterly path passes closer to the village of Beckingham and also crosses a narrow section of the solar panels proposed as part of the Bumble Bee Farm Solar Farm development.

Figure 12-16 – Section 9 (Chesterfield Canal – A620 east of North Wheatley)



Section 10: A620 – Fledborough

12.3.79 This section of the preliminary preferred corridor is bounded to the north by the A620 Gainsborough Road and extends south to a point approximately 1km from the existing High Marnham 400kV Substation, located on the site of the former High Marnham Power Station Site, as shown in **Figure 12-17** below and on Sheet 11, Sheet 12 and Sheet 13 of **Appendix C**.

12.3.80 The emerging preferred corridor generally parallels the ridge of higher ground located between the rivers Idle and Trent. The corridor is located on the eastern slope of the ridge and crosses local valleys which generally drain east or south-eastwards towards the River Trent.

12.3.81 At the northern end of this section of the corridor are the twin villages of North and South Wheatley. Helping to define the eastern edge of the corridor is the line of villages located on the edge of the Trent valley flood plain, including Sturton le Steeple, North Leverton and South Leverton and Treswell. Further south in this section the smaller settlements of Woodbeck, East Drayton and Darlton all help to inform and constrain the location of the less constrained graduated swathe within the emerging preferred corridor.

Section 10: Eastern and Western Paths between South Wheatley and Treswell

12.3.82 Whilst paths within the graduated swathe are less well defined at the northern end of this section, the presence of farm buildings and a single property on the minor Wheatley Road that runs southeast from South Wheatley means that two alternative paths; one to the east and one to the west of this property have been defined.

12.3.83 South of Wheatley Road, both paths of the graduated swathe cross the consented Wood Lane Solar Farm development site to the south of South Wheatley, although the eastern path has potential to conflict less with this development. In this location an existing 132kV overhead line also crosses the emerging preferred corridor from east to west. Work will be needed to this line in order to allow any new line to be constructed and operated. Subject to discussion with NGED (the owner and operator of the line) and detailed design consideration, this work could involve replacing a section of the existing line with underground cables.

12.3.84 Further south the graduated swathe continues with alternative eastern or western paths either side of properties and businesses on Retford Road, west of South Leverton.

12.3.85 South of this point the two paths recombine into a single swathe, passing to the east of Treswell Wood SSSI and Nature Reserve and to the west of the villages of Treswell and Woodbeck.

Section 10: Eastern and Western Paths south of Woodbeck

12.3.86 South of Woodbeck the swathe again divides into a western and an eastern path, to avoid a small number of properties on Main Street and on Retford Road, East Drayton. Further south, between East Drayton and Darlton, the paths again merge into a single graduated swathe, passing to the east of Darlton.

12.3.87 Between Darlton and the Whimpton Moor mediaeval village Schedule Monument, the swathe again divides into two to provide alternative paths to the east and the west of isolated farmsteads and Long Row Cottages on Main Street, Fledborough.

Figure 12-17 – Section 10 (A620 – Fledborough)

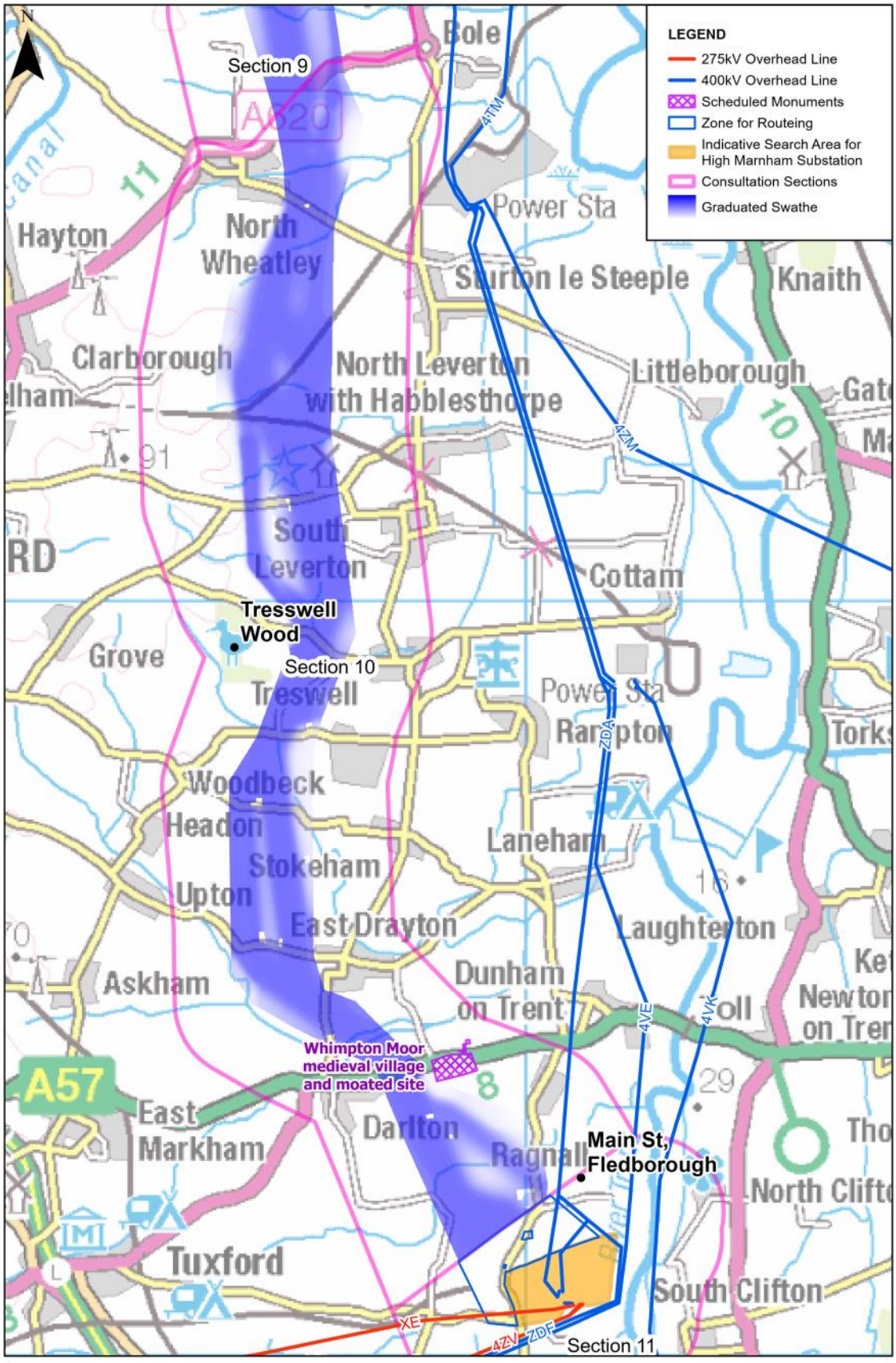


Figure 12-17 – Section 10 (A620 east of North Wheatley – Fledborough)

SCALE: 1:80,000

0 1 2 3 4 5 km

Section 11: Fledborough - High Marnham

12.3.88 The final section of the emerging preferred corridor begins around 1km northwest of the existing High Marnham Substation. No graduated swathe is shown within this section because the final route of the new overhead line will be heavily influenced by the location of the new substation to which the new overhead line is to connect. Work is ongoing to identify the most appropriate location for the new substation within the indicative search area shown in **Figure 12-18** below and on Sheet 13 of **Appendix C**. It is expected that this will be brought forward for local consultation in early 2024 before a planning application is submitted to Bassetlaw District Council.

Figure 12-18 – Section 11 (Fledborough - High Marnham)

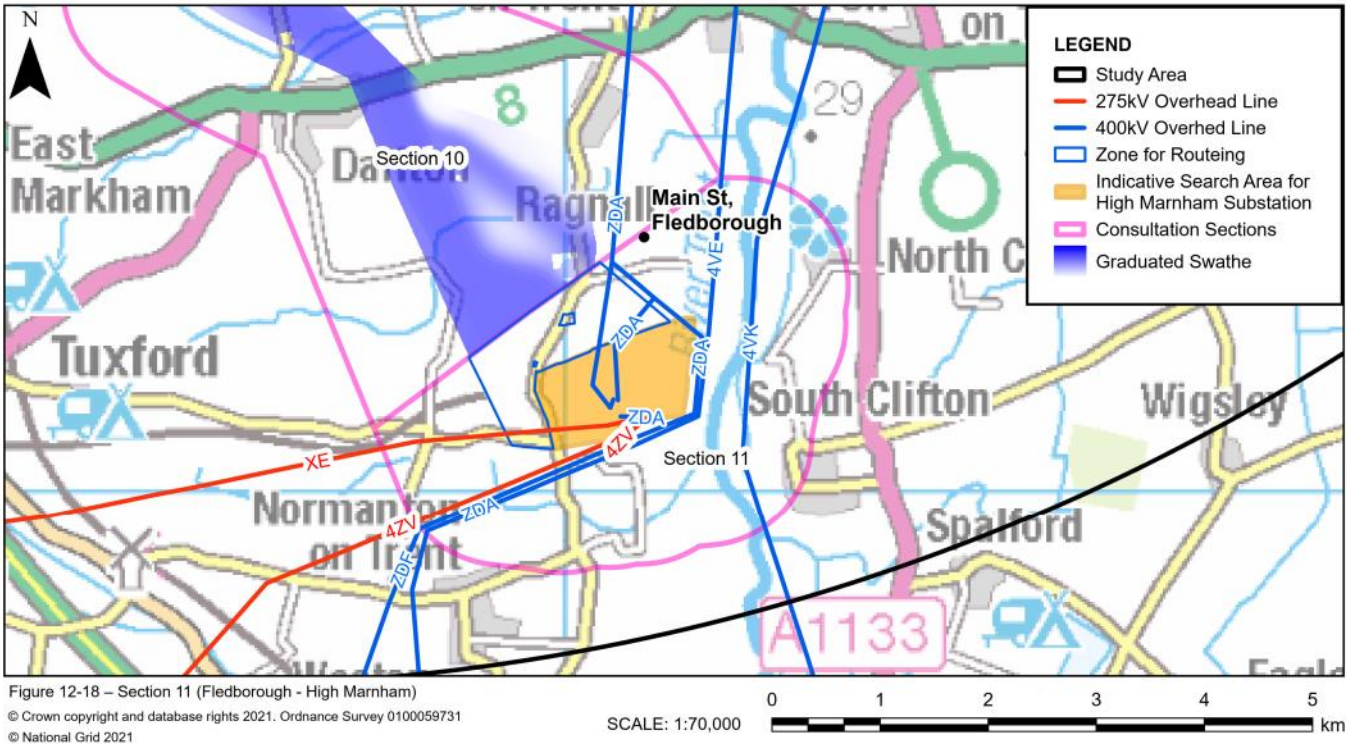


Figure 12-18 – Section 11 (Fledborough - High Marnham)

12.3.89 The presence of further properties on Main Street in Fledborough will also influence the final design of the approach into the new High Marnham Substation as will existing and proposed land uses within the environment of the former High Marnham Power Station Site.

12.4 Summary of the Graduated Swathe

12.4.1 The graduated swathe, for non-statutory consultation, as shown in the figures presented in this chapter and in **Appendix C** depicts the following:

- The existing overhead line, shown as a dark blue line;
- The areas for potential line swap overs, shown as the pink hatching; and
- The areas for the anticipated undergrounding of an existing line east of Ealand, shown as the purple hatching.

12.4.2 Also shown indicatively on the drawings and interactive map for the graduated swathe are the following elements:

- The zones for the new substation at Creyke Beck and the proposed new substation at High Marnham (areas bounded in orange);
- The potential zone for the substation extension at Creyke Beck (area bounded in orange); and
- The zones for routeing into the new substation at High Marnham (areas bounded in blue).

12.4.3 These elements have been shown on the plans for the graduated swathe because they directly inform the overall graduated swathe, particularly the existing overhead line which provides an idea of where close parallel is more or less likely to be implemented.

12.5 Conclusion

12.5.1 The graduated swathe represents the current thinking on where the Project infrastructure is more or less likely to be located. This will be informed by feedback received during consultation and therefore there is the potential for the design of the Project to extend beyond the graduated swathe. This will be fully considered through the development of the Project, whilst maintaining the principles used to develop the current graduated swathe, for instance, the avoidance where practicable of areas of highest constraint such as settlements.

13. Summary and Next Steps

13. Summary and Next Steps

13.1 Summary of Options Identification and Selection Process (Stage 2)

13.1.1 A detailed Options Identification and Selection Process (Stage 2) (see **Chapter 4**) has been undertaken to identify the proposed corridor for a 400kV electricity transmission connection between new substations to be built in the vicinity of Creyke Beck Substation and the former High Marnham Power Station site, a straight-line distance of approximately 68km. The connection is expected to wholly or largely comprise of a new overhead line. NGET will also need to replace a short section of existing 400kV overhead line with underground cables and commission local changes to the lower voltage distribution networks in order to facilitate the construction of the new overhead line.

13.1.2 For the Project, four preliminary overhead line corridors were identified and appraised (in **Chapter 6** to **Chapter 11**). The four preliminary corridors were divided in sections, links and loops for appraisal and the identification of an emerging preferred corridor. Following the appraisal of the sections, links and loops in isolation an end-to-end solution review was then undertaken between Creyke Beck and High Marnham. This review considered each progressed section, link or loop of the preliminary corridor in the context of the wider end-to-end solution and ensured that the reasoning and justification for progressing one part of the emerging preferred corridor did not incorrectly impact on the decision made for the next section, link or loop of the corridor. The wider end-to-end solution review also incorporated cost performance, reported in **Chapter 10**. The review did not cause any amendments to the preferred emerging corridor.

13.1.3 To summarise the emerging preferred corridor for a new overhead line:

- broadly follows the existing 4ZQ 400kV overhead line from the eastern edge of the Yorkshire Wolds to near Luddington (Lincolnshire) including crossing the River Ouse alongside the existing overhead line river crossing;
- from Luddington, loops west around Keadby Windfarm to pass east of Ealand and then parallels the two existing 400kV overhead lines south from near Beltoft to a point near the crossing of the Warping Drain, south-east of Haxey; and
- from there loops west to pass west of Misterton, then south, passing west of the line of villages along the edge of the Trent valley (Wallingham, Beckingham, Sturton le Steeple, North and South Leverton, Tresswell and Woodbeck) to pass west of East Drayton then approach High Marnham from the north-east.

13.1.4 The conclusion was drawn that routeing the new overhead line closely parallel to existing 400kV network would minimise the overall environmental impacts – concentrating impacts in areas already impacted rather than spreading them more widely. The main exceptions to this are at Keadby with the technical constraints around the Keadby Windfarm and south of Haxey, identifying a new corridor three to four kilometres west of the existing 400kV overhead lines in the Trent Valley where the increasing numbers of existing lines form a broad and complex network.

13.1.5 The emerging preferred corridor broadly looks to close parallel with existing electricity transmission infrastructure. Close paralleling would minimise overall environmental and socio-economic impacts, whilst avoiding areas of highest engineering challenge. The deviations from close parallel make little difference to the overall length of the emerging preferred corridor which is close to the shortest practicable given the constraints posed by the Humber Estuary. Overall, the emerging preferred corridor is considered to offer the optimum balance between environmental, technical, cost and socio-economic considerations.

13.2 Non-statutory Consultation

13.2.1 This report will be used as part of the non-statutory consultation and engagement with key stakeholders, including landowners. The non-statutory consultation will take place in Spring and Summer 2023.

13.2.2 During the non-statutory consultation, feedback will be gathered from consultation events and feedback forms.

13.2.3 The proposed corridor identified in this report, in conjunction with the other elements of the Options Identification and Selection Process (Stage 2), will be kept under review throughout the development of the Project.

13.3 Analysing Non-statutory Consultation Feedback

13.3.1 The feedback from non-statutory consultation, along with information from surveys undertaken to obtain baseline data and ongoing design studies, will inform the further development of the Project.

13.4 Defined Proposal and Statutory Consultation (Stage 3)

13.4.1 Following the completion of non-statutory consultation in Summer 2023, including the analysis of the consultation feedback, NGET will progress the Defined Proposal and Statutory Consultation Stage (Stage 3). As part of this, the design will be subject to an EIA, further statutory consultation, and integrative design development prior to submission of the application for a DCO.

Appendix A

River Ouse – Possible Installation Methods for Underground Cables

Appendix A
River Ouse – Possible Installation Methods for Underground Cables

Introduction

As set out throughout this Report in addition to an overhead line, an underground cable crossing could be considered for the River Ouse crossing within the emerging preferred corridor[43]. This would require the installation of long ducts or the construction of one or more tunnels to accommodate the eighteen transmission cables likely to be required, as these could not be laid securely on the riverbed.

NGET has not reached any final conclusion with regard to the acceptability of an overhead line crossing. This decision will need to be informed by engagement with stakeholders, in particular Natural England, the RSPB and other nature conservation organisations, as well as by the results of extensive site surveys. However, it was noted that underground cable would result in very significant increases in cost and potentially delay the completion date for the Project. At this stage, geological data is also limited for the crossing areas and so detailed studies would be required to confirm the technical viability of installing underground cables across the River Ouse within any of the four corridors considered.

This Appendix provides a description of infrastructure required to facilitate an underground cable crossing of the River Ouse, an indication of the potential installation techniques that could be used, any operation and maintenance requirements of each technique and potential environmental impacts.

Where a section of underground cable resurfaces to connect to an overhead line a SEC is required. These would be required regardless of the underground cable installation method used. **Section 2.3** provides a description of SECs and indicative dimensions.

Underground Cables

There are several cable installation methods which are summarised below:

- Open cut methods: These would typically be utilised in open agricultural land. This involves the excavation of a trench into which the cables could either be directly laid, or a duct could be laid through which cables could then be pulled. This is usually followed by land reinstatement.
- Trenchless methods: These would typically be utilised where features (watercourses, roads, railway lines, flood defences or other utilities) require to be crossed. This would involve the installation of ducts or a tunnel below the feature. The cables would then be pulled through the ducts or the tunnel.

A trenchless method would be required at the River Ouse should an underground cable crossing be required at this location. The following sections provide a description of the potential methods that could be used for a trenchless crossing of the River Ouse.

---

[43] This is the case with any of the other corridors with crossings of the River Ouse.

In determining the most appropriate trenchless technique for installing underground cables for a 400kV cable system, NGET need to ensure the electrical performance of the cables are not compromised. Therefore, it is important that the physical environment of the cables enables:

- Heat dissipation, to prevent overheating and subsequent reduction in cable rating (capacity for carrying current);
- Physical protection, so that the cable does not become damaged or become a potential danger to third parties; and
- Proper access in order to ensure efficient inspection repairs or replacement.

The ability of the rock or soil that surrounds underground cables to dissipate the heat emitted by the cables could determine the number of cables required. This is because heat build-up reduces the current that the cables are able to carry, potentially requiring the installation of further cables to make up for any capacity shortfall.

To meet the double circuit rating required for this connection, based on our work to date and the preliminary rating studies, eighteen transmission cables are likely to be required for an underground crossing of the River Ouse.

Potential Installation Methods

There are a number of potential trenchless installation methods that could be considered for an underground cable crossing of the River Ouse. These are:

- Horizontal Directional Drilling (HDD);
- Tunnel Boring Machine (TBM) Tunnelling:
  - Microtunnelling/Pipejacking; and
  - Conventional Tunnelling Method (CTM).

These options are described in more detail in the sections below.

Horizontal Directional Drilling (HDD)

HDD is a multistep process which involves:

- Drilling a small diameter pilot bore along the proposed route from a launch location on one side of a crossing to a reception location on the other side of a crossing;
- The pilot bore is then enlarged by pulling a larger drilling tool (back reamer) from the reception pit to the launch pit connected to drill rods installed during pilot boring. The back reamer is rotated during the pull back, enlarging the pilot bore to later fit the permanent duct. If required, the reaming stage may be repeated to achieve larger bores at the diameter required for the duct; and
- The permanent duct is installed by pulling it back through the bore enlarged by the reaming process.

For the typical 400kV cable conductor, each installed duct would likely be of the order of 400mm in outer diameter, requiring an overall drilled bore diameter of 500mm to 600mm.

Construction

During construction, a construction compound is required at both the launch and reception locations. The required area depends on the length of the HDD crossing and the diameter of the duct but typically, a minimum of 30m wide by 120m long per drill would be required at the launch location. Adequate space is also required at the reception location to pull the duct as a continuous length.

At the River Ouse it is likely that a minimum working width of 240m would be required at both the launch and reception locations subject to the specific location of the drill, the length of the drill and more detailed geotechnical and environmental information.

A HDD rig and associated equipment would be set up at the launch location. This includes electricity supply (portable generator), drill mud filter, control unit and welfare facilities. Drilling utilises a drill bit, drill head and drilling fluid.

HDD requires a reliable, clean, and potable water source. If this is not available, on-site water treatment may be required.

Throughout all drilling stages of the process the drilling fluid is pumped down the bore to the drill head. The fluid pressure drives the rotation of a mud motor, facilitates the removal of cuttings, stabilises the borehole, cools the drill head and transmitter, and lubricates the passage of the duct. The constituents of the drilling fluid are selected to reflect the properties of the ground being drilled, typically they contain bentonite. Shallow launch and reception pits are dug at the launch and reception locations to collect the drilling fluid throughout the process. This fluid is recycling during drilling and removed from site for disposal upon completion.

The rate of drilling is largely dependent on ground conditions and the length of the drill. The construction period can however be shortened by employing multiple rigs for synchronous boring.

Once the ducts are installed a winch is used to draw the cables through ducts. Once the cables are installed the working areas would be removed and the land reinstated.

Operation and Maintenance

With the exception of the SECs and small kiosks either side of the ducted sections there is no requirement for any additional permanent above ground infrastructure.

For cables installed using HDD it is not possible to undertake direct inspections or maintenance, though in-situ testing is still possible. Should there be a fault on a cable this will require direct replacement via new HDD ducts. It is likely that spare ducts would be installed during construction to allow for ease of replacement should any faults be identified in future.

Underground cables have an assumed operational life of 40 years, but this may be extended dependent upon the actual operational conditions. Once the cables become life expired new ducts and cables would need to be installed as described above.

Environmental Considerations

The ducts and cables would be installed at a sufficient depth under the feature being crossed so as to remove the potential for any environmental impacts during operation.

During installation, in certain geology, there can be the potential for frack out (loss of drilling fluid to the environment and potential failure of the bore) and, where the rock formations are

loosely bound, losing control of the drill path and collapse of the bore. Whilst frack out is unlikely, method statements would be in place during installation to manage any frack out with measures being proportionate to the amount and location of any frack out should it occur.

There is the potential for temporary impacts during installation at the launch and reception locations including noise associated with the drilling machinery and lighting at the compounds. HDD can also sometimes require 24-hour working during certain stages of the drilling process.

There would be temporary habitat removal at the launch and reception locations, this would be reinstated upon completion of the works.

The SEC sites would result in the permanent loss of land and related adverse landscape and visual impacts. In addition, adverse ecological and cultural heritage impacts could also result, dependent upon final siting.

Cost Considerations

The civil engineering operation to pre-install up to twenty long ducts beneath the River Ouse would add significantly to the capital cost associated with the use of underground cables to achieve any crossing. The use of underground cables installed in drilled ducts is likely to increase the overall capital cost of the reinforcement by in excess of £70m.

In addition, underground cables have an assumed operational life of 40 years. It would not be possible to remove the old cables from the ducts and refurbish the ducts themselves. Hence a complete set of new ducts would likely be needed and replacement costs likely to be in excess of £70m would again be incurred at this point.

Tunnelling - Tunnel Boring Machine (TBM)

TBM tunnelling is a term that can encompass the installation of tunnels by microtunnelling, pipejacking and conventional tunnelling as these forms of construction tend to share the common application of TBM to excavate tunnels.

Characteristically, microtunnelling/pipejacking methods are used for tunnel diameters of 0.3m to 2.4m and are typically limited to tunnel lengths of approximately 2km. Tunnels constructed using the CTM typically have minimum diameters of 4m and whilst possible for short tunnel lengths are most cost effective for tunnels greater than 5km.

The method of TBM tunnelling selected would also be based on the predicted geological conditions.

The main difference between microtunnelling/pipejacking and CTM is the method of lining the tunnel. Whilst pre-formed pipes are used as the structural lining in pipejacking/microtunnelling, in CTM, the lining is typically formed of precast concrete segments that are interlocked to line the tunnel bore as the TBM advances.

The following section describes the TBM tunnelling installation in general.

Construction

During construction, construction compounds are required at the launch and reception areas. Typically, a larger compound is required at the launch area as additional workspace is required for the siting of a slurry separation plant and tunnel pipes. A substantive power supply would also need to be established to power the TBM.

Once the construction compounds are established the first phase of tunnelling is to construct the launch and reception shafts. There are a range of methodologies for the sinking of shafts, typically these are either caisson or underpinning. The methodology would be determined based on the ground conditions. The depths of the shafts are dependent on the depth that the tunnel needs to be beneath the feature that is being crossed.

Following construction of the shafts, a base slab and tunnel headwall structure would be cast at the bottom of each shaft and a thrust wall installed within the launch shaft to allow the TBM to advance.

The TBM would be lowered into the launch shaft and tunnelling commenced between the launch and reception shafts. Depending on the method used either product pipes or concrete segmental rings are inserted behind the TBM as it processes. Water or mud mix is utilised to fluidise excavated material which is pumped to the slurry separation plant within the launch area construction compound. At the slurry separation plant, water is separated from the mix and treated with flocculants to facilitate reuse of clean water in the system.

Excavated material would typically be removed from site in HGVs for disposal or reuse where appropriate, although opportunities to move this material by boat would also be explored.

The amount of material and associated vehicle movements would depend on the length and diameter of the tunnel, the depths of the shafts and the type of material that is excavated.

Once the tunnel has been constructed and the cables installed the shafts would either be capped using prefabricated beams/slabs with the ground above the slab being backfilled and reinstated or a tunnel head house constructed. The requirement for a tunnel headhouse would be determined depending on whether the required cable ratings could be achieved without mechanical ventilation within the tunnel. If mechanical ventilation was required (which would be likely) a tunnel head house structure to house that equipment would be constructed above each shaft. These are likely to be approximately 15m by 15m with an approximate height of 10m and would require a permanent vehicle access.

Operation and Maintenance

Should there be a requirement for tunnel ventilation and therefore tunnel head houses these would be unmanned during normal operation.

The tunnel ventilation fans would operate according to the tunnel cooling demand and the tunnel would also be cleared as required of excess water using sump pumps.

The cables within the tunnel would be subject to maintenance inspections over the length of the tunnel comprising at least one annual inspection. The inspection would report on any defects or changes, identifying any additional requirements such as repairs/replacements. It is also anticipated that ventilation fans would be tested on a monthly basis.

Any replacement of cables within the tunnel or larger equipment within the tunnel head houses would require a temporary construction compound in proximity to the tunnel head house or cap and new cables installed as described above.

Environmental Considerations

The tunnel would be installed at a sufficient depth under the feature being crossed so as to remove the potential for any environmental impacts during operation.

During tunnelling there is the potential for ground borne noise/vibration due to the action of the TBM drilling head.

Similar to HDD in certain geology there is also the potential for the accidental release of drilling fluids via fissures in the geology at the drilling face. Whilst this is unlikely, method statements would be in place during installation to manage any risk, with measures being proportionate to the amount and location of any release should it occur.

There is the potential for temporary impacts during installation at the launch and reception locations including noise associated with the tunnelling machinery and lighting at the compounds. Tunnelling tends to require 24-hour working below ground when driving the main tunnel bore, but above ground vehicle movements can be restricted or avoided during night-time periods.

There would be traffic movements during construction associated with both the removal of material from site and bringing tunnelling materials such as precast concrete segments to site. The amount of vehicle movements would be dependent on the length of the tunnel and depth of the shafts as well and the type of material excavated. As an example, constructing a 40m deep, 5m diameter tunnel over two kilometres would generate approximately 60,000 cubic metres of spoil that would need to be disposed of, resulting in a significant number of vehicle movements. Opportunities to move this material by boat would be explored as an alternative to vehicle movements.

Permanent ventilation of any tunnel would likely be required, housed within one or more tunnel head houses. These may be co-located with the SEC or located separately.

Permanent sites would result in the loss of land and related adverse landscape and visual impacts. In addition, adverse ecological and cultural heritage impacts could also result, dependent upon final siting.

Tunnel head houses would need to include an appropriate acoustic design and mitigation to meet appropriate noise levels in order to mitigate any noise associated with the ventilation equipment being housed.

Given the geography of the River Ouse basin it is also likely that any head houses would be located within the flood zone and therefore any associated flood risk would also require appropriate mitigation which could include increasing the height of the head houses and providing compensation flood storage.

Cost Considerations

The civil engineering operation to install a bored tunnel beneath the River Ouse would add significantly to the capital cost associated with the use of underground cables to achieve any crossing. The use of underground cables installed in a tunnel is likely to increase the overall capital cost of the reinforcement by in excess of £100m.

In addition, insulated cables have an operational life of 40 years. Hence a minimum replacement cost of approximately £35m would need to be incurred at this point in time.

Appendix B

Option Selection Process

Appendix C

Graduated Swathe (detailed)

National Grid plc
National Grid House,
Warwick Technology Park,
Gallows Hill, Warwick.
CV34 6DA United Kingdom

Registered in England and Wales
No. 4031152
nationalgrid.com