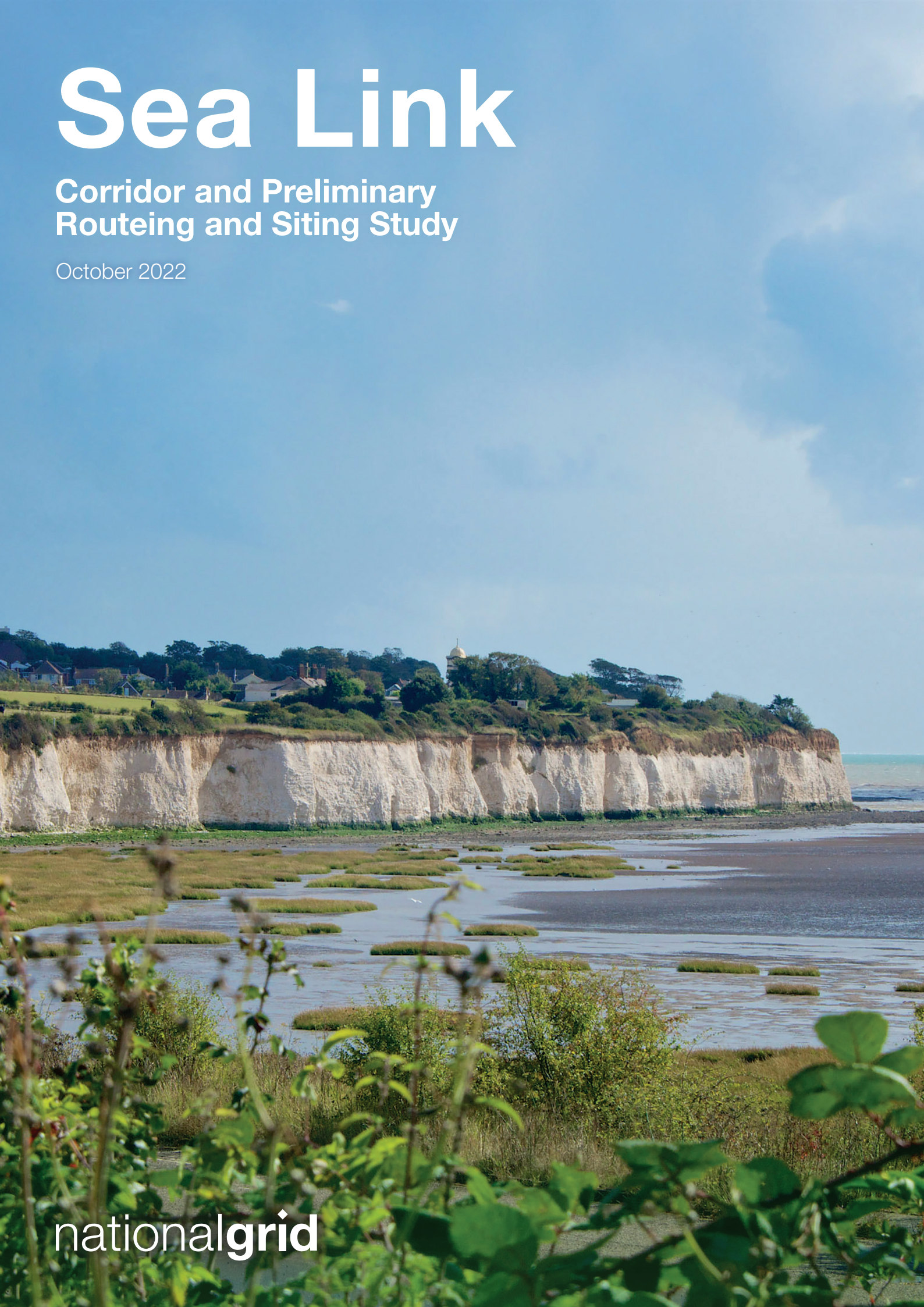
Sea Link

Corridor and Preliminary Routeing and Siting Study

October 2022



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Figures and Tables

Executive Summary

This report is the Corridor and Preliminary Routeing and Siting Study (CPRSS) which has been undertaken to define the emerging preference locations for the Sea Link Project.

The Project is being developed by National Grid Electricity Transmission (NGET) and comprises a major reinforcement of the electricity transmission system to facilitate the transfer of power between East Anglia and the South East regions and onto the rest of the Main Interconnected Transmission System (MITS).

The Project is expected to include the construction of new 2GW High Voltage Direct Current Link (HVDC) comprising of converter stations, marine and terrestrial HVDC cable and High Voltage Alternating Current (HVAC) connections back to the existing network.

This report considers options for the emerging locations for the proposed infrastructure. The emerging preferred options presented may be subject to modification following stakeholder engagement, public consultation, further design development and survey work.

1. Introduction

1.1 Overview and Purpose

1.1.1 The Sea Link Project (hereinafter referred to as the 'Project') is being developed by National Grid and comprises a major reinforcement of the electricity transmission system which is required to accommodate additional power flows generated from renewables (especially from offshore wind), in addition to new interconnectors, and ensuring they can reach consumers.

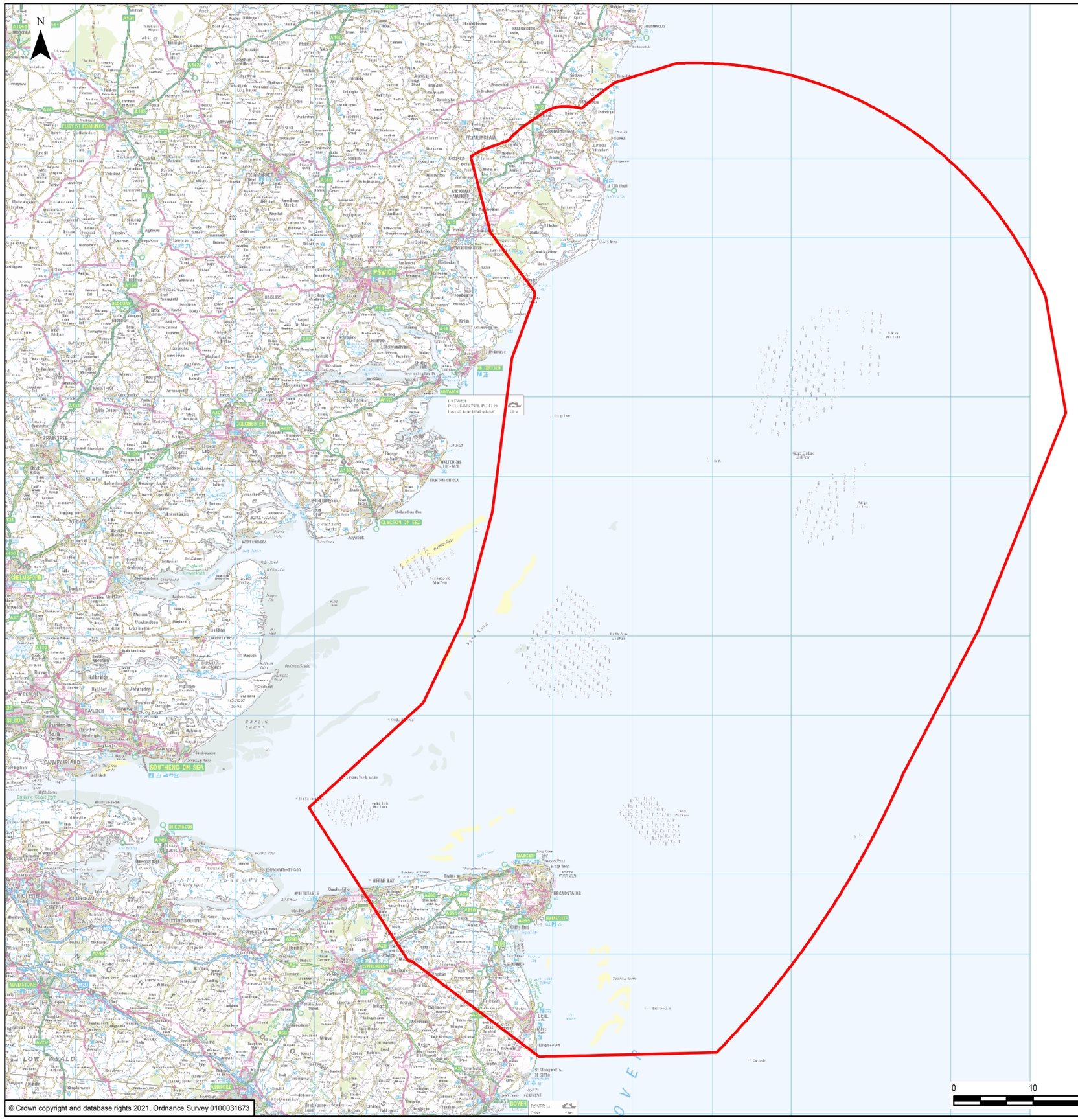
1.1.2 The Project will include the construction of new infrastructure consisting of underground terrestrial and marine HVDC cables, converter stations, HVAC Overhead Lines (OHL) or underground cables, as well as potentially new substations or substation extension/upgrade works.

1.1.3 The purpose of this report is to present the outcome of the CPRSS that has been undertaken to identify the emerging location of the Project infrastructure within the identified Project study area (**Figure 1-1**).

1.1.4 This report focuses on the environmental, socio-economic, technical and cost constraints that have materially influenced decision making related to routeing and siting options. It does not present an exhaustive account of all baseline information gathered during the study.

1.1.5 The emerging preference and alternative options identified in this report will be subject to modification following stakeholder engagement, public consultation, further design development and environmental survey work.

Figure 1-1 Project Study Area



Legend

Project Study Area

Rev	Date	Description			
0	19/08/2022	CPRSS REPORT	EB	DF	KS

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Scheme: SEA LINK

Document Title: SEA LINK PROJECT STUDY AREA

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EB	19/08/2022	DF	19/08/2022	KS	19/08/2022

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FIGURE 1-1	1:500,000	A3	1	0

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1.2 Background and Need

1.2.1 The UK's target to achieve Net Zero carbon emissions by 2050 is resulting in fundamental changes to the way that electricity is generated and supplied. The Government has established intermediary targets such as the development of up to 50GW of offshore wind by 2030, up from approximately 11GW today.

1.2.2 Offshore wind generation, nuclear generation and Interconnectors to mainland Europe are strategically important investments to meet 2050 net-zero targets. Proximity to mainland Europe and suitability of the seabed off the coast of East Anglia region has resulted in large-scale offshore wind and interconnector connection applications in the East Anglia region. NGET as the transmission network owner in England and Wales has the responsibility to provide these applications with a network that is compliant to the criteria contained within the National Electricity Transmission System Security and Quality of Supply Standard (NETS SQSS).

1.2.3 The future energy scenarios, established by the National Grid Electricity System Operator, highlight that additional generation between 7 and 25GW could be expected to connect in the East of England Region by 2035 and up to 14GW of interconnector and energy storage in the South of England.

1.2.4 Increasing levels of generation will drive substantial increases in the north - south power flows within and beyond these regions. Therefore, significant reinforcement of the transmission system is needed in the East Anglian and South East of England regions, requiring the development of additional transmission circuits.

1.2.5 The increase in interconnector capacity between Britain and continental Europe is likely to substantially increase the duration and magnitude of power exported from Britain during periods of high wind generation and imported from continental Europe during periods of low wind generation requiring power to be supplied to and from the interconnectors located along the south and east coasts of England.

1.2.6 Given the substantial increase in generator-driven power flows out of East Anglia, and the region's proximity to the south coast and London, the optimum reinforcement solutions for the two regions are interactive. When generation levels are high in East Anglia, power will need to be transmitted to centres of demand in London and the South East of England. During these periods of high generation much of the 'surplus' power exported to the continent will also need to be transmitted to the south coast to supply the power requirements of the continental interconnectors, further increasing the East Anglia to South East of England power flows.

1.2.7 The Sea Link project therefore seeks to address these two different but interrelated transmission system constraints which trigger the need for significant reinforcement of the transmission system in both East Anglia and the South East of England. Sea Link is needed in addition to other network reinforcements identified in the region.

2. Strategic Options

2.1 Background

2.1.1 The strategic options considered for the Project were developed and appraised alongside the needs case to rationalise network reinforcement where possible whilst still ensuring compliance with the National Grid's statutory duties.

2.1.2 The need to reinforce the transmission system is reviewed on an annual basis in response to predicted changes, such as new renewable and low-carbon energy generation forecasted to connect to the network. This review, which sets out which the parts of the network that require reinforcing, is within the Electricity Ten Year Statement[1]. Proposals that provide those reinforcements are then assessed through the Network Options Assessment (NOA)[2] which is published annually.

2.1.3 The need to reinforce the network in the South East of England is driven by interconnection with mainland Europe as described in **Chapter 1**. This reinforcement was assessed in the 2018/2019 NOA and National Grid explored several strategic options that could deliver that required reinforcement. One of the strategic options that was considered was a nominal subsea HVDC link between the South East of England and East Anglia. This was included in order to appraise the performance of this strategic option, which crossed multiple system boundaries, against others which just addressed the need in the South East of England. The appraisal identified that this strategic option provided the reinforcement required to the network in the South East of England as well as providing reinforcement to the network in East Anglia. The network in East Anglia was also identified in the 2018/2019 NOA as likely to need reinforcing reinforcement in the future due to the volume of possible future generation connecting within this region.

2.1.4 Strategic options were then developed that explored alternative subsea HVDC links between the South East of England and East Anglia that could provide the reinforcement required. This work identified that a connection between East Anglia and Richborough in Kent provided this reinforcement, this was then reflected in the subsequent 2019/2020 NOA.

2.1.5 Additional network studies in East Anglia were then undertaken to confirm which connection point provided the best value to customers whilst minimising potential environmental and socio-economic impacts. These studies identified that the HVDC Link needed to connect into the Sizewell area in order to maximise the system benefit.

[1] https://www.nationalgrideso.com/research-publications/etys

[2] https://www.nationalgrideso.com/research-publications/network-options-assessment-noa

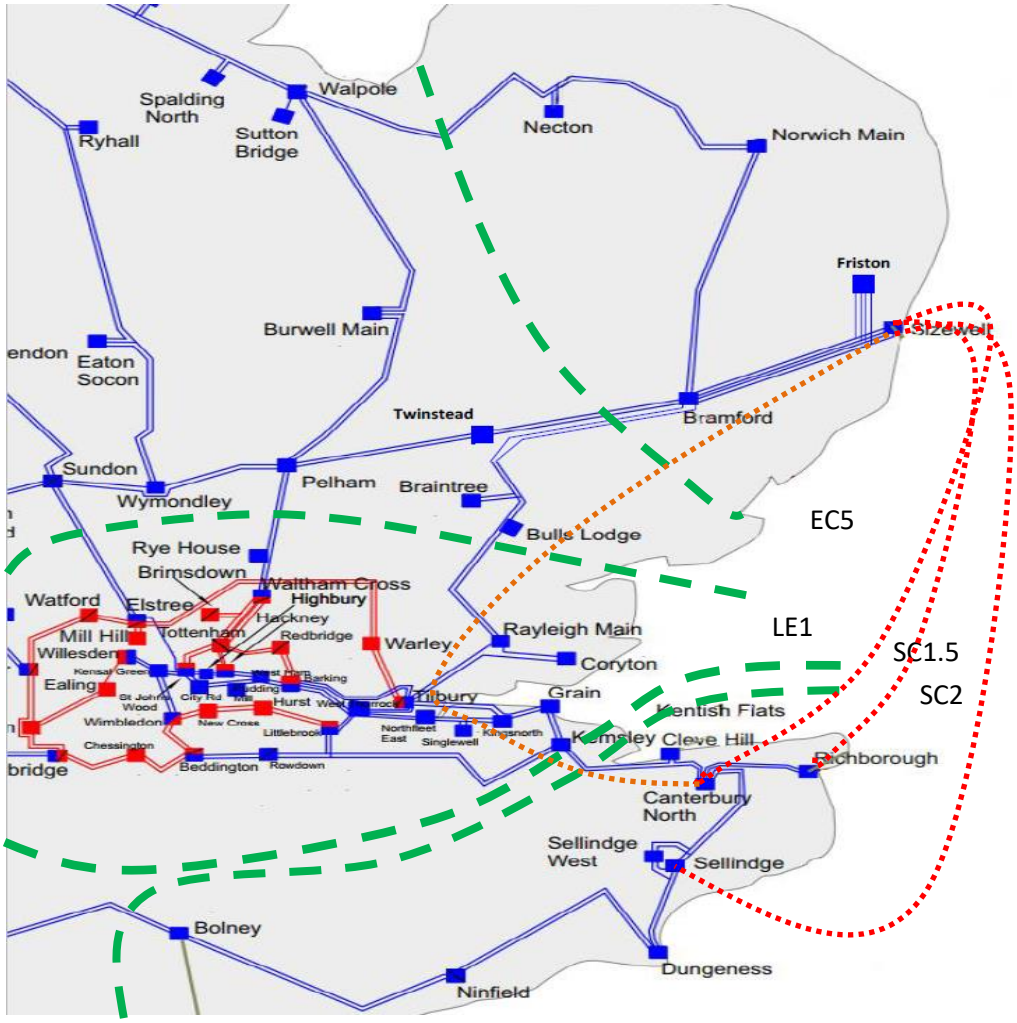
2.2 Strategic Options

Sea Link Strategic Options

2.2.1 Four Strategic Options were considered to address the Sea Link need: These were:

- SL1 – Sizewell Area to Sellindge subsea – approx. 180km
- SL2 – Sizewell Area to Richborough subsea approx. 120km
- SL3 – Sizewell Area to Canterbury subsea approx. 120km
- LL 1 – Sizewell Area to Canterbury onshore approx. 220km

Figure 2-1 Schematic of Sea Link Strategic Options



2.2.2 As part of the Strategic Optioneering for Sea Link, National Grid considered the:

- technology options available for each potential Strategic Option for transmission system reinforcement;
- environmental and socio-economic constraints relevant to each option; and

- lifetime costs of each technology option as well as the initial capital cost.

Technical Comparison

Technology Issues

2.2.3 Two offshore technologies were considered for potential connections. There is some operational experience of offshore HVDC systems, but there is limited experience of 400kV Alternating Current (AC) subsea cable installation and operation for the connection distances considered.

2.2.4 Four onshore technology options were considered for the potential connections. There is extensive operational experience of both OHL and underground cables but limited experience of Gas Insulated Lines (GIL) and onshore HVDC for the connection distances considered.

Additional System Benefits

2.2.5 The strategic options were assessed as to whether they offer any major additional system benefits for the transmission system beyond meeting the identified reinforcement need. Such benefits are considered because some degree of future-proofing may negate the need for further reinforcement works in the near future.

Cost Comparison

2.2.6 **Table 2-1** below provides a comparison of options based upon the lowest economic technology choice for each option.

Table 2-1 Cost Summary of Sea Link Strategic Options

	SL 1 – Sizewell Area to Sellindge	**SL2 – Sizewell Area to Richborough**	**SL3 – Sizewell Area to Canterbury**	**LL1 – Sizewell Area to Canterbury**
Economic Technology (Capacity)	HVDC 215km (2000MW)	HVDC 145km (2000MW)	HVDC 145km (2000MW)	AC OHL 265km (6380MW)
Capital Cost including non-circuit works	£1,260m	£1,076m	£1,076m	£994m
Circuit 40yr Lifetime Net Present Value (NPV) Cost (Inclusive of circuit Capital cost)	£1,662m	£1,328m	£1,328m	£1,678m

2.2.7 The lowest overall capital cost connection to resolve the need would be LL1. However, this circuit even as an OHL for the complete 265km would not provide the lowest lifetime cost compared to any of the HVDC options.

2.2.8 It should also be noted that LL1 would need to cross the River Thames. It is likely this would need to be done via a cable tunnel adding significant capital cost in the order of £100's m to this option, along with the requirement for any cable mitigation along the route of 265km. All of which would increase capital costs far in excess of the subsea alternatives to meet this specific need due to the capacity requirement only being 2000MW in this case.

2.2.9 The lowest cost subsea option is equal between option SL2 and SL3, a connection from Sizewell Area to Richborough or Canterbury over a distance of 145km utilising a 2000MW Voltage Source Converter (VSC) HVDC connection.

2.2.10 Therefore, on the basis of technical and cost appraisal SL2 or SL3 would represent the most economic and coordinated way to meet the need in this case.

Environmental and Socio-economic

2.2.11 As the onshore alternative in this specific case did not pass the technical and cost filters, environmental and socio-economic evaluation of LL1 was not undertaken.

Sizewell Area

2.2.12 Part of the needs case is to manage requirements under the NETS SQSS and economic criteria from the Sizewell area. Therefore, all options to satisfy the need, are required to start from the Sizewell area in this case.

2.2.13 The coastal areas are part of the Suffolk Coasts and Heaths Area of Outstanding Natural Beauty (AONB), and the Suffolk Heritage Coast extends along the whole coastline within the Sizewell area. The existing Sizewell substation is within both designations.

2.2.14 Onshore at Sizewell, the Sandlings Special Protection Area (SPA), Leiston to Aldeburgh SSSI, the Alde-Ore and Butley Estuaries Ramsar, SPA and Special Area of Conservation (SAC) are located to the south and the Minsmere-Walberswick Ramsar, SPA and SAC, Minsmere – Walberswick Heaths and Marshes SSSI and Sizewell Marshes SSSI are located to the north, a large proportion of which is also designated as a Royal Society for the Protection of Birds (RSPB) reserve.

2.2.15 There are a number of proposed developments in the Sizewell area including the proposed Sizewell C nuclear power station, along with a number of offshore windfarm connections proposing a new substation at Friston.

2.2.16 The area is relatively sparsely populated with the small settlements of Leiston, Knodishall and Friston. Blaxhall, Tunstall, Chillesford and Sudbourne. Ornfordness National Nature Reserve (NNR) which is owned by the National Trust is located to the south.

2.2.17 It is likely that significant effects on the ecology can be avoided or mitigated. Due to the extent of the AONB setting effects of a converter station or substation are likely to be a principal consideration.

2.2.18 In addition, there is a significant amount of proposed development in the vicinity of Sizewell and the settlements of Leiston and Friston which would need to be considered in combination.

Sellindge Area

2.2.19 Thanet Coast and Sandwich Bay SPA, Ramsar and SAC is located along the north and east coasts with the Swale designated sites to the far northwest. Dungeness and Romney Marsh designated sites are present along the south Kent coast and all but the SPA could be avoided with a landfall along the south Kent coast.

2.2.20 Overall, the area is relatively sparsely populated but there are areas of higher population density around Canterbury and Ashford and along the coastal strip including Herne Bay, Margate, Ramsgate, Deal, Dover and Folkstone.

2.2.21 Sellindge substation is located adjacent to the M20 and the High Speed 1 (HS1) corridor and the siting of a converter station close to the existing substation would be in keeping with existing infrastructure in this locality. The existing substation is located within flood zone 3 therefore the extension to this substation is likely to require an exception test to demonstrate no suitable alternatives, however as this is an existing substation this is unlikely to be a significant constraint.

2.2.22 There is designated Heritage Coast within this area at Dover and Folkstone which is avoidable, and the Royal Military Canal runs through to the south. This latter designation would need to be crossed with a landfall on the south Kent coast, however, should standard trenchless construction techniques be used it is likely that any impacts on this designation could be avoided.

Canterbury Area

2.2.23 This area includes the settlement of Canterbury which includes the World Heritage Site of Canterbury Cathedral, St. Augustine's Abbey and St. Martin's. There is a large area of Ancient Woodland to the west and north of Canterbury which in contiguous with Blean complex SAC and West Blean and Thornden Woods Site of Special Scientific Interest (SSSI) with very limited opportunity to avoid all three if a landfall on the north Kent coast is made, in particular when considered in conjunction with other constraints. The Stodmarsh Complex of protected sites is located to the east of Canterbury and together with the existing settlement pattern in this locality could constrain potential future route options.

2.2.24 Canterbury substation is within flood zone 3 therefore the extension to this substation is likely to require an exception test to demonstrate no suitable alternatives, however as this is an existing substation this is unlikely to be a significant constraint. Due to the extent of development around Canterbury Substation there are limited opportunities to site a converter station in close proximity.

2.2.25 Coastal designated sites include The Swale SPA/Ramsar/SSSI and Thanet Coast and Sandwich Bay SPA/Ramsar and Thanet Coast SSSI, when considered individually these designations are avoidable, however, when considered in-combination with other constraints avoidance is unlikely. The former of these designations is designated for both breeding and over wintering populations of bird species therefore the timing of cable installation is considered to be principal consideration. Saltwater Levels and Blean Woods RSPB Reserves are located to the northwest of Canterbury and in-combination with other constraints are considered to be a principal consideration.

2.2.26 The main settlements in this area include Canterbury, Whitstable and Herne Bay. The Kent Downs AONB is located to the south of Canterbury but is likely to be avoidable. The area at Canterbury has a large amount of the Best and Most Versatile (BMV) agricultural land and in addition to this a large amount of high value agricultural land including orchards and vineyards.

Richborough Area

2.2.27 Richborough substation is located on the east Kent coast within Richborough Energy Park. The area around the substation is sparsely populated and the existing substation is surrounded by similar infrastructure.

2.2.28 The majority of the coastline at Richborough is designated as Thanet Coast and Sandwich Bay designated sites and where there are gaps in these designations there is a denser settlement pattern at Deal and Ramsgate. The Stodmarsh designated sites are located to the west.

2.2.29 A large proportion of the area is sparely populated however there is a denser network of settlements around the coast including Herne Bay, Birchington, Margate, Broadstairs, Ramsgate Sandwich and Deal.

2.2.30 Richborough substation itself is partly within flood zone 2 therefore the extension to this substation is likely to require an exception test to demonstrate no suitable alternatives, however as this is an existing substation this is unlikely to be a significant constraint. There are also large areas of flood zone in the area associated with the low-lying coastal marshes and the River Stour. The siting of a converter station close to the existing substation would be in keeping with existing infrastructure in this locality.

2.2.31 There is a large proportion of high value agricultural land within the area associated with vineyards and orchards.

Offshore Marine Environment

2.2.32 Offshore there are number of designated sites including the Outer Thames Estuary SPA, Margate and Long Sands SAC, the Southern North Sea SAC and the Goodwin Sands, Kentish Knock East and Orford Inshore Marine Conservation Zones (MCZs). Whilst the Outer Thames Estuary SPA is likely to be unavoidable it is likely that impacts could be managed through timing and construction practice and therefore this site is not considered to be a barrier to future development. Likewise, the Southern North Sea SAC is designated for harbour porpoise, and it is expected that any potential effects could be managed through timing and construction practices. Margate and Long Sands SAC is considered to be a principal consideration due to the potential for permanent habitat loss associated with cable crossings and protection however this site is avoidable. The offshore MCZs are avoidable when considered in isolation. Coastal designations include the Thanet Coast MCZ/SAC, Thanet Coast and Sandwich Bay SPA/Ramsar, Sandwich Bay SAC, Orfordness – Shingle Street SAC, Alde-Ore Estuary SPA/Ramsar, Minsmere-Walberswick SPA/Ramsar and Minsmere to Walberswick Heaths and Marshes SAC/SSSI and Leiston to Aldeburgh SSSI, whilst unlikely that some degree of interaction with one or more of these sites is unavoidable, through appropriate routeing and mitigation a likely significant effect is likely to be avoidable.

2.2.33 The Outer Thames Estuary is a highly mobile environment. Mobile sediment is considered to be an important consideration as cable spanning or over burial could

result. Within the area in the outer Thames there are extensive areas outside of the main shipping channels which are very shallow principally Kentish Flats, Goodwin Sands, and Sunk Sand. These shallow waters whilst not precluding placement of transmission infrastructure are a consideration for installation methods and in particular any rock placement required for crossings of other infrastructure. This is likely to be a determining factor where any rock placement would result in a reduction of water depth of 5% or more which is generally considered to be unacceptable. Within the area it is unlikely cable crossings could be avoided within the shallow waters of Kentish Flats with a north Kent landfall however it may be possible to avoid shallow water crossings at Goodwin Sands should an east Kent landfall be made.

2.2.34 The primary marine uses within the area include shipping and navigation and fishing, with the most significant port area being the Port of London Authority (PLA). However, the Port of Ramsgate, is also present and the dredged channel for the Ports of Harwich and Felixstowe extends into the area. The main shipping channels into the Port of London include Princes, Black and Borrow Deep which converge into the Yantlet Channel that extends up the inner Thames. Due to the shallow and mobile nature of the seabed within the Thames Estuary a number of these channels are dredged to facilitate access for the larger vessels along with channels into both Ramsgate, Harwich and Felixstowe. Shipping channels, in particular, those which are dredged are considered to be a primary determining factor as dredging could result in the exposure and potential damage to the cable.

2.2.35 Within the area other marine infrastructure is present including Kentish Flats, Thanet, London Array, Greater Gabbard and Galloper offshore wind farms and export cables, BritNed and Nemo Link interconnectors and the proposed NeuConnect and GridLink Interconnectors. Whilst the offshore wind farms are avoidable, it is unlikely that crossings of cables, could be avoided entirely. As discussed above where these crossings can't be avoided in shallow waters such as Kentish Flats this is considered to be a principal consideration due to potential reduction in water depth. Whilst (with the exception of the Outer Thames Estuary SPA, Southern North Sea SAC and cable crossings) most constraints in the marine area are avoidable when considered in isolation, when considered in combination avoidance may not be possible.

Environmental and Socio-economic Overview

2.2.36 Aligned with the technical and cost appraisal, the environmental and socio-economic appraisal highlights issues in each of the most viable option locations. However, none of the environmental and socio-economic options outweigh each other or present an issue that would move away from the most economical technical option being the right solution. The current evidence supports locating the option between the Sizewell area and Canterbury/Richborough (or a point in-between) that supports a solution based on the overall technical, cost, environmental and socio-economic considerations for the connection to meet the need set out.

Conclusions

2.2.37 NGET has a key role providing a transmission system which benefits all consumers in England and Wales. Where new network infrastructure is needed National Grid must work within the regulatory, legislative and policy framework that is set by government on behalf of consumers and society in developing proposals. That means considering

the various impacts that potential works could have, including: the cost to consumers, technical, environmental and socio-economic.

2.2.38 NGET have considered the information which is available at this stage of the process and will continue to review and back check this information. In addition to this, NGET have also considered:

- duties under the Electricity Act 1989 to develop efficient, co-ordinated and economical solutions; and
- the advice and guidance provided by Government through the National Policy Statements EN1 and EN5:

2.2.39 Taking all of this into account, NGET are currently proposing to take forward the lowest cost overall offshore HVDC option to meet the need to increase capacity across the Sizewell group and Kent boundaries. The lowest cost subsea option is equal between option SL2 and SL3 a connection from Sizewell Area to Canterbury or Richborough utilising a 2000MW VSC HVDC connection. From an environmental and socio-economic perspective SL2 was preferred to SL3 due to the marine constraints off the north Kent coast and onshore siting opportunities close to Canterbury substation. As such SL2 was identified as the preferred strategic option for Sea Link.

2.2.40 It was recommended in the NOA 2020/2021 that a new offshore HVDC link (SCD1) between Suffolk and Kent be taken forward. On completion of strategic options appraisel an HVDC link between the Sizewell area in Suffolk and Richborough in Kent was taken forward to the detailed routeing and siting appraisal stage (**Figure 2-2**).

2.2.41 The preferred strategic option identified is an HVDC connection between Richborough substation in Kent and the Sizewell area in East Anglia rather than a specific connection point. The routeing and siting appraisal has:

- provided more detailed information and understanding regarding constraints and opportunities associated with connecting an HVDC link at the existing Sizewell and Richborough substations.
- considered whether it might be more appropriate to connect into the proposed 400kv substation at Friston or the proposed 400kV substation at Sizewell or a new substation connected to the 400kV transmission lines that run between Sizewell and Bramford, within the defined study area (**Figure 2-3**)**.**

2.2.42 Therefore, more detailed routeing and siting work has been undertaken and the study findings and recommendations are presented in this report.

Figure 2-2 Richborough to Sizewell Strategic Proposal

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RICHBOROUGH

National Grid - Substation	56 : RAYLEIGH MAIN 400KV S/S
ID : Substation name	58 : RICHBOROUGH - DIGITISED
11 : BRADWELL 132KV S/S	62 : SELLINDGE 400KV S/S
13 : BRAINTREE 400KV S/S	63 : SELLINDGE 400KV S/S
15 : BRAMFORD 400KV S/S	64 : SELLINDGE 400KV S/S ICB ASSETS
16 : BULLS LODGE 400KV S/S	65 : SINGLEWELL 400KV S/S
18 : CANTERBURY NORTH 400KV S/S	66 : SIZEWELL 400KV S/S
23 : CLEVE HILL 400KV S/S	67 : TILBURY 275KV S/S
24 : CORYTON SOUTH 400KV S/S	68 : TILBURY 400KV S/S
33 : GRAIN 400KV S/S	75 : WEST THURROCK 400KV S/S
39 : KEMSLEY 400KV S/S	83 : LONGFIELD TEE - DIGITISED
41 : KINGSNORTH 400KV S/S	84 : MAIDSTONE - DIGITISED
44 : LITTLEBROOK 400KV S/S	85 : CORRINGHAM - DIGITISED
53 : NORTHFLEET EAST 400KV S/S	86 : ISTEAD RISE - DIGITISED

0 5 10 15 20 km

LEGEND

- SIZE-RICH study area
- National Grid - Overhead
  - 400kV
  - 275kV
- National Grid - Substation
  - 400kV
  - 132kV
  - 275kV
  - Other
- Anchorage Point
  - Anchorage area
  - Pilot boarding place
- Listed Building
  - Grade I
- Mooring Cable
- Power line
- Telephone
- Undefined
- GridLink Proposed Route
- NeuConnect Proposed Route
- Ancient Woodland
- Registered Parks and Gardens
  - Grade I
  - Grade II
  - Grade II*
- Ramsar
- Special Protection Area (SPA)
- Special Area of Conservation (SAC)
- SAC with Marine Components
- Site of Special Scientific Interest (SSSI)
- Anchorage area
- Dredged Channel
- Urban Settlement (DCLG OS Dataset)
- Aquaculture
- Protected Wreck
- World Heritage Site
- Area of Natural Beauty (AONB)
- Scheduled Monument Location
- Scheduled Monument Boundary
- Marine Conservation Zone (MCZ)
- RSPB Reserve
- Offshore Wind Farm
- Minerals Aggregate

Rev	Date	Description	GIS	Chk	App
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Scheme: SEA LINK

Document Title: RICHBOROUGH - SIZEWELL STRATEGIC PROPOSAL

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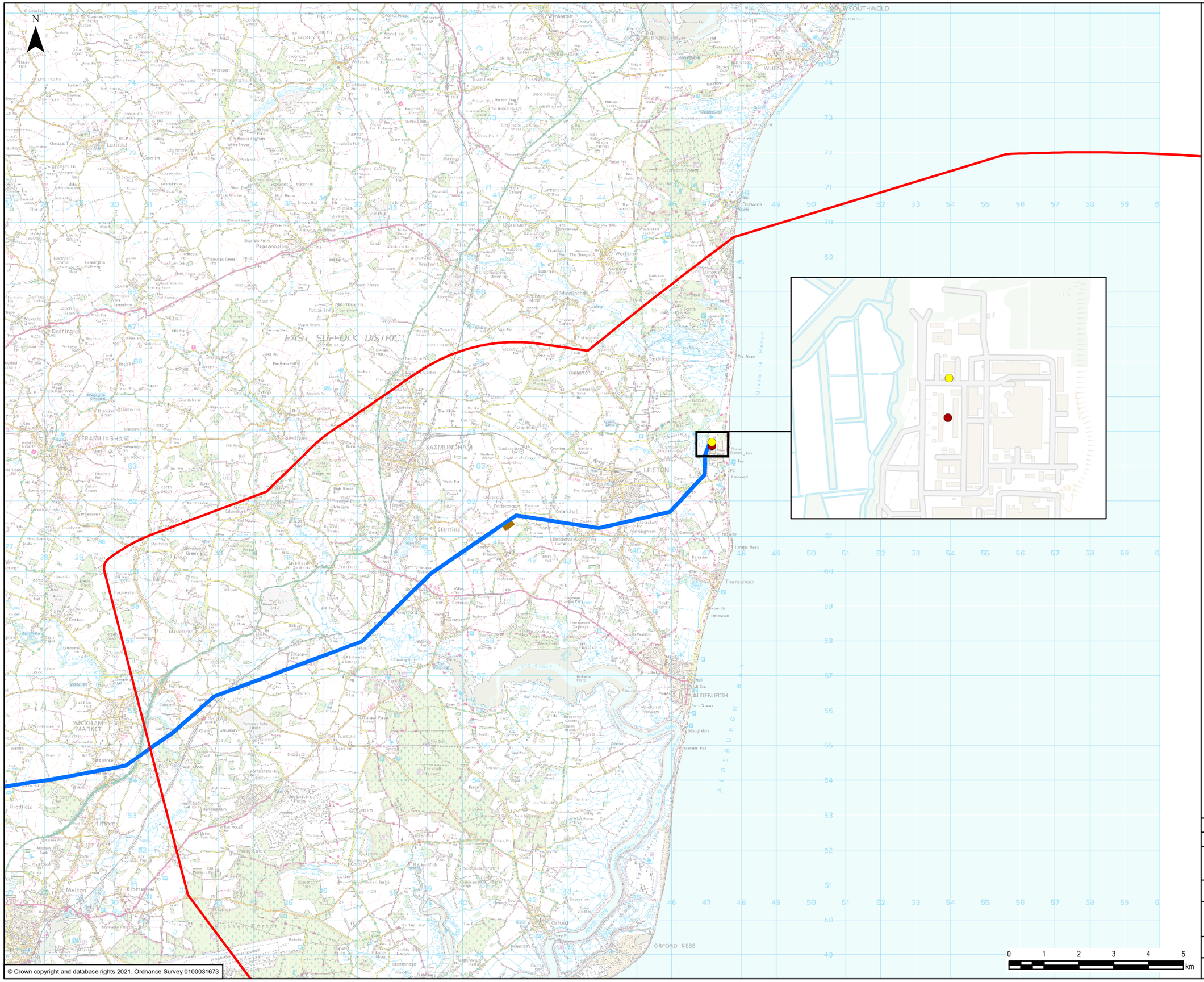
Figure 2-3 Potential Connection Points in Suffolk



Legend

- Project Study Area
- Indicative Location of Proposed Sizewell Substation
- Existing Sizewell Substation
- 400kV Overhead Line
- Proposed Friston Substation

Rev	Date	Description	GIS	Chk	App
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Scheme: SEA LINK

Document Title: POTENTIAL CONNECTION POINTS IN SUFFOLK

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3. Project Description

3.1.1 The existing electricity transmission systems in England and Scotland both operate using predominantly HVAC. Subsea electrical links often use HVDC technology because it is more effective at transmitting large amounts of electricity over longer distances, with lower energy losses than an equivalent HVAC system, and with a greater degree of control over the magnitude and direction of power flow. This flexibility brings operational benefits; however, specialist electrical equipment is required to convert from HVDC to HVAC and vice versa. This equipment is contained within a converter station.

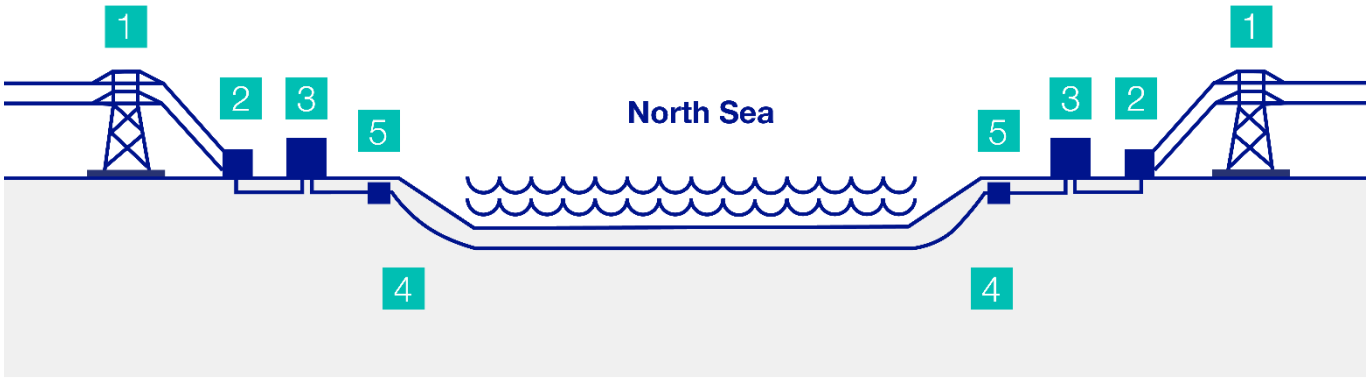
3.1.2 The purpose of the routeing and siting work has been to identify emerging preference locations for the equipment necessary to make the proposed HVDC connection including:

- extension of the existing Richborough 400kV Substation;
- new converter station within 5km of Richborough Substation and HVAC connection back to the substation;
- underground HVDC cable route from the new converter station to a landfall on the Kent coast;
- marine HVDC cable route from a landfall on the Kent coast to a landfall on the Suffolk coast;
- underground HVDC cable from a landfall on the Suffolk coast to a converter station;
- new converter station within 5km of the existing Sizewell 400kV Substation or the proposed Friston or Sizewell Substations or the existing 400kV OHL within the project study area as shown on **Figure 2-3**; and
- extension to the existing Sizewell substation or, extension to the proposed Sizewell substation that would be delivered as part of the Sizewell C Nuclear Power Station Project or an extension to the proposed Friston substation that would be delivered as part of the East Anglia One North and Two Offshore Wind farm Projects, or, where it provides a better alternative, a new substation somewhere along the existing 400kV OHL within the study area as shown on **Figure 2-3**.

3.1.3 The options appraisal summarised in this report considers only the siting and routeing of the key components of the Project as described above; it does not consider the details of potential layouts, permanent access requirements, or any auxiliary works that may be required to connect to the existing infrastructure. Furthermore, the options appraisal does not consider construction works including requirements for construction compounds, temporary construction access, diversions and the installation of temporary structures. These temporary components and activities will be subject to appraisal as the Project progresses to the next stage of development.

3.1.4 **Figure 3-1** shows a schematic diagram of the proposed works.

Figure 3-1 Schematic of the Proposed Works



HVAC Electricity	HVDC Electricity	HVAC Electricity

HVAC = High Voltage Alternating Current
HVDC = High Voltage Direct Current

1. Existing network
2. Substation
3. Converter station
4. Underground cable
5. Transition joint bay

3.1.5 As the Project is still at the early stages a detailed project description of construction activities and methods is not presented however, the assumptions set out below have been used when undertaking this routeing and siting study.

3.1.6 The HVDC cable would be buried in the terrestrial environment; in the marine environment it would mostly be buried, although there is some potential for areas of surface lay requiring rock protection, particularly where existing cables or pipelines need to be crossed.

3.1.7 There are a number of burial methods for cable installation, however it is assumed at this stage of the Project and subject to further site investigation that the likely installation method within the terrestrial environment would be open cut trenches within which the cables would be laid, being subsequently backfilled once cable laying sections are complete. Trenchless techniques such as Horizontal Directional Drilling (HDD) would be used to cross some features where open trench construction would not be possible or advisable. This could include beneath railway lines, selected roads and main rivers, and also to cross areas designated for their nature conservation value where open cut techniques could have a substantial impact, technical restrictions permitting. A working corridor width of 40m and 100m has been assumed for the HVDC and HVAC terrestrial cable works respectively.

3.1.8 At landfall, where possible and required a trenchless technique would be used to minimise disturbance to the intertidal area and adjacent terrestrial habitats. The marine HVDC cable would extend up to the Transition Joint Bay (TJB) where it would join the terrestrial underground HVDC cables.

3.1.9 Within the marine environment, whilst the specific cable lay method has not yet been confirmed, a working corridor of 500m has been assumed as a realistic corridor within which installation activities could occur. The following methods likely to be used:

- Simultaneous cable lay and burial.
- Post-lay burial of the cable.

4. Purpose of this Report

4.1.1 This report describes the work undertaken to date to inform the identification of the emerging preference end-to-end solution for the Project. The purpose of this report is to provide stakeholders with an understanding of the information used to inform the options appraisal work and the decision-making process. This will enable statutory consultees and other stakeholders to provide feedback on the approach taken and to obtain the informed views of the stakeholders and local communities on National Grid's emerging preference for the end-to-end project.

4.2 Structure of this Report

4.2.1 The remainder of the report is structured as follows:

- **Chapter 5:** Approach to Routeing and Siting
- **Chapter 6:** Environmental and Socio-economic Appraisal Methodology
- **Chapter 7:** Options Appraisal - Marine
- **Chapter 8:** Options Appraisal – Terrestrial - Kent
- **Chapter 9:** Options Appraisal – Terrestrial - Suffolk
- **Chapter 10:** Emerging Preference
- **Chapter 11:** Graduated Swathe
- **Chapter 12:** Next Steps

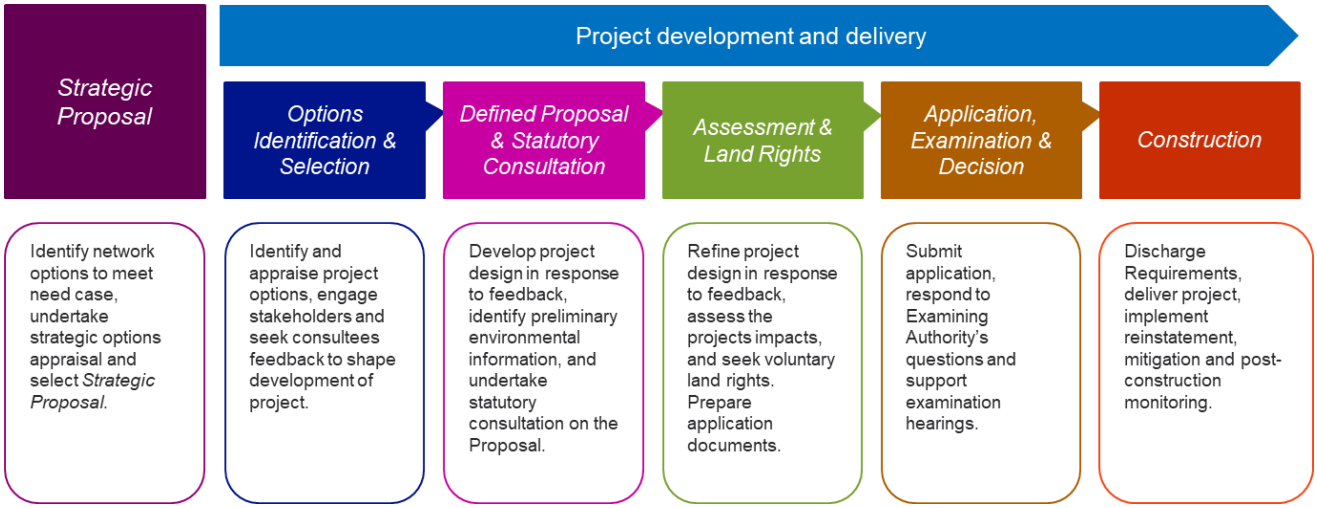
5. Approach to Routeing and Siting

5.1.1 A staged approach has been adopted to identify corridors and potential preliminary routeing and siting options for the Project. This approach has considered the potential effects on the environment, the local community, relevant spatial planning policy and planning applications, other existing and proposed developments as well as technical and engineering design considerations.

5.1.2 The aim of the approach is to identify emerging preferences for landfall, converter stations and potential substation sites that could be developed and potential route corridors within which preliminary alignments could be developed.

5.1.3 An overview of National Grid's approach to developing, consenting and delivering projects is provided on **Figure 5-1** below[3].

Figure 5-1 National Grid's Approach to Project Development and Delivery



5.1.4 The Project is currently within the Options Identification & Selection stage; a summary of the main objectives of the various stages of the consenting process is provided below.

- **Options Identification & Selection** – this includes identifying the Project study area, mapping constraints, identifying, and appraising corridor and siting options to identify a preferred option and working with stakeholders to reach these decisions, consulting the public on our preferred option and considering feedback, and screening for Environmental Impact Assessment (EIA).
- **Defined Proposal & Statutory Consultation** – this stage in the development of a project design considers, the views of various stakeholders. This stage includes statutory consultation on the draft proposals and initial environmental information and builds upon any amendments made following the informal consultation stage.
- **Assessment & Land Rights** – this includes refining designs and any required mitigation, environmental and other site surveys, negotiating land rights and

[3] National Grid, April 2022, Our Approach to Consenting

other agreements, environmental assessment of the project, and production of planning application documents.

- **Application & Decision** – submission of planning application and responses to any questions asked by statutory consultees.
- **Construction** – procure and appoint Main Works Contractor, development of any detailed designs where required, agreement of any minor amendments if required, discharge and pre-commencement planning conditions, early enabling works (site establishment, bellmouths, access), construction, and undertake any reinstatement, implement mitigation measures, and ongoing monitoring.

5.1.5 Each of the elements identified have been appraised in accordance with National Grid's approach to options appraisal[4]. This guidance has been developed by National Grid to provide a thorough and consistent approach to the appraisal of network reinforcement options; it represents a best practice approach to inform decision-making. The aim is to ensure that decisions regarding the technology options and/or location of infrastructure are based upon a full understanding of the implications of each option, using a wide range of criteria.

5.1.6 In addition to the above and in the absence of any specific siting guidance for converter stations, the Horlock Rules[5] have been used when identifying and appraising converter site option areas.

5.1.7 **Table 5-1** presents the topics and criteria that are considered which has been informed by National Grid's Option Appraisal Guidance and additional topics have been listed to include for the assessment of the marine HVDC element of the Project.

Table 5-1 Appraisal Topics

Environment	Socio-economic	Technical	Cost
Landscape and visual	Settlement and Population	Technical Complexity	Capital cost
Historic environment (terrestrial and marine)	Tourism and Recreation (terrestrial and marine)	Construction / project delivery issues	Lifetime cost
Biological environment (terrestrial and marine)	Infrastructure (terrestrial and marine)	Suitability of Technology	
Physical environment (terrestrial and marine)	Land Use (ownership/type)	Network Capacity	
	Traffic and Access	Network Efficiencies/Benefits	
	Shipping and Navigation	Commercial / regulatory / third party issues	
	Planning - Future development and receptors (including planning applications and allocations,		

[4] National Grid, 2012, Our Approach to Options Appraisal

[5] Microsoft Word - horlock_rules.doc (nationalgrid.com)

Environment	Socio-economic	Technical	Cost
	planning policy designations and marine plans)		

5.1.8 The guidance sets out a methodology for evaluating options and recording when and why certain options have been discounted or progressed to the next stage and is a tool for demonstrating how different considerations informed both the decision-making process and the design evolution of the Project.

5.1.9 Options Appraisal is underpinned by a set of overarching principles that reflect National Grid's statutory duties, which assist in decision-making and help achieve an appropriate balance between competing interests that must be considered in Options Appraisal. These principles are that:

- Using or adapting existing infrastructure will generally be of benefit/advantage compared with creating new infrastructure.
- Shorter routes will generally be of benefit/advantage compared with longer routes, as smaller scale infrastructure projects are generally likely to have lower environmental, safety, sustainability and cost implications (for comparable technology options).
- Financially less-expensive options, both in terms of capital and lifetime cost, will generally be of benefit/advantage, as these support National Grid's statutory duty under Section 9 of the Electricity Act 1989 to develop and maintain an 'efficient, co-ordinated and economical' transmission network.
- Options which avoid or minimise and mitigate impacts on environmental or socio-economic constraints will generally be of benefit/advantage compared with those which have likely significant residual effects, as less environmentally or socially damaging routes support National Grid's statutory duty under Schedule 9 of the Electricity Act 1989 to 'have regard to the desirability of preserving amenity' and will more readily achieve consent.

5.1.10 The guidance sets out the topics (environment, socio-economic, technical and cost) and sub-topics that should be considered as part of the options appraisal. It acknowledges that where appropriate, sub-topics (and potentially whole topics), may be scoped out if it is evident that there would be no material effects as a result of any of the options (because of the nature of the Project), or if they would not assist in distinguishing between the options (because all options would have the same effect). However, as the cost and technical topics do not refer to receptors, but to inherent features of the Project, they are not subject to the same approach to scoping.

5.1.11 The appraisal process comprises the following:

- The collation of relevant data for each sub-topic - for this stage of appraisal relevant data comprises desk study information on internationally, nationally, regionally and locally important receptors.
- Appraising the potential effects of each option - for each constraint, consideration has been given to the nature of the constraint or receptor, its value or sensitivity and how it could be affected by the option, including details of how the effect could be avoided or mitigated. The capital and lifetime costs of the options, based on broad assumptions regarding the technology to be used and the likely length or scale of the project, have been considered.

5.1.12 Following completion of the appraisal of each of the options, discussions have been held by the Project Team to review the findings, challenge judgements made as to the effects of particular options, check understanding and assumptions, and to develop an overall view of the relative performance of each option taking into account the full range of available information. Each of the options has been considered in turn and the extent of any possible environmental or socio-economic impacts or technical issues associated with each option for each of the scoped-in sub-topics has been reviewed in order that a shared understanding regarding the emerging preferred option has been reached.

5.1.13 The Project specific marine survey (geophysical/geotechnical/environmental) was undertaken in Summer 2021 and as such it was determined that it would be beneficial to embark on engagement with marine stakeholders in advance of commencement of the survey to discuss the emerging landfalls and routeing preferences in the marine environment to ensure any feedback that may require/influence route selection/optimisation could be taken into consideration prior to survey starting. This is discussed in more detail in **Chapter 7**.

5.1.14 A broad overview of the stages undertaken to identify the preferred options of the Project is outlined below, with further details on the approach taken at each stage detailed in the relevant chapters of this report.

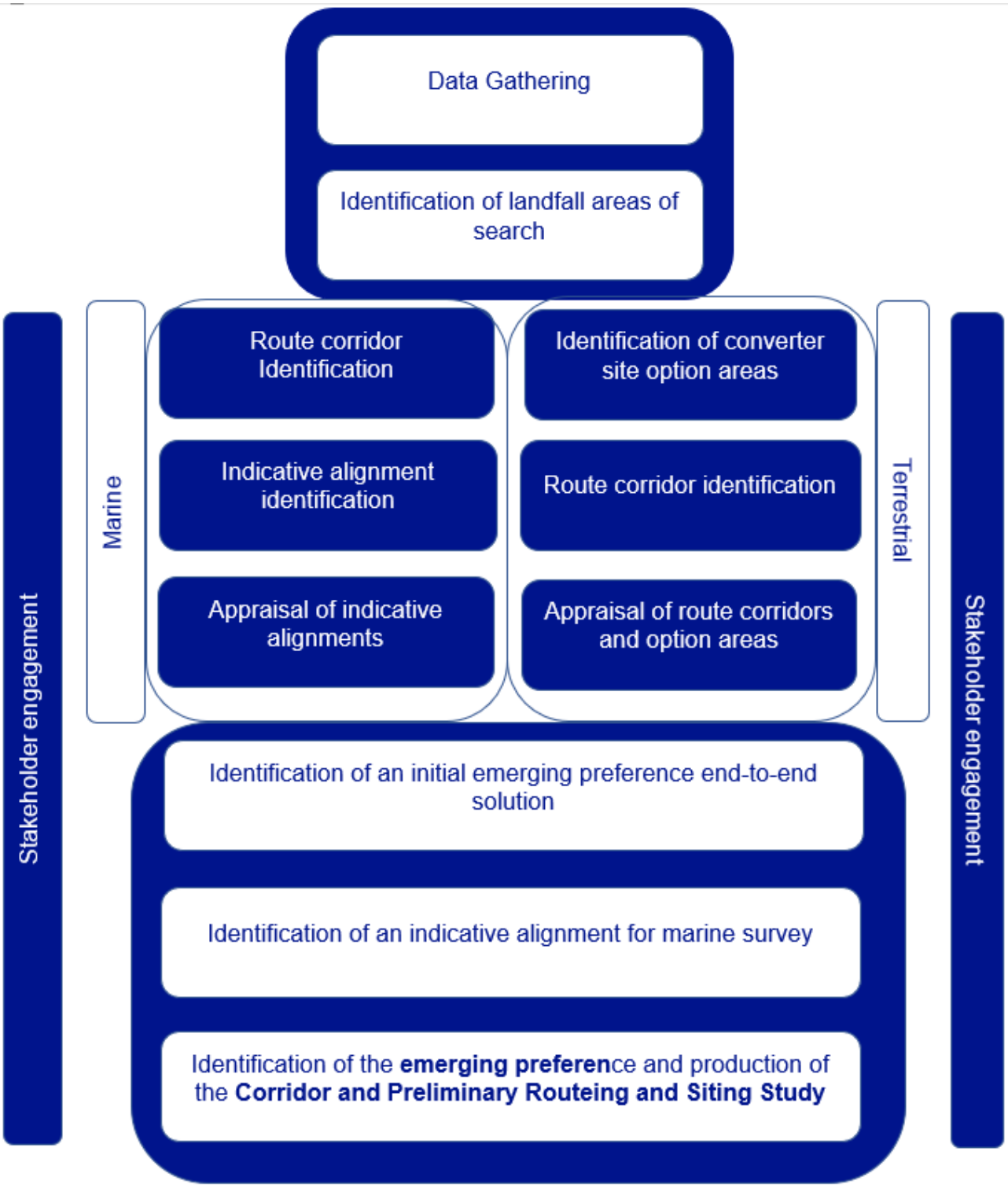
5.1.15 The material environmental, socio-economic, and technical appraisal findings are reported as appropriate in **Chapters 6 to 9**. The costings are provided in **Appendix A**.

5.2 Route Corridor and Site Selection Process

5.2.1 The overarching principle of National Grid's approach is to follow a staged process to routeing and siting, as set out above. This has been applied to the selection of the preliminary routes for the proposed works.

5.2.2 **Figure 5-2** presents the approach taken by the Project; this was based on the initial identification of corridors and siting/search areas, which were subject to further refinement through the review and analysis of available data. The appraisal methodology is described in **Chapter 6**.

Figure 5-2 Routeing and Siting Process



5.2.3 The sections below provide further detail of the process outlined above in **Figure 5-2**. In line with the process shown above there are a number of individual project elements that need to be identified before end to end solutions can be considered.

Element 1: Identification of Landfall Areas of Search

5.2.4 This initial stage involved the identification of areas of potential landfall. This is where the offshore (submarine) cables come ashore and is therefore the interface between the

onshore (terrestrial) and offshore elements of the Project; the marine cables would connect to onshore cables at a buried TJB.

5.2.5 Several landfall areas of search were identified on the Kent and Suffolk coasts based on the following criteria:

- access to the proposed onshore grid connection point (see **Chapter 2**).
- suitability of ground conditions (e.g., areas of low elevation, avoidance of estuarine habitats).
- potential for site access.
- avoidance of existing infrastructure.
- high level consideration of potential key environmental and socio-economic constraints such as populated areas and ecological designations.

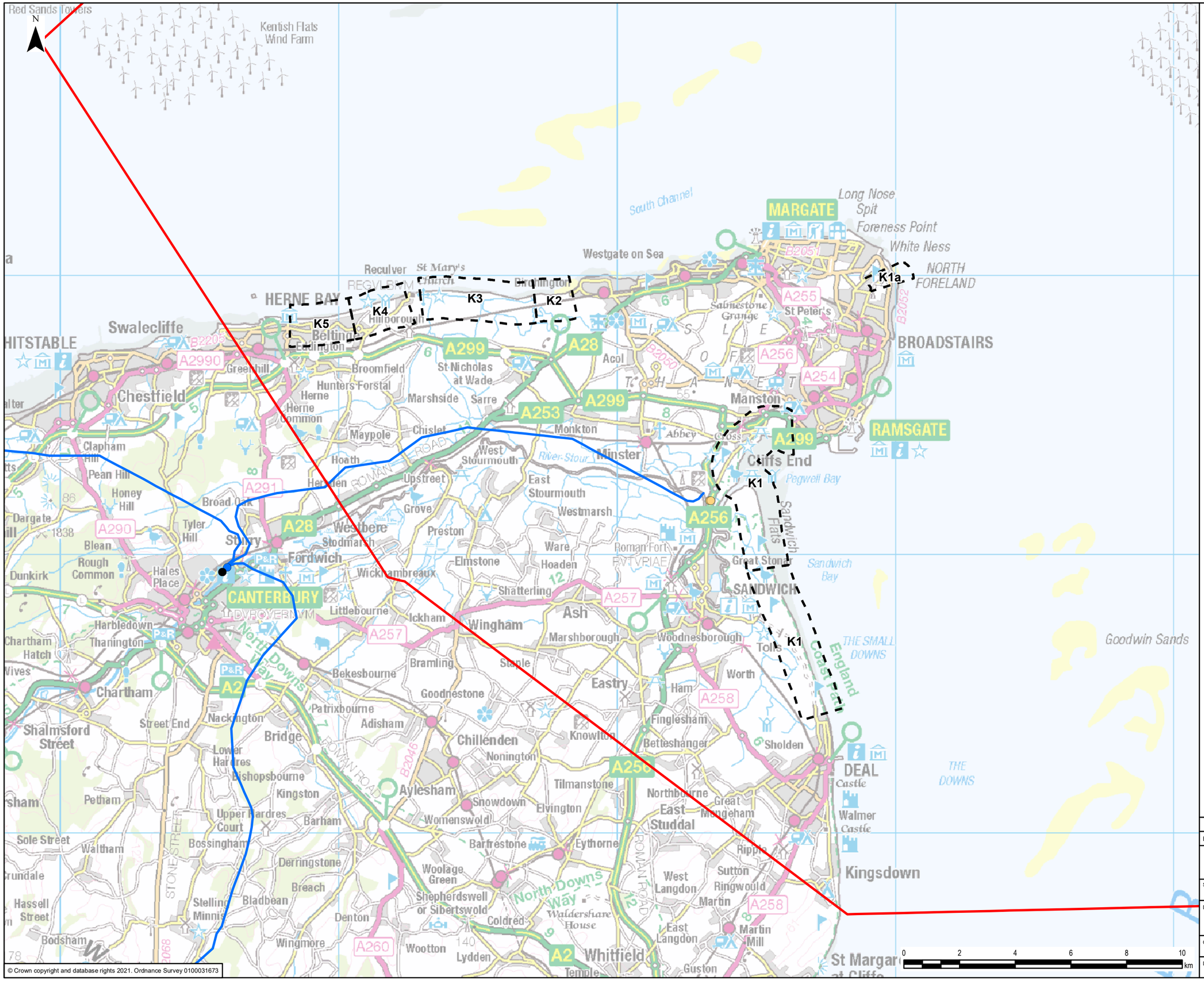
5.2.6 Areas of search were not necessarily ruled out on the basis of environmental and socio-economic constraints and were taken forward in order to be subjected to an initial routeing and siting environmental and socio-economic options appraisal.

5.2.7 **Figure 5-3** and **Figure 5-4** show the identified landfall areas of search for Kent and Suffolk respectively.

Embedded Mitigation and Assumptions

5.2.8 Many of the landfall areas of search included sites designated for their nature conservation interest. It was agreed that, where feasible, trenchless techniques would be used at the landfalls to minimise disturbance to coastal habitats, acknowledging that the installation of cables using trenchless techniques has technological limitations that limit the lengths that can be achieved, limitations will in part be linked to the specific topography and geology of the individual sites, this has been considered initially to ensure it is a viable mitigation at all landfall search locations, but will need to be further validated through detailed geotechnical surveys.

Figure 5-3 Landfall Areas of Search - Kent



Legend

- Project Study Area
- Landfall Area of Search
- 132kV Substation
- 400kV Substation
- Richborough Substation
- 400kV Overhead Line

0 2 4 6 8 10 km

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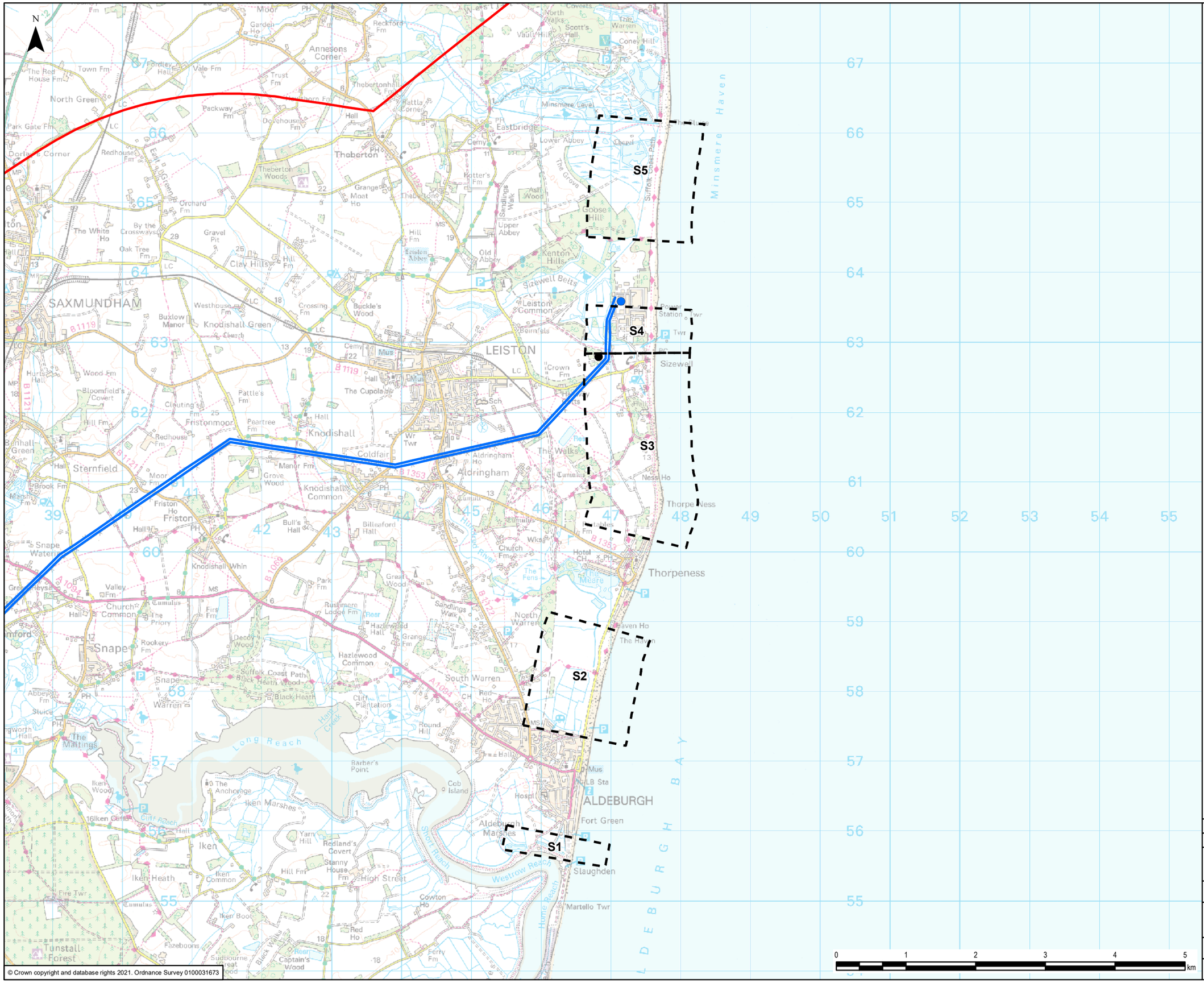
Figure 5-4 Landfall Areas of Search - Suffolk



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- Project Study Area
- Landfall Area of Search
- 132kV Substation
- 400kV Substation
- 400kV Overhead Line

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Element 2: Identification of Marine Corridors and Indicative Alignments

5.2.9 Once landfall areas of search were identified and agreed, it was then possible to begin identifying marine corridors to connect to them (**Figure 5-5**).

5.2.10 Due to the extensive geographical marine study area and large-scale nature of many of the constraint features, in order to perform a meaningful routeing appraisal in the marine environment it was necessary to identify indicative marine alignments within the broader corridors (**Figure 5-6**). A 500m wide corridor has been appraised to incorporate the marine route working corridor and as such a buffer of 250m either side of the indicative alignments was added for appraisal purposes.

5.2.11 The principal driver in defining the marine alignments capable of connecting to the landfall areas of search was then to identify areas that would ensure the long-term integrity and security of the cable whilst also avoiding key constraints. The following design criteria were taken into consideration when developing the marine corridors and marine alignments:

5.2.12 Shortest route possible to minimise the cable length, which in turn reduces the manufacturing and installation cost as well as the environmental and security footprint.

- Designed to avoid environmentally sensitive areas where possible.
- Designed to avoid areas that have restricted movement i.e., anchorages.
- Designed to avoid known wrecks and areas of archaeological importance.
- Designed to avoid offshore installations (renewable, oil/gas, wells/platforms, etc.).
- Designed to minimise crossing of in-service cables and pipelines, where crossings do occur the route has been designed to ensure the crossing angle is optimal and water depth is sufficient for navigational safety.
- Designed to consider shipping density, i.e., anchorage areas, high density shipping lanes.
- Designed to avoid hazardous seabed terrain (e.g., bedrock outcrop and mobile sediments) where possible, ensuring the cable can be protected by achieving an acceptable depth of burial.
- Designed to minimise the impact on third-party considerations including seasonal fishing activities, local tourist trade and military practice zones.

5.2.13 The bathymetry data presented in **Figure 5-5** and **Figure 5-6** shows that the primary constraints for the route corridors/alignments are the mobile sandbanks that define the morphology of the inner and outer Thames Estuary. Avoiding these mobile sandbanks results in the marine corridors/alignments being pushed further offshore. Routeing through the mobile sandbanks would result in an extremely high-risk route because of both the protected nature of the sandbank features, which would possibly render any corridors as un-consentable, and because of the significantly higher maintenance costs, due to the highly mobile nature of the seabed increasing the risk of cable exposure.

5.2.14 Another consideration is that the channels in between the sandbanks in the Thames Estuary are used as main shipping lanes to reach the Port of London potentially posing additional risk to the cable and its ability to be consented. Consideration has also been

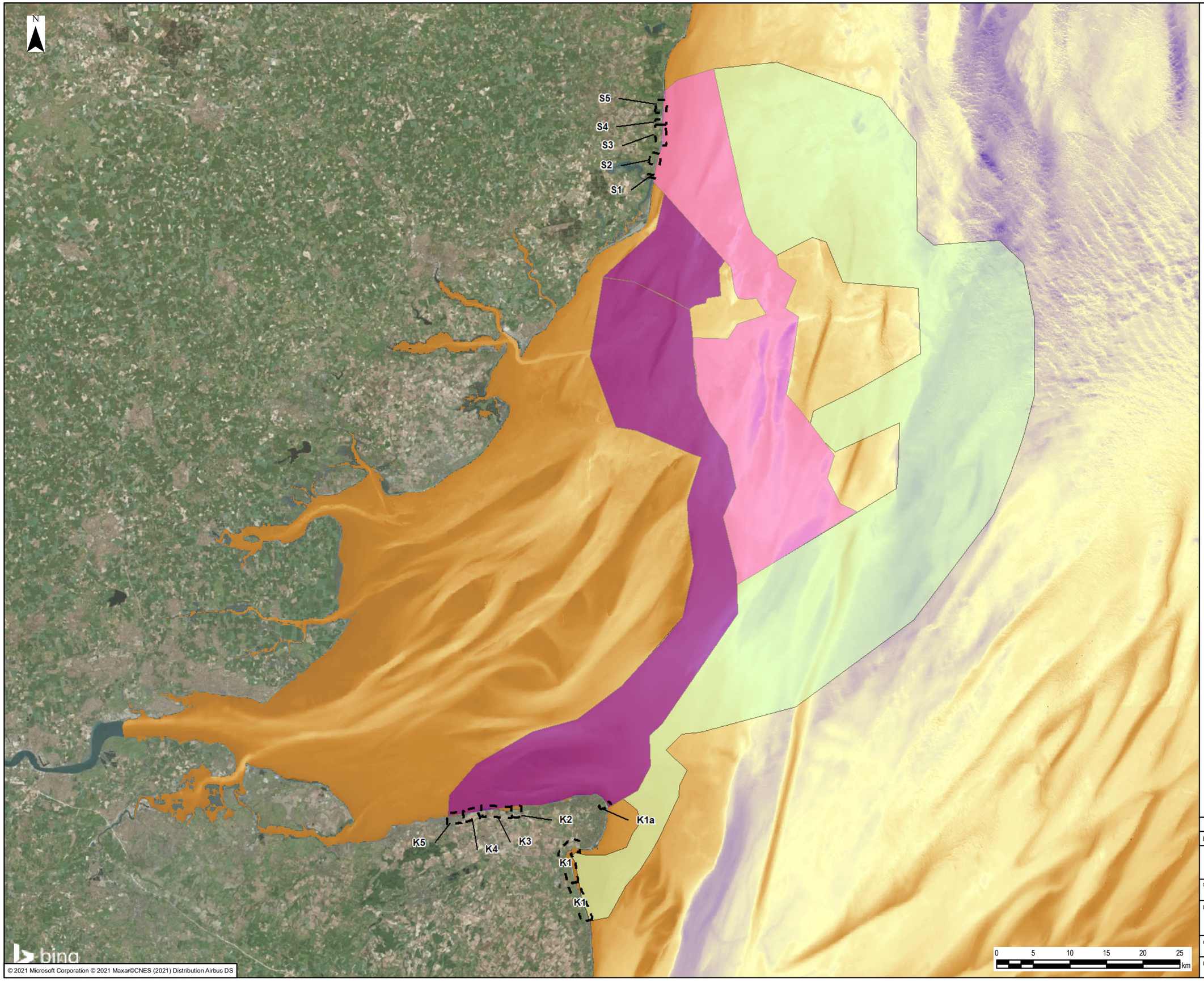
given to the navigational shipping channels that serve the ports of Ramsgate, Harwich and Felixstowe and marine alignments have been designed to avoid/minimise interaction with these channels where possible.

5.2.15 Marine alignment sections are shown on **Figure 5-6.** The sections were named as per the associated landfall area of search. Where routes share a common central section, these were named C1, C2 etc (see **Chapter 7 Figure 7-2** to **Figure 7-4**).

Embedded Mitigation and Assumptions

5.2.16 Considering the design criteria listed above that has been applied when developing the marine alignments, no additional mitigation measures for the marine corridor/alignment options have been included at the routeing and siting stage.

Figure 5-5 Landfall Options and Proposed Marine Corridors



Legend

- Landfall Area of Search
- Marine Corridor 1
- Marine Corridor 2
- Marine Corridor 3

Bathymetry

High : 29.4

Low : -103.85

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Document Title: LANDFALL OPTIONS AND PROPOSED MARINE CORRIDORS

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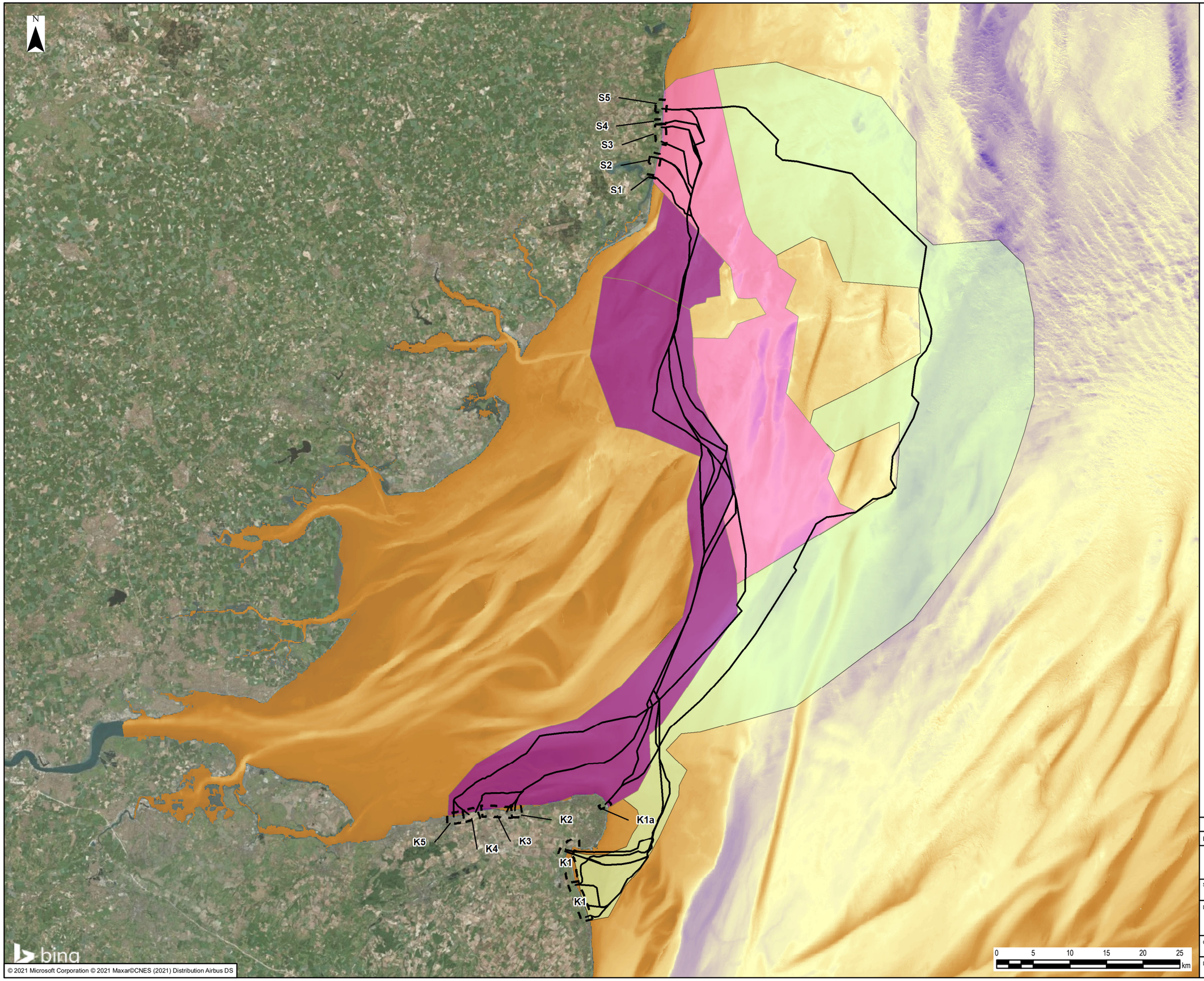
Figure 5-6 Indicative Marine Alignments



Legend

- Marine Alignments
- Landfall Area of Search
- Marine Corridor 1
- Marine Corridor 2
- Marine Corridor 3

Bathymetry

High : 29.4

Low : -103.85

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Document Title: INDICATIVE MARINE ALIGNMENTS

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Element 3: Identification of Terrestrial Zones

5.2.17 The identification of landfall areas of search (Element 1) and the identification of the marine corridors/alignments (Element 2) allowed for the identification of broad terrestrial zones to connect the potential landfalls to the proposed connection points. Whilst high level consideration was given to key constraints, zones were kept as wide as possible to allow for flexibility and to ensure potentially feasible corridors were not discounted prematurely (see **Chapter 8** and **Chapter 9**).

5.2.18 The Kent area was divided geographically based on landfall option areas into three zones; namely the 'North Kent Coast Zone', the 'Broadstairs Zone' and the 'Pegwell Bay Zone' all of which were designed to allow for the development of corridors to connect back to the Richborough Substation site (**Figure 5-7**).

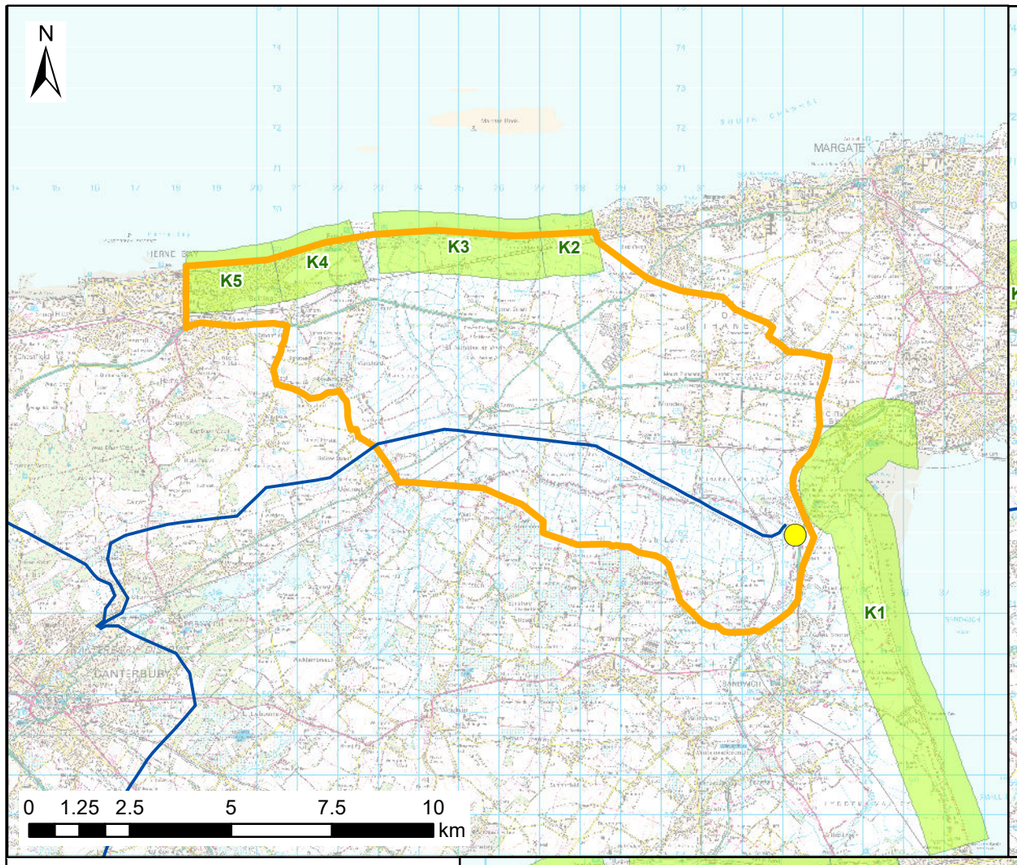
5.2.19 The Suffolk area was divided into three zones based on the connection point referred to as the 'Sizewell to Sizewell Zone' (**Figure 5-8**), the 'Sizewell to Friston Zone' and the 'Sizewell to 4Z Zone' to allow for connections into the existing and proposed Sizewell Substations, the proposed Friston Substation, or potentially a new substation along the existing 4Z OHL within the Project study area.

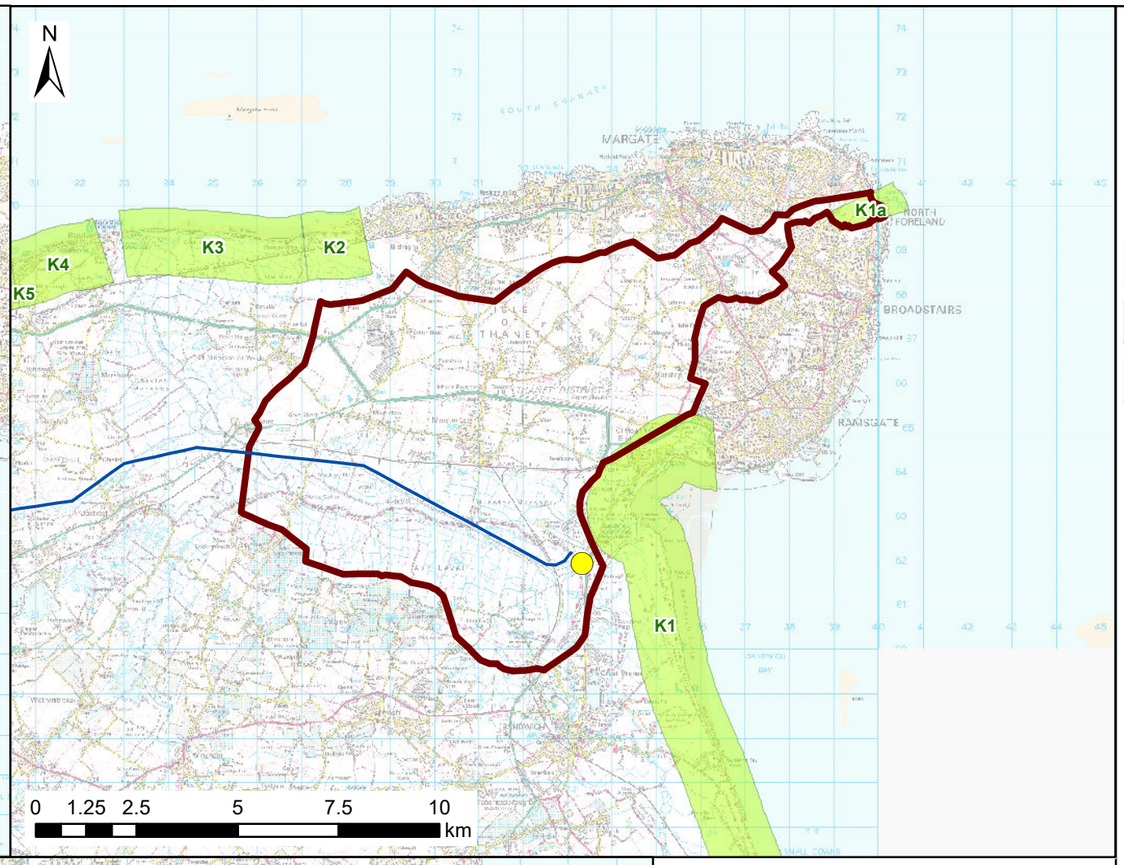
5.2.20 In summary the zones incorporate the following landfall areas of search and allow for the following connections:

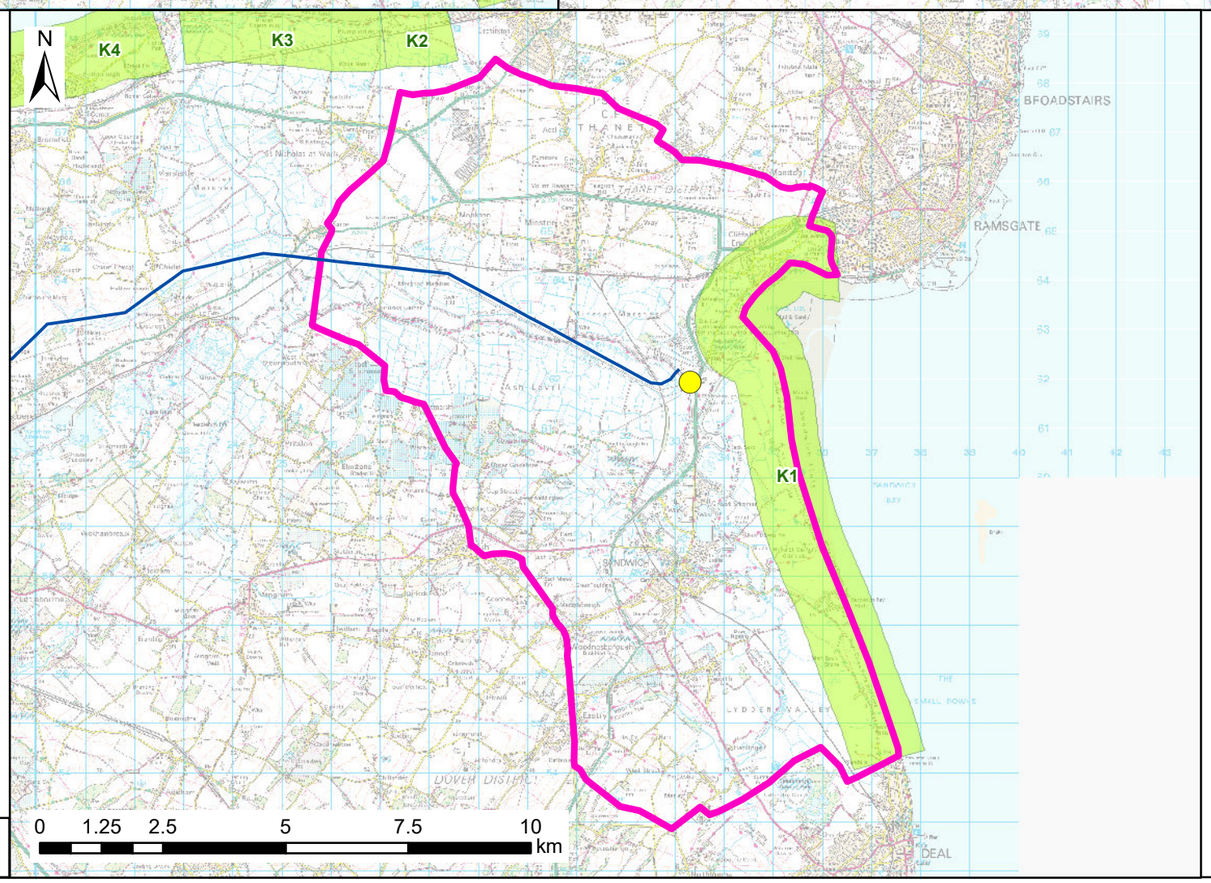
Table 5-2 Terrestrial Zones and Associated Landfalls

Terrestrial Zone	Connection Point	Associated Landfall Option
North Kent Coast	Richborough	K2/K3/K4/K5
Broadstairs	Richborough	K1a
Pegwell Bay	Richborough	K1
Sizewell – Sizewell	Existing or proposed Sizewell substations	S1/S2/S3/S4/S5
Sizewell – Friston	Proposed Friston substation	S1/S2/S3/S4/S5
Sizewell – 4Z Area	New substation along the existing 4Z OHL within the study area	S1/S2/S3/S4/S5

Figure 5-7 Kent Terrestrial Zones







LEGEND

- Richborough Substation
- 400 kV Overhead Line
- Landfall Area of Search
- North Kent Coast - Richborough Zone
- Broadstairs - Richborough Zone
- Pegwell Bay - Richborough Zone

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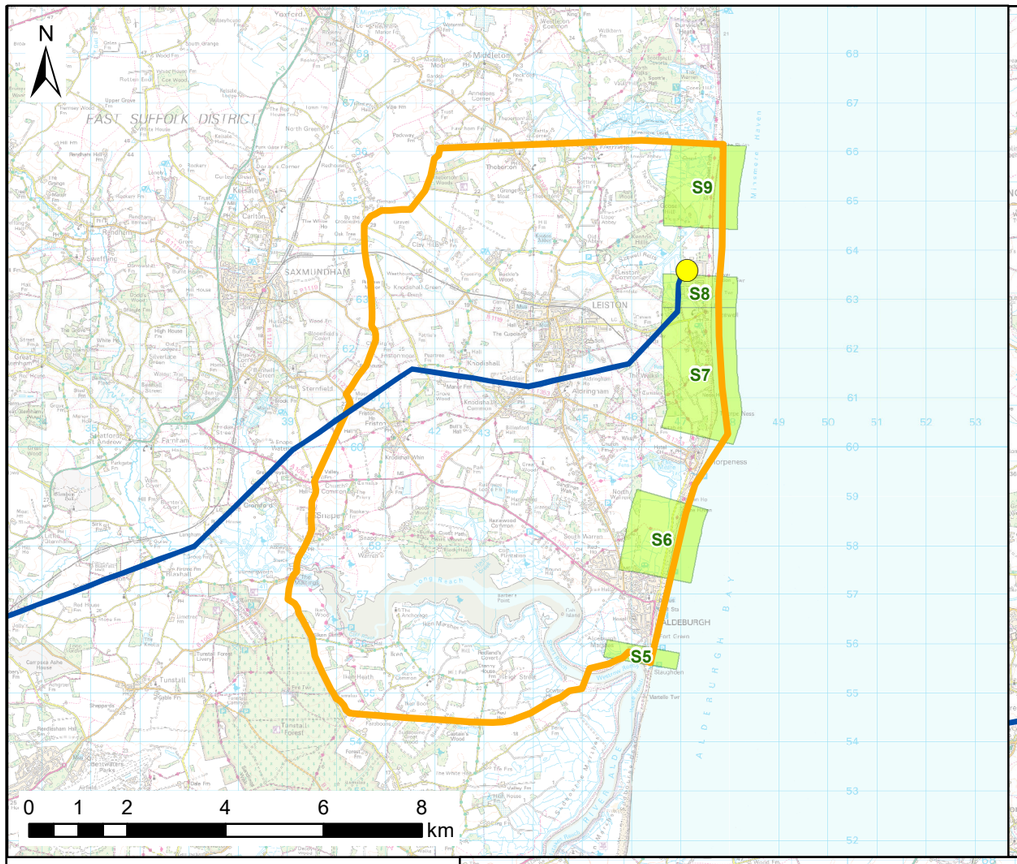
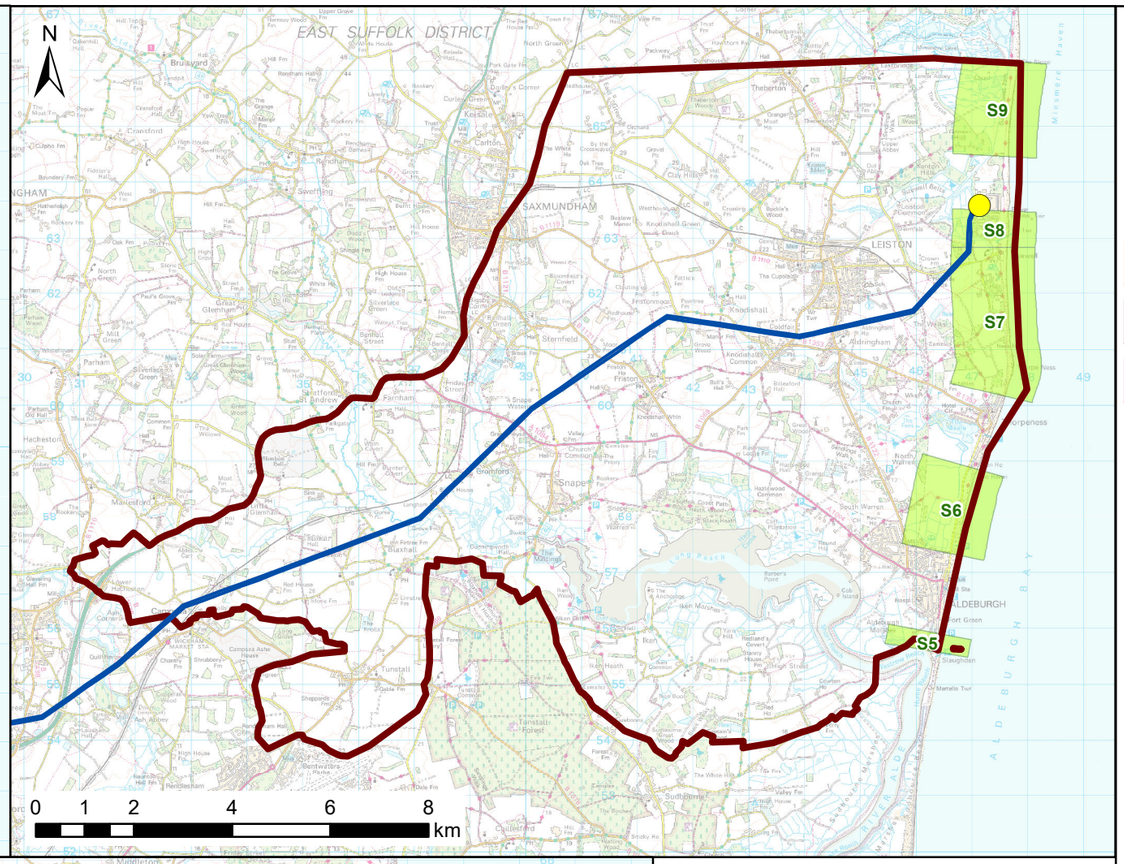
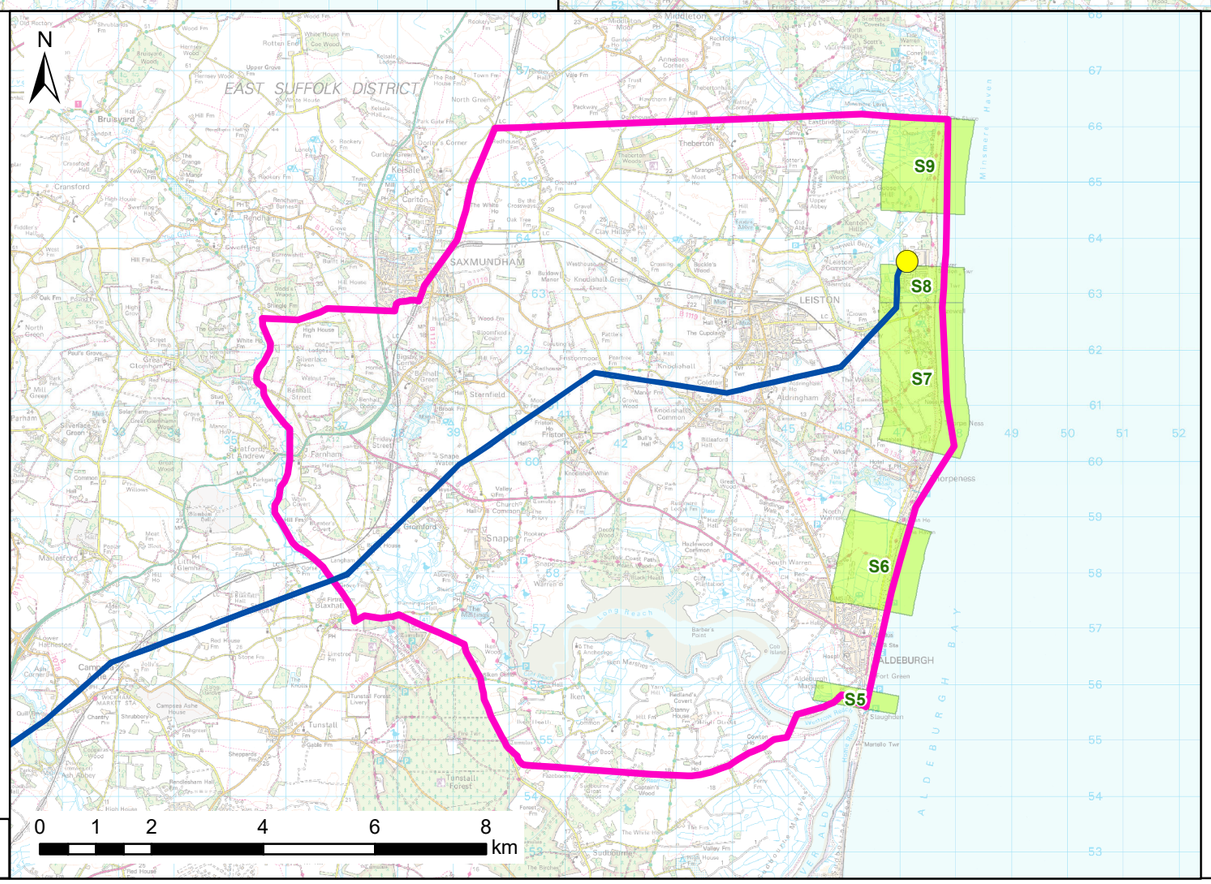
Figure 5-8 Sizewell Terrestrial Zones







LEGEND

● Sizewell Substation

— 400 kV Overhead Line

🟩 Landfall Area of Search

▭ Sizewell - Sizewell Zone

▭ Sizewell - 4Z Area 1 Zone

▭ Sizewell - Friston Zone

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Scheme:
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Document Title:
SIZEWELL TERRESTRIAL ZONES

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Element 4: Identification of Converter Site Option Areas and HVAC Connections

5.2.21 Areas of search for potential converter site locations were limited to within an approximate 5km radius of the identified National Electricity Transmission System (NETS) connection points, this was to ensure as short as possible AC connection between the converter station and connection point. The greater the AC cable length the greater the losses which need to be reduced with the use of reactive compensation equipment, which would result in additional land take and cost.

5.2.22 Due to land use of the Project study area defined by the connection points, there was limited opportunity to identify brownfield sites that could accommodate the technical parameters required. Therefore, the identification of converter site option areas was based on avoidance of designated sites as far as possible, landform, opportunities for natural screening and to minimise visual impacts on settlements.

5.2.23 Converter site option areas have been identified based on supporting the two main converter technologies VSC and Current Source Converter (CSC) as well as the need to co-locate a substation (where required by the connection point).

5.2.24 The areas considered for locating converter stations have been developed to support the following parameters:

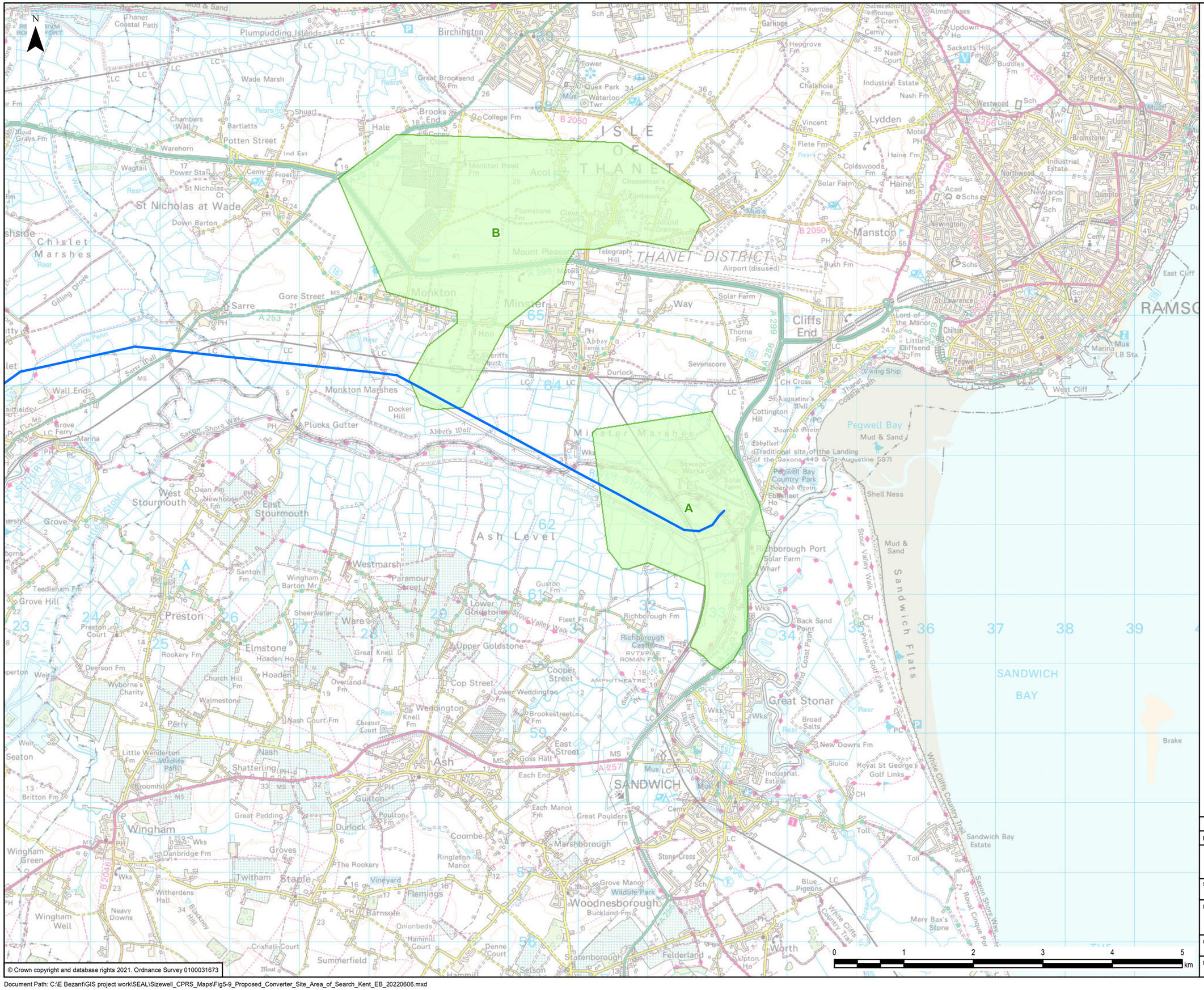
- VSC – 6 hectare site supporting a building footprint of approximately 200x300m and building height of 30m.
- CSC – 10 hectare site supporting a building footprint of approximately 320x320m and building height of 30m.

5.2.25 Converter site option areas within the 5km area for the Kent and Suffolk connection points are shown on **Figure 5-9** and **Figure 5-10** respectively and the connection points and their associated converter site option areas are listed in **Table 5-3**.

Table 5-3 Connection Point and Associated Converter Site Option Areas

Connection Point	Converter Site Option Area
Existing Sizewell 400kV Substation	A,B,C,D,E
Proposed Sizewell C Substation	A,B,C,D,E
Proposed Friston Substation	C,B,D,E,F,G,H
New Substation along existing 4Z line	B, D, E,F,H,I

Figure 5-9 Proposed Converter Site Option Areas - Kent



Legend

- 400kV Overhead Line
- Proposed Converter Site Option Areas

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Document Title: PROPOSED CONVERTER SITE OPTION AREAS - KENT

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FIGURE 5-9	1:50,000	A3	1	0

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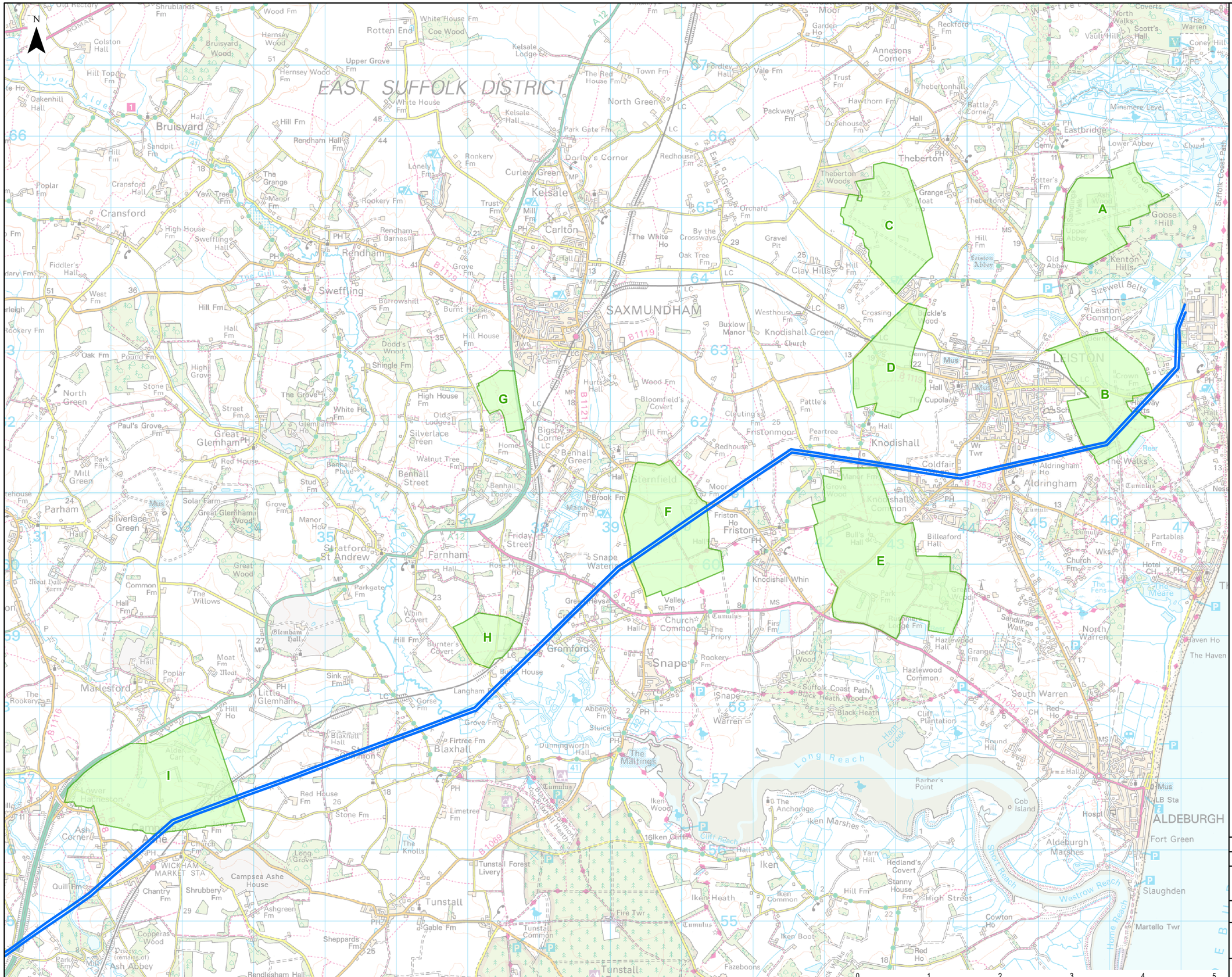
Figure 5-10 Proposed Converter Site Option Areas - Suffolk



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- 400kV Overhead Line
- Proposed Converter Site Option Areas

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FIGURE 5-10	1:50,000	A3	1	0

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Element 5: Identification of Terrestrial Corridors

5.2.26 Having identified the broad terrestrial zones (Element 3) further refined corridors were identified within each zone allowing for connection to each of the identified landfall areas of search (Element 1) and corresponding marine alignments (Element 2)[6], thus allowing for a number of combinations of Suffolk – Kent potential end-to-end solutions to be taken forward for detailed appraisal.

5.2.27 Landfall areas of search K5 and S4 shown in **Figure 5-3** and **Figure 5-4** respectively were discounted due to the complexities and constraints associated with identifying a suitable terrestrial corridor for onshore routeing and are therefore not considered further in this report.

5.2.28 These refined corridors were identified by means of professional judgement, rather than a set of defined parameters e.g., they were not developed to a specified width but were limited by larger constraints such as:

- avoidance of designations where possible;
- avoidance of settlements; and
- consideration of traffic and access opportunities.

5.2.29 This was to allow for maximum flexibility when also factoring in potential technical constraints and to avoid prematurely discounting potentially favourable/feasible alignment options.

5.2.30 High level environmental and socio-economic constraints, such as settlements, existing infrastructure and nature conservation designations were used to limit corridor widths if routeing around them was either not possible or not realistic given available alternatives.

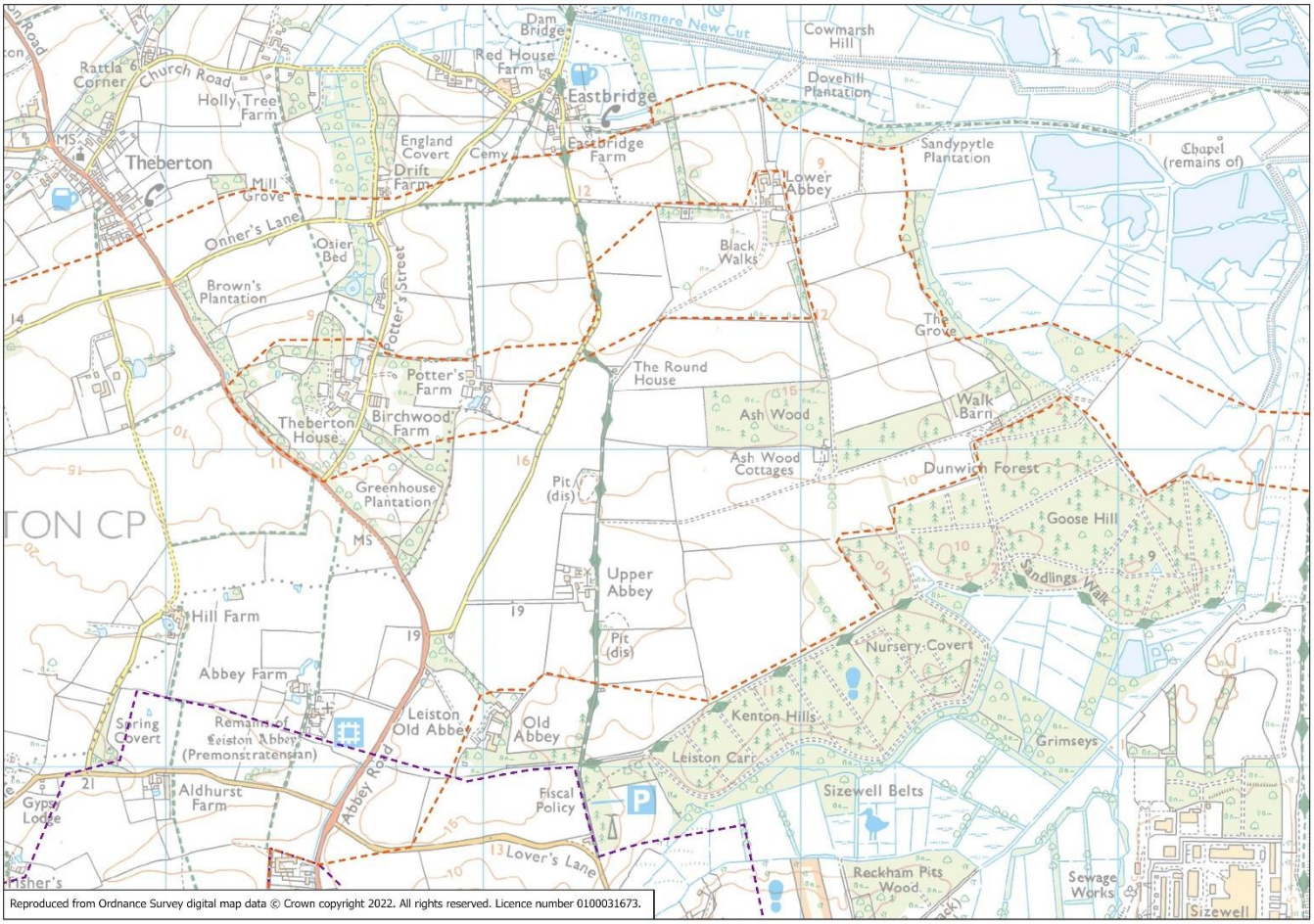
Embedded Mitigation and Assumptions

5.2.31 The potential effects of a cable route are very different depending upon whether the construction uses open cut or trenchless techniques. Open cut cable installation is more economic than trenchless techniques, so it is the preferred technique for substantial lengths of the cable. In addition, typical trenchless techniques used for cable installation can have technical constraints that limit the distance that this technology can be utilised at a given location, this is assessed on a case-by-case basis depending on the findings of technical surveys.

5.2.32 In some instances, the use of trenchless techniques can be used to avoid impacts on key constraints, for example where sites are designated for their nature conservation value cannot be avoided. Other examples include crossing rivers or major infrastructure such as railway lines or motorways.

5.2.33 Smaller constraints, such as individual properties or small wooded areas that could be easily routed around, were left inside corridors or excluded as ‘islands’ as shown on the following image.

[6] As shown in Figure 5-2 the identification of indicative marine alignments (Element 2) and identification of terrestrial corridors (Element 5) occurred in parallel and helped to inform each other i.e. where no onward terrestrial corridor was identified no marine alignment to that area of landfall was brought forward as such marine alignment section S4 was not brought forward for further appraisal.



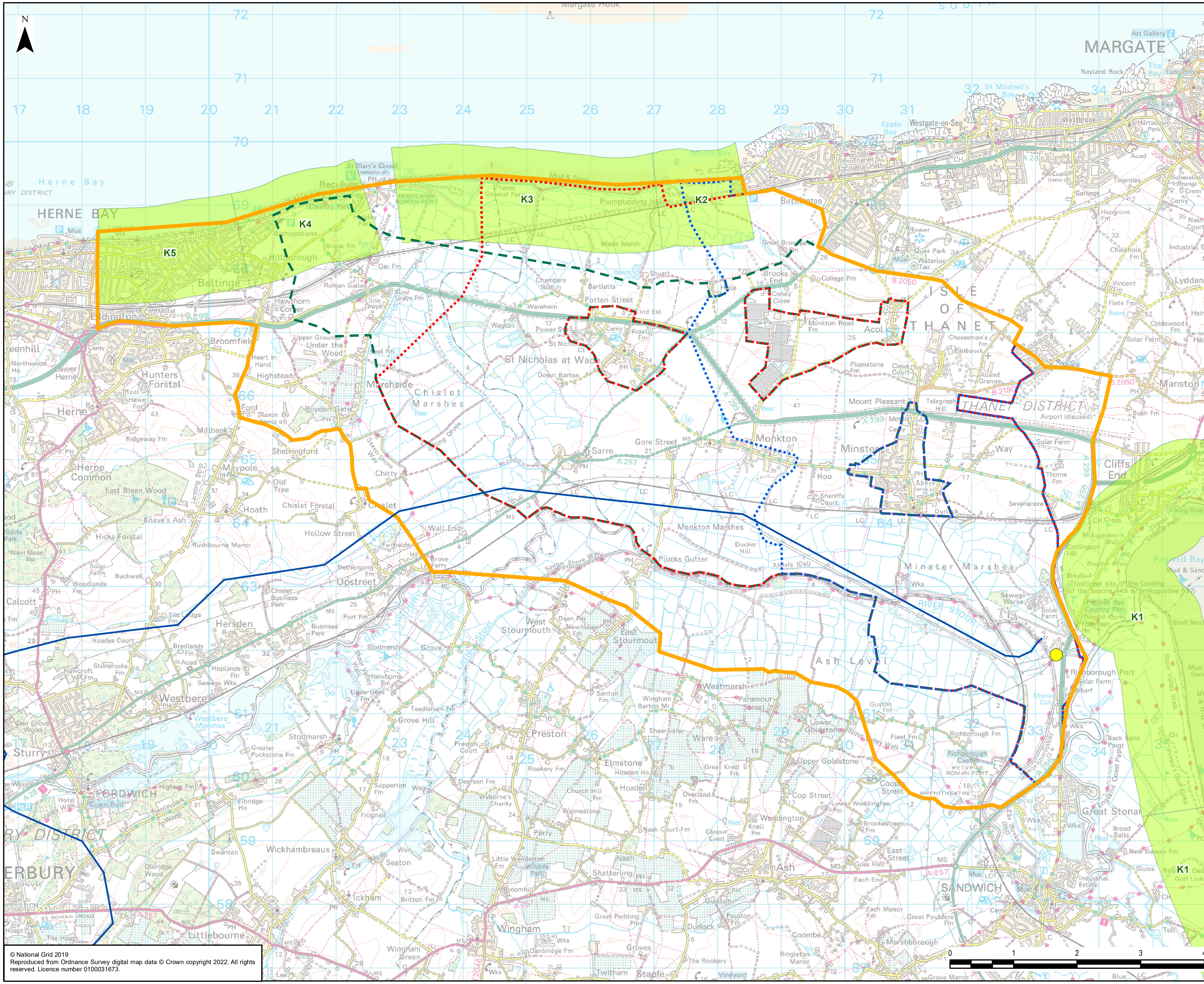
5.2.34 The route corridor options within the zones were colour coded. All corridor options, associated converter site option areas and landfall areas of search are listed in **Table 5-4** below and shown in **Figure 5-11** to **Figure 5-12**.

Table 5-4 Combination Options - Terrestrial Corridors, Converter Site Option Areas and Landfall Areas of Search

Terrestrial Zone	Connection Point	Terrestrial Corridor Option	Converter Site Option Area	Associated Landfall Area of Search
North Kent Coast	Richborough	Green	A & B	K4
		Red	A & B	K3
		Blue	A & B	K2
Broadstairs	Richborough	Green	A & B	K1a
Pegwell Bay	Richborough	Green	A & B	K1
		Red	A & B	K1
		Blue	A & B	K1
Sizewell	4Z Area	Green	F, H, I	S1
		Red	E, F, H, I	S2

Terrestrial Zone	Connection Point	Terrestrial Corridor Option	Converter Site Option Area	Associated Landfall Area of Search
		Blue	B, D, E, F, H, I	S3
		Purple	B, D, E, F, H, I	S3
		Orange	D, E, F, H, I	S5
Sizewell	Friston	Green	E, F, G, H	S1
		Red	E, F, G, H	S2
		Blue	B, D, E, F, G, H	S3
		Purple	B, D, E, F, G, H	S3
		Orange	C, D, E, F, G, H	S5
Sizewell	Sizewell (including existing and proposed)	Green	A, B, C, D	S1
		Red	A, B, C, D	S2
		Blue	A, B, C, D	S3
		Purple	A, B, C, D	S3
		Orange	A, B, C, D	S5

Figure 5-11 Kent Zones and Terrestrial Corridors



LEGEND

- Richborough Substation
- 400 kV Overhead Line
- Landfall Area of Search
- North Kent Coast - Richborough Zone
- Blue Corridor
- Red Corridor
- Green Corridor

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FIGURE 5-11	1:55,000	A3	1	0

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N

LEGEND

- Richborough Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Broadstairs - Richborough Zone
- Green Corridor

K1a K2 K3 K1

MARGATE · NORTH FORELAND · BROADSTAIRS · RAMSGATE · ISLE OF THANET · THANET DISTRICT · SANDWICH · SANDWICH BAY · Minster Marshes · Ash Level · Monkton Marshes

0 1 2 3 4 km

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FIGURE 5-11	1:50,000	A3	1	0

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N

K1

K2

K3

K4

LEGEND

- Richborough Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Pegwell Bay - Richborough Zone
- Red Corridor
- Green Corridor
- Blue Corridor

0 1 2 3 4 km

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FIGURE 5-11	1:60,000	A3	1	0

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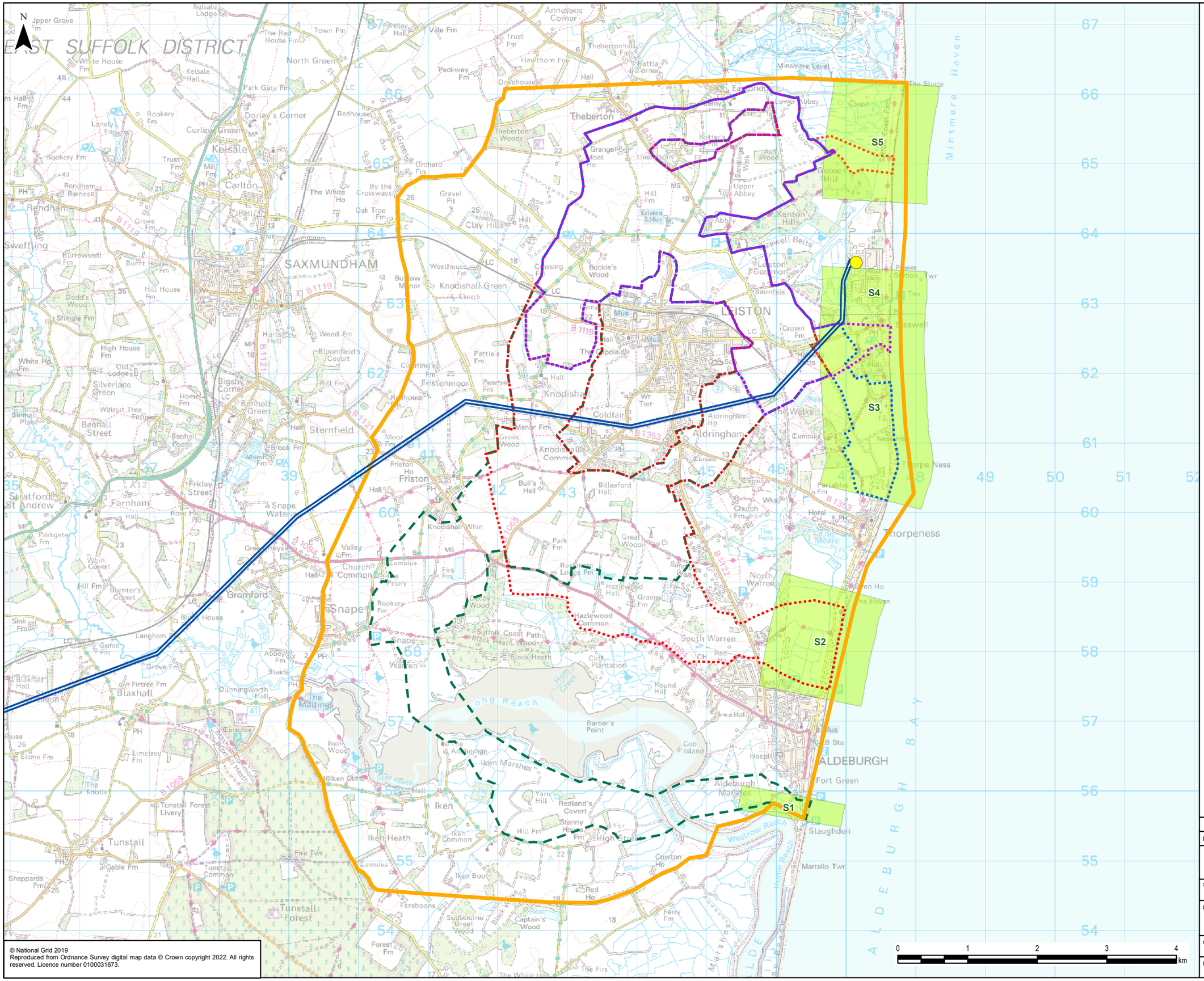
Figure 5-12 Sizewell Zones and Terrestrial Corridors



LEGEND

- Sizewell Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Sizewell - Sizewell Zone
- Purple Corridor
- Blue Corridor
- Orange Corridor
- Red Corridor
- Green Corridor

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FIGURE 5-12	1:50,000	A3	1	0

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N

EAST SUFFOLK DISTRICT

SAXMUNDHAM

LEISTON

ALDEBURGH

S1

S2

S3

S4

S5

LEGEND

- Sizewell Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Sizewell - 4Z Area 1 Zone
- Green Corridor
- Blue Corridor
- Purple Corridor
- Red Corridor
- Orange Corridor

0 1 2 3 4 km

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FIGURE 5-12	1:55,000	A3	1	0

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N

EAST SUFFOLK DISTRICT

SAXMUNDHAM

LEISTON

ALDEBURGH

S1

S2

S3

S4

S5

LEGEND

- Sizewell Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Sizewell - Friston Zone
- Green Corridor
- Orange Corridor
- Purple Corridor
- Red Corridor
- Blue Corridor

0 1 2 3 4 km

Rev	Date	Description	GIS	Chk	App
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FIGURE 5-12	1:50,000	A3	1	0

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6. Environmental and Socio-economic Appraisal Methodology

6.1 Introduction

6.1.1 The appraisals of each of the elements described in **Chapter 5** were completed in line with National Grid's Our Approach to Options Appraisal Guidance[7].

6.1.2 Appraisals assumed standard industry best environmental practice measures during design, construction and operation and all agreed design mitigation is inherent within the appraisals.

6.2 Methodology

6.2.1 The marine and terrestrial environmental appraisal focused on the following relevant broad topics:

- landscape and visual;
- historic environment;
- biological environment; and
- physical environment.

6.2.2 The marine and terrestrial appraisal of relevant socio-economic factors included:

- settlement and population;
- tourism and recreation;
- land/marine use;
- infrastructure;
- traffic and access; and
- shipping and navigation.

6.2.3 The appraisal has also taken into account planning policy and future development.

6.2.4 Potential constraints falling under each of the broad topic areas highlighted above were reviewed; careful consideration was given to ensure that information was gathered only for those subtopics likely to be material in the decision making. The ecological and socio-economic receptor topics and associated sensitivities/potential constraints considered are set out in **Table 6-1** below.

[7] National Grid, 2012, Our Approach to Options Appraisal

Table 6-1 Environmental and Socio-economic Constraints

Landscape and Visual	
National Parks	Primary consideration as expansive designation with limited opportunity to avoid if within the study area. Highly sensitive to above ground transmission infrastructure.
Areas of Outstanding Natural Beauty (AONBs)	Primary consideration as expansive designation with limited opportunity to avoid if within the study area. Highly sensitive to above ground transmission infrastructure.
Heritage Coasts	Coastal site which is defined rather than designated to conserve the best stretches of undeveloped coast. Highly sensitive to above ground infrastructure but limited in extent (confined to coastal areas).
National Trails	Long distance footpaths generally through areas designated for their landscape quality (AONBs, National Parks). Users of the National Trails are sensitive to above ground transmission infrastructure but sensitively likely to vary dependant on the specific location on the trail
National Character Areas	A natural subdivision of England based on a combination of landscape, biodiversity, geodiversity and economic activity. We have undertaken a high-level appraisal of those character areas relevant to the study areas in terms of their value and sensitivity to both a new OHL and underground cable.
Marine Character Areas	Highlight the key natural, cultural and perceptual influences that make the character of each seascape distinct and unique. Limited sensitivity to marine cables but more sensitive to offshore substations and coastal infrastructure.
Historic Environment	
World Heritage Sites	Is a landmark or area which is selected by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as having cultural, historical, scientific or other form of significance, and is legally protected by international treaties. With regards to the study area they are discrete sites which are easily avoided however are highly sensitive to above ground transmission infrastructure.
Conservation Areas	Local planning authorities are obliged to designate as conservation areas any parts of their own area that are of special architectural or historic interest, the character and appearance of which it is desirable to preserve or enhance.
Scheduled Monuments	Is an historic building or site that is included in the Schedule of Monuments kept by the Secretary of State (SoS) for Digital, Culture, Media and Sport. Highly sensitive to direct effects from underground and above ground transmission infrastructure, however, generally they are discrete sites that are avoidable. Also sensitive to indirect setting effects. The sensitivity to setting effects varies dependant on the monument and the surrounding landform and landcover and at this stage we have not assessed the sensitivity of each site.

Registered Parks and Gardens	Is a Register of Historic Parks and Gardens of special historic interest and are graded in a similar way to Listed Buildings. Sensitive to both direct impacts from underground and above ground transmission infrastructure and setting impacts. Generally, they are discrete sites so direct impacts can be avoided. Sensitivity varies for example a Grade I Park and Garden which has mainly inward facing views would be less sensitive than a Grade II Park and Garden with mainly outward facing views. At this stage we have not undertaken a sensitive assessment of each site.
Listed Buildings	Buildings that are listed for their special architectural and historic interest. It is assumed that all buildings would be avoided in terms of direct effects. Sensitive to indirect setting effects. The sensitivity to setting effects varies dependant on the individual building and the surrounding landform and landcover and at this stage we have not assessed the sensitivity of each site. In general Grade I and II* are considered to be more sensitive than Grade II.
Registered Battlefields	Register of Historic Battlefields to promote a better understanding of their significance and public enjoyment. There are none within the study area.
Conservation Areas	Local planning authorities are obliged to designate as conservation areas any parts of their own area that are of special architectural or historic interest, the character and appearance of which it is desirable to preserve or enhance.
Military Remains	Provides protection to military remains sensitive to direct impacts from underground or above ground transmission infrastructure however they are generally small discrete sites which can be avoided.
Protected Wrecks	Designated as being likely to contain the remains of a vessel, or its contents, which are of historical, artistic or archaeological importance. Sensitive to direct impacts from subsea transmission infrastructure however they are generally small discrete sites which can be avoided.
Biological Environment	
European Sites (SACs, SPAs and Ramsar Sites)	SPAs are a designation for the protection of certain over wintering, breeding and on passage bird species, SACs are designated for the protection of certain habitats and species that are most in need of conservation at the European level and a Ramsar site is a wetland site of international importance for nature conservation. The sensitivity of a European site varies depending the technology (overhead vs underground) and the reasons for the designation of the site. In general, coastal sites are more expansive with less opportunity to avoid than inland sites.
Sites of Special Scientific Interest (SSSIs)	National level designation for natural heritage (flora and fauna) as well as for geological and geomorphological reasons. As with Natura 2000 sites their sensitivity to either underground or overhead transmission infrastructure varies both due to the infrastructure and the reasons for the designation of the site.
MCZs	National level designation to protect a range of nationally important, rare or threatened habitats and species. As above their sensitivity to a

	subsea cable varies both due to the infrastructure and the reasons for the designation of the site.
NNRs	National level designation which were established to protect important habitats, species and geology in addition to a SSSI they also provide a recreational and educational environment. As above their sensitivity to either underground or overhead transmission infrastructure varies both due to the infrastructure and the reasons for the designation of the site.
RSPB Important Bird Areas (IBAs) and Reserves	In general, these are contiguous with the SPAs, Ramsar's and SSSI and protect rare or endangered bird species. IBAs are in general more expansive and their sensitivity to underground or above ground infrastructure varies dependant on the species and the timing of the installation. Reserves are generally more discrete site and also offer an educational and recreational facility.
Ancient Woodland	By definition ancient woodland is a woodland that has existed continuously since 1600 or before however there are different types and the ground flora is important as well as the trees. In general, has a high sensitivity to underground or overhead transmission infrastructure as loss is not considered to be temporary however tis can be reduced where there are opportunities to span for cross using a trenchless technique.
Local Nature Reserves (LNRs)	LNRs are a statutory designation made under Section 21 of the National Parks and Access to the Countryside Act 1949. LNRs are for people and wildlife. They are places with wildlife or geological features that are of special interest locally.
Local Wildlife Sites (LWSs) / Sites of Importance for Nature Conservation (SINC)	LWSs are wildlife-rich sites selected for their local nature conservation value. They vary in shape and size and can contain important, distinctive and threatened habitats and species. In many parts of the UK, they are the principal wildlife resource but their designation is non-statutory and their only protection comes via the planning system. They are not protected by law like SSSIs or NNRs.
Physical Environment	
Topography	Generally considered under landscape, relevant in relation to Holford Rules 4 and 5: Choose tree and hill backgrounds in preference to sky, backgrounds, wherever possible; and when the line has to cross a ridge, secure this opaque background as long as possible and cross obliquely when a dip in the ridge provides an opportunity. Where it does not, cross directly, preferably between belts of trees. Prefer moderately open valleys with woods where the apparent height of the towers will be reduced, and views of the line will be broken by trees.
Watercourses	Any natural or artificial channel above or below ground through which water flows, such as a river, brook, beck, ditch, mill stream or culvert
Flood Zones	In general development in flood zones 2 and 3 should be avoided in favour of development in flood Zone 1. Almost always impossible for linear projects to avoid development in flood zone 2 and 3 however

	both underground cables and OHL are considered to have a low sensitivity as in the case of the former the effect is temporary and can be managed by good construction practice and construction techniques such as a ducted solution and in the case of the later flood water being able to inundate footprints. The siting of new substations and converter stations has a greater sensitivity as these would result in permanent infrastructure in the floodplain and would require an exception test to be passed as part of any flood risk assessment.
Source Protection Zones (SPZs)	SPZs are defined around large and public potable groundwater abstraction sites. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon a drinking water abstraction.
Landfill and Historic Landfill Sites	Areas of land in which waste is/has been deposited. They are carefully designed structures built into the ground so that waste is kept separate from the surrounding environment.
Superficial geology and bedrock geology	Superficial deposits refer to geologically recent unconsolidated sediments whereas bedrock geology is the main mass of rocks forming the Earth that are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.
Marine Environment	Bathymetry Offshore geology
Socio-economics	
Settlement and Population	Urban regions Main settlements Allocation and growth areas Residential density (people per hectare) Educational facilities Medical facilities
Tourism and Recreation	National Cycle Network Visitor attractions Accommodation facilities Historic Landmarks Sports and Leisure Centres and Sports Clubs
Land/Marine Use	Agricultural Land Classification (ACL) Golf Courses Allotments Forest and Country Parks Countryside and Rights of Way Access Land Land Allocations Major Planning Applications Fishing density Shipping and navigation

	Traffic and access
	Aquaculture areas
	Marine extraction and disposal sites
	Anchorage areas
	Other sea users
Infrastructure	Transmission network / subsea cables
	Gas transmission network / subsea pipelines
	Ports and harbours
	Aerodromes
	Offshore windfarms
	Motorways /Trunk roads
	Other Roads
	Railways

6.2.5 Spatial data representing the various environmental and socio-economic constraints identified above (**Table 6-1**) were obtained for the Project study area. All data were uploaded to an online project Geographic Information System (GIS).

6.2.6 The various corridors and sites were analysed within the GIS environment to extract information about where the corridors and sites interacted with various environmental and socio-economic spatial constraints also held within the GIS environment. Extracted information was provided to each of the topic leads to aid them in their assessment of the potential challenges and opportunities presented by each corridor/site.

6.2.7 The element options making up each potential end to end solution were collated and qualitative assessments were undertaken, and these were then the focus of the final decision-making process.

6.3 Other Considerations

6.3.1 The approach to identifying and assessing suitable sites and routes seeks to balance technical and commercial feasibility alongside environmental and socio-economic impacts, these are considered in the following chapters.

7. Options Appraisal – Marine

7.1 Introduction

7.1.1 The following constraints have been taken into consideration to undertake the appraisal of the marine alignment options shown on **Figure 7-1** to **Figure 7-4** and listed in **Table 7-1**:

- **Environmental**

  Biological environment

  Historic environment
- **Physical Environment**

  Bathymetry

  Offshore Geology
- **Socio-Economic**

  Infrastructure

  Shipping and Navigation

  Restricted Areas

  Commercial Fisheries

  Other Sea Users
- **Marine Planning**

Marine Alignments

7.1.2 **Table 7-1** lists the marine alignments which have been appraised and their associated landfall area of search, terrestrial corridors and connection points. These alignments are also illustrated on **Figure 7-1** to **Figure 7-4**.

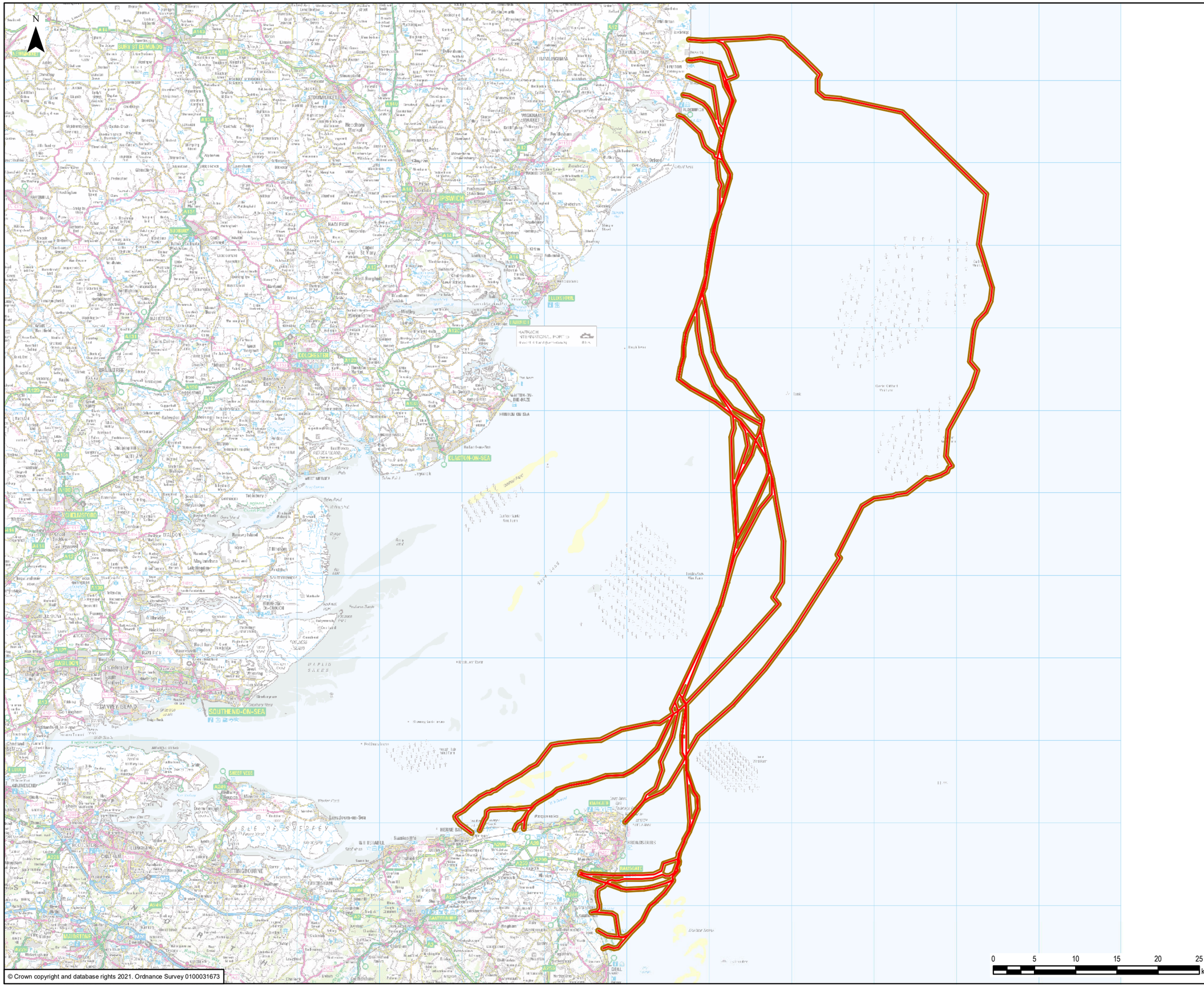
Table 7-1 Combination Options - Marine Alignments, Terrestrial Corridors and Landfalls

Terrestrial Zone	Connection Point	Terrestrial Corridor Option	Associated Landfall Option	Landfall Approach	Central section
North Kent Coast	Richborough	Green	K4	K4 & K4a	C1-C8 and J1/J2/J3/J4/J5[8]
		Red	K3	K3	
		Blue	K2	K2	
Broadstairs	Richborough	Green	K1a	K1a & K1a-S9	

[8] These are small 'joining' sections to allow all possible route sections to be connected

Terrestrial Zone	Connection Point	Terrestrial Corridor Option	Associated Landfall Option	Landfall Approach	Central section
Pegwell Bay	Richborough	Green	K1	K1b & K1c	
		Red	K1	K1f &K1g	
		Blue	K1	K1d	
Sizewell	4Z Area	Green	S1	S1	
		Red	S2	S2	
		Blue	S3	S3	
		Purple	S3	S3N	
		Orange	S5	S5	
Sizewell	Friston	Green	S1	S1	
		Red	S2	S2	
		Blue	S3	S3	
		Purple	S3	S3N	
		Orange	S5	S5	
Sizewell	Sizewell (existing and proposed)	Green	S1	S1	
		Red	S2	S2	
		Blue	S3	S3	
		Purple	S3	S3N	
		Orange	S5	S5	

Figure 7-1 Marine Alignments Overall



Legend

- Marine Alignments
- Marine Alignments - 250m Buffer

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Document Title: MARINE ALIGNMENTS - OVERALL

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FIGURE 7-1	1:425,000	A3	1	0

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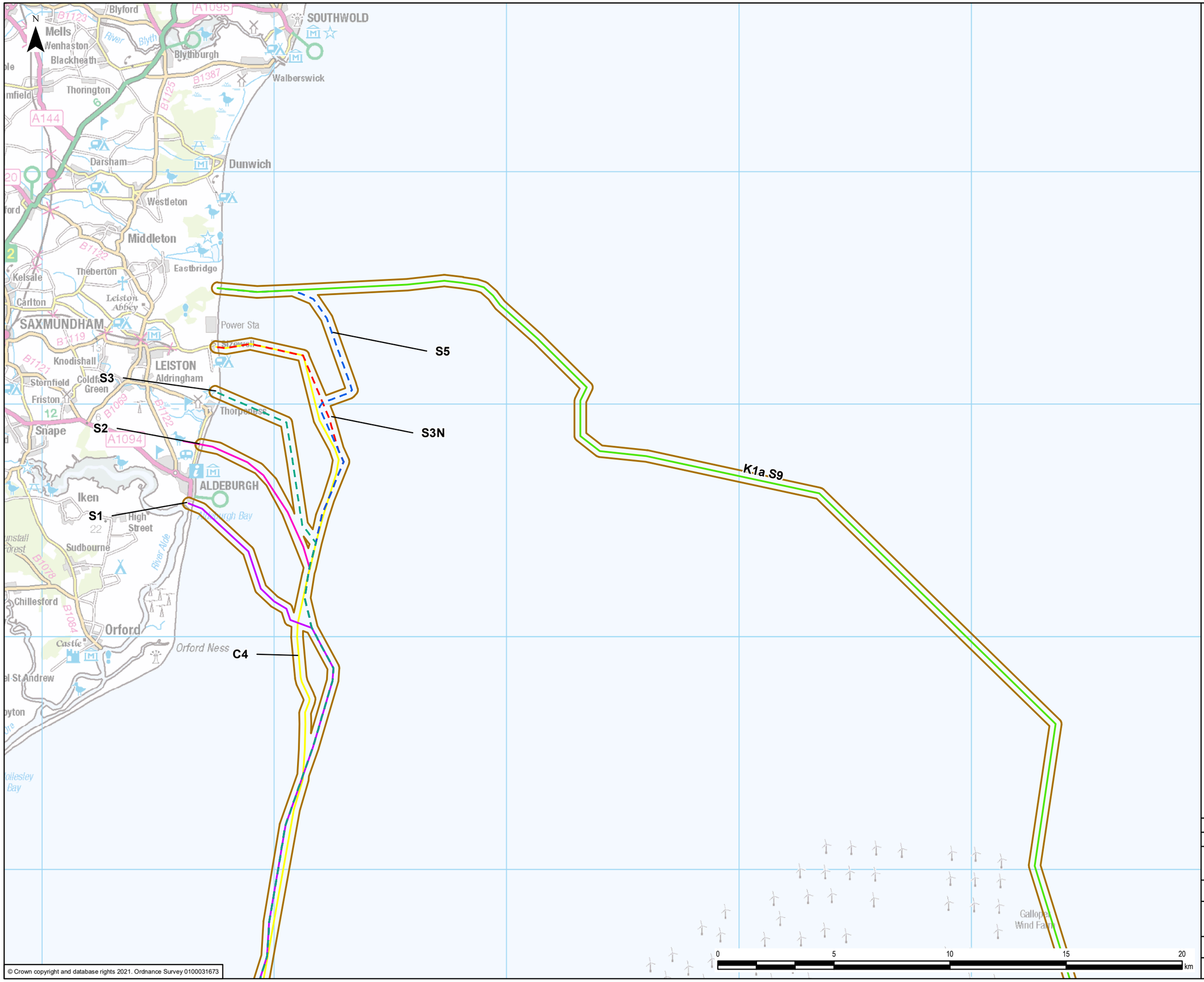
Figure 7-2 Marine Alignments North



Legend

Marine Alignments

- C4
- K1a S9
- S1
- S2
- S3
- S3N
- S5
- Marine Alignments - 250m Buffer

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FIGURE 7-2	1:150,000	A3	1	0

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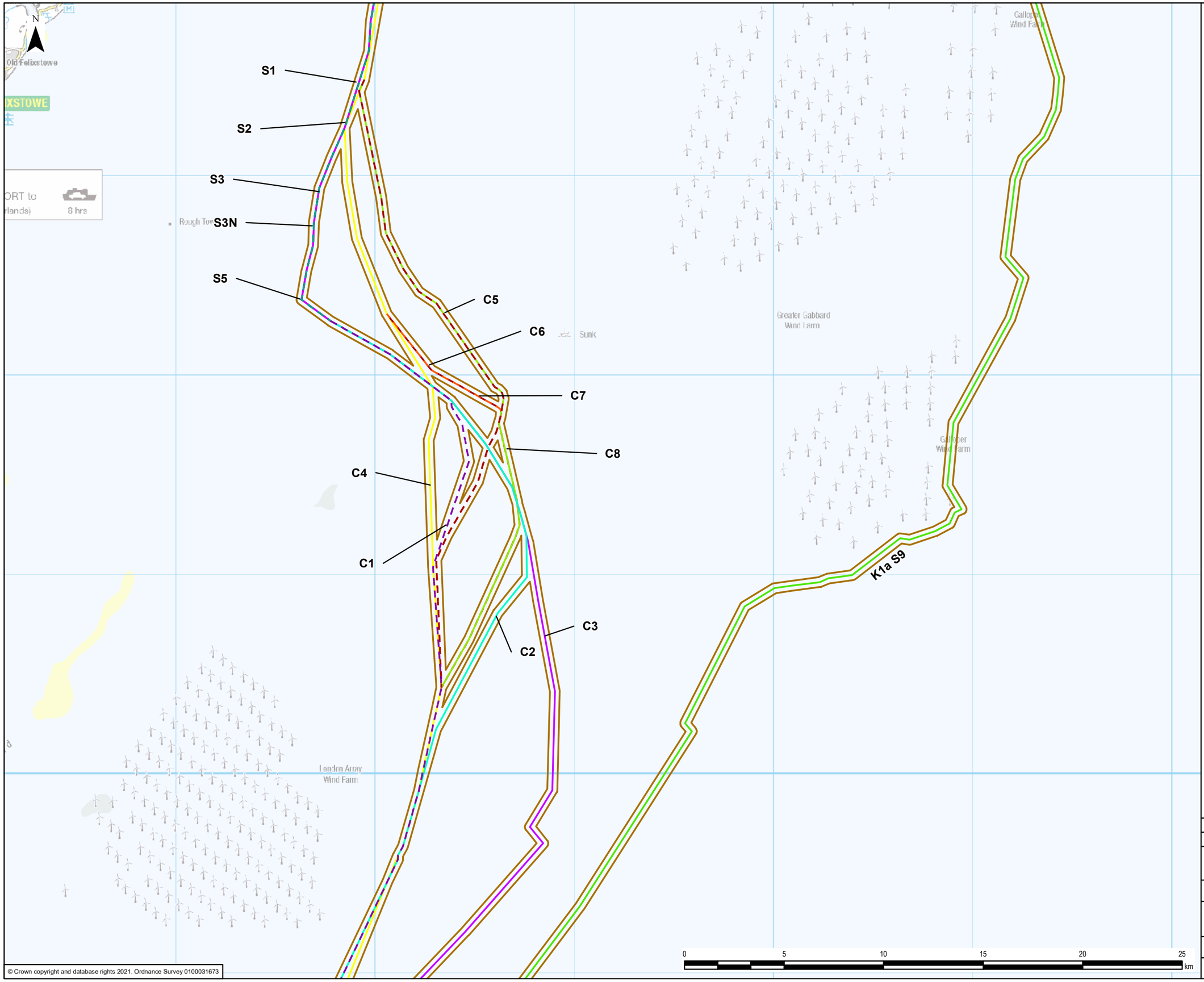
Figure 7-3 Marine Alignments Central



Legend

Marine Alignments

- C1
- C2
- C3
- C4
- C5
- C6
- C7
- C8
- K1a S9
- S1
- S2
- S3
- S3N
- S5
- Marine Alignments - 250m Buffer

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FIGURE 7-3	1:175,000	A3	1	0

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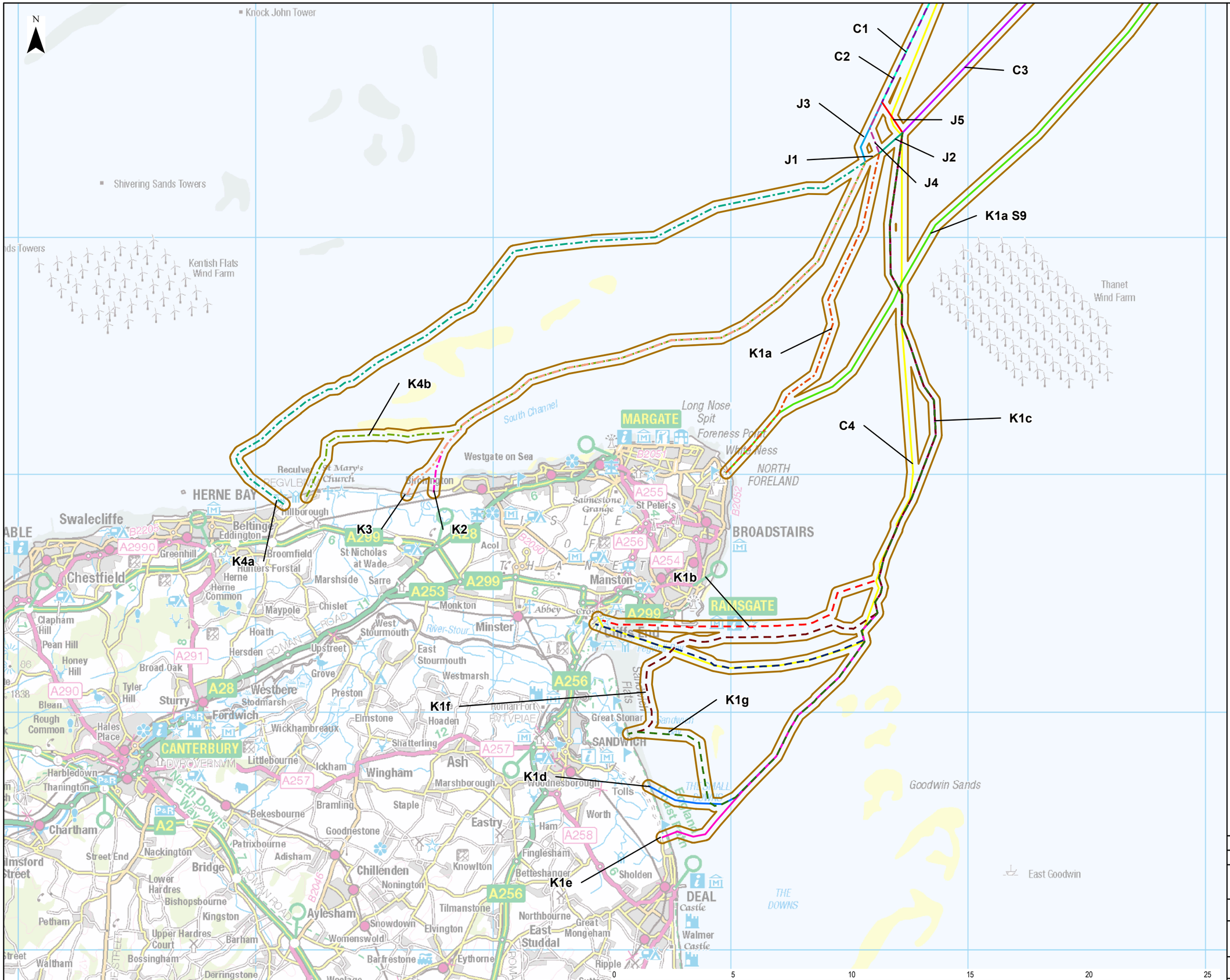
Figure 7-4 Marine Alignments South



Legend

Marine Alignments

- C1
- C2
- C3
- C4
- J1
- J2
- J3
- J4
- J5
- K1a
- K1a S9
- K1b
- K1c
- K1d
- K1e
- K1f
- K1g
- K2
- K3
- K4a
- K4b
- Marine Alignments - 250m Buffer

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Document Title: MARINE ALIGNMENTS - SOUTH

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FIGURE 7-4	1:150,000	A3	1	0

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7.2 Environmental

7.2.1 This section presents the potential biological and historical environment constraints considered when developing and appraising marine alignments.

Biological Environment

7.2.2 All initial marine alignment sections subject to appraisal (250m buffer either side resulting in 500m wide sections) have been appraised with regards to potential interactions with ecological designations that have boundaries that fall below Mean High Waters Springs (MHWS) and extend into the marine environment. The following type of designations have been considered:

- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)
- Ramsar Sites
- Marine Conservation Zones (MCZ)
- Sites of Special Scientific Interest (SSSI)
- National Nature Reserves (NNR)
- Local Nature Reserves (LNR)

7.2.3 **Figure 7-5** to **Figure 7-7** show landfall areas of search and marine alignment sections in relation to the designations listed above.

Figure 7-5 Marine Alignments in relation to SAC/SPA/Ramsar/MCZ Overall

N

Legend

- Marine Alignments - 250m Buffer
- Marine Conservation Zone
- Ramsar
- Special Protection Area (SPA)
- Special Area of Conservation (SAC)

0 5 10 15 20 25 km

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Document Title: MARINE ALIGNMENTS IN RELATION TO SAC/SPA/RAMSAR/MCZ - OVERALL

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FIGURE 7-5	1:425,000	A3	1	0

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Figure 7-6 Marine Alignments in relation to SAC/SPA/Ramsar/MCZ Approaching/at Landfall in Kent and Suffolk

KENT

SUFFOLK

K1a
K4
K3
K2
K1
K1
S5
S4
S3
S2
S1

Legend

- Marine Alignments - 250m Buffer
- Landfall Area of Search
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Ramsar
- Marine Conservation Zone

0 2 4 6 8 10 km

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Document Title: MARINE ALIGNMENTS IN RELATION TO SAC/SPA/RAMSAR/MCZ APPROACHING LANDFALL IN KENT AND SUFFOLK

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FIGURE 7-6		A3	1	0

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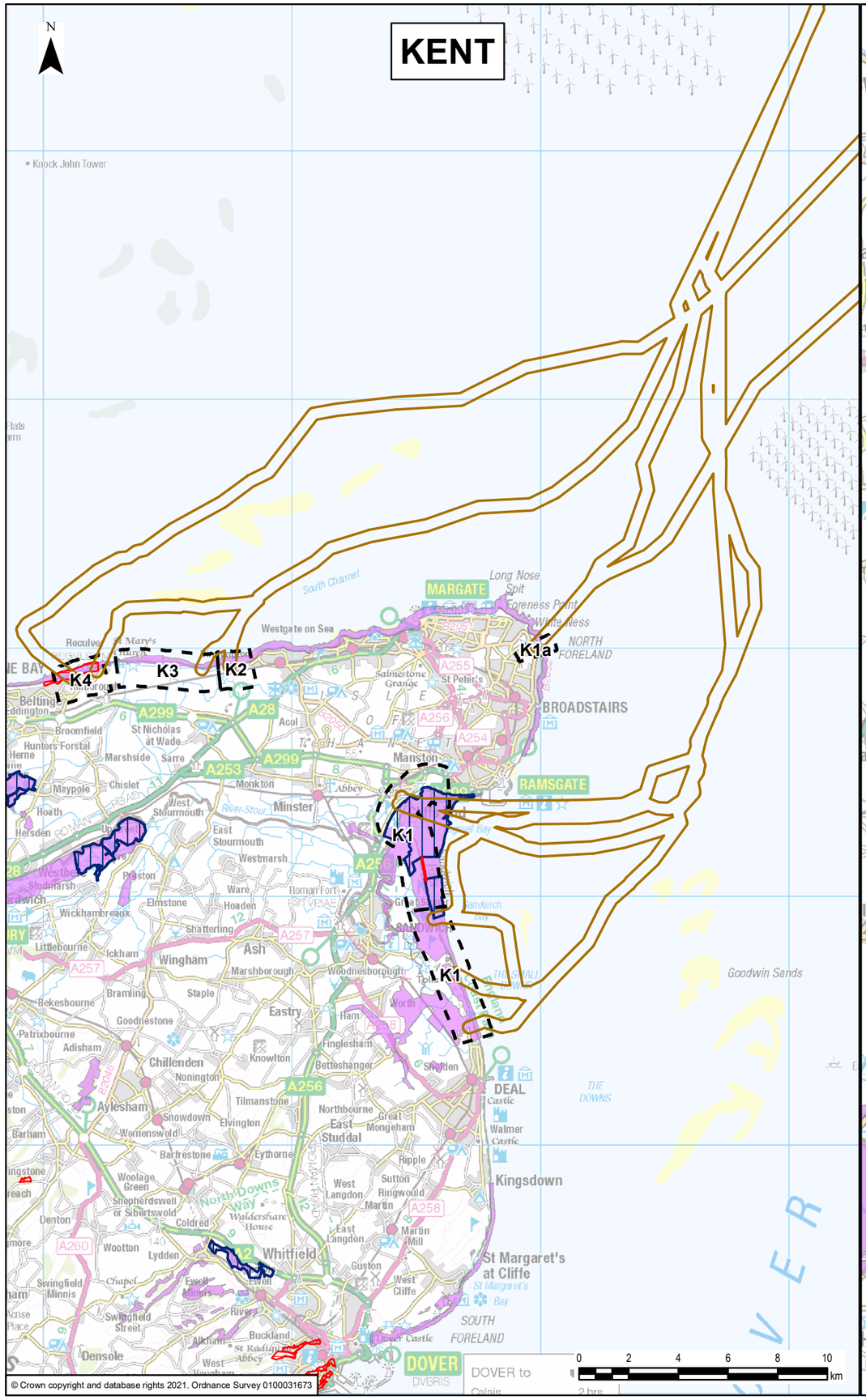
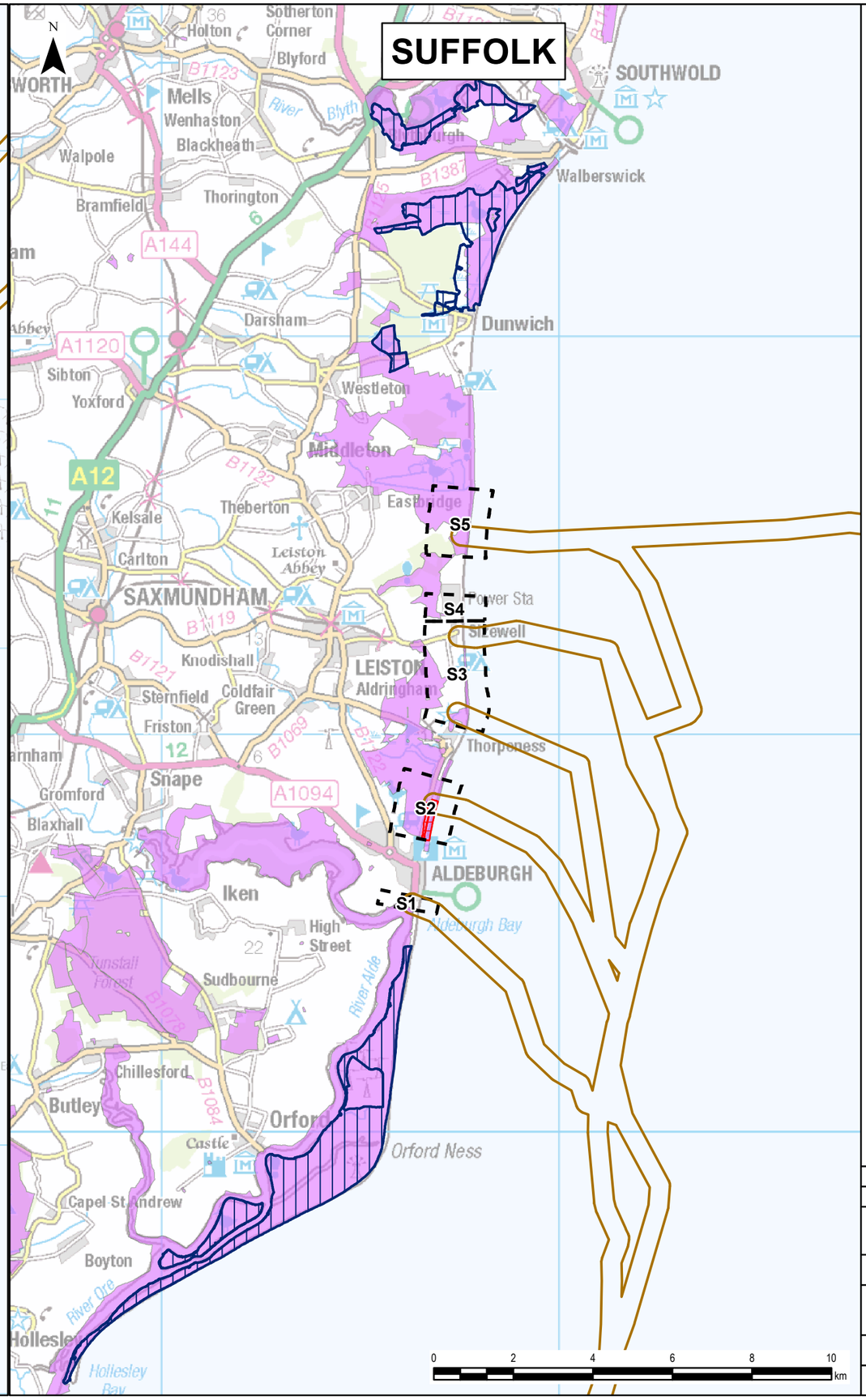
Figure 7-7 Marine Alignments in relation to SSSI/NNR/LNR Approaching/at Landfall in Kent and Suffolk





Legend

- Marine Alignments - 250m Buffer
- Landfall Area of Search
- Local Nature Reserve (LNR)
- National Nature Reserve (NNR)
- Site of Special Scientific Interest (SSSI)

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Document Title: MARINE ALIGNMENTS IN RELATION TO SSSI/NNR/LNR APPROACHING LANDFALL IN KENT AND SUFFOLK

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EB	22/08/2022	DF	22/08/2022	KS	22/08/2022

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FIGURE 7-7		A3	1	0

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Historic Environment

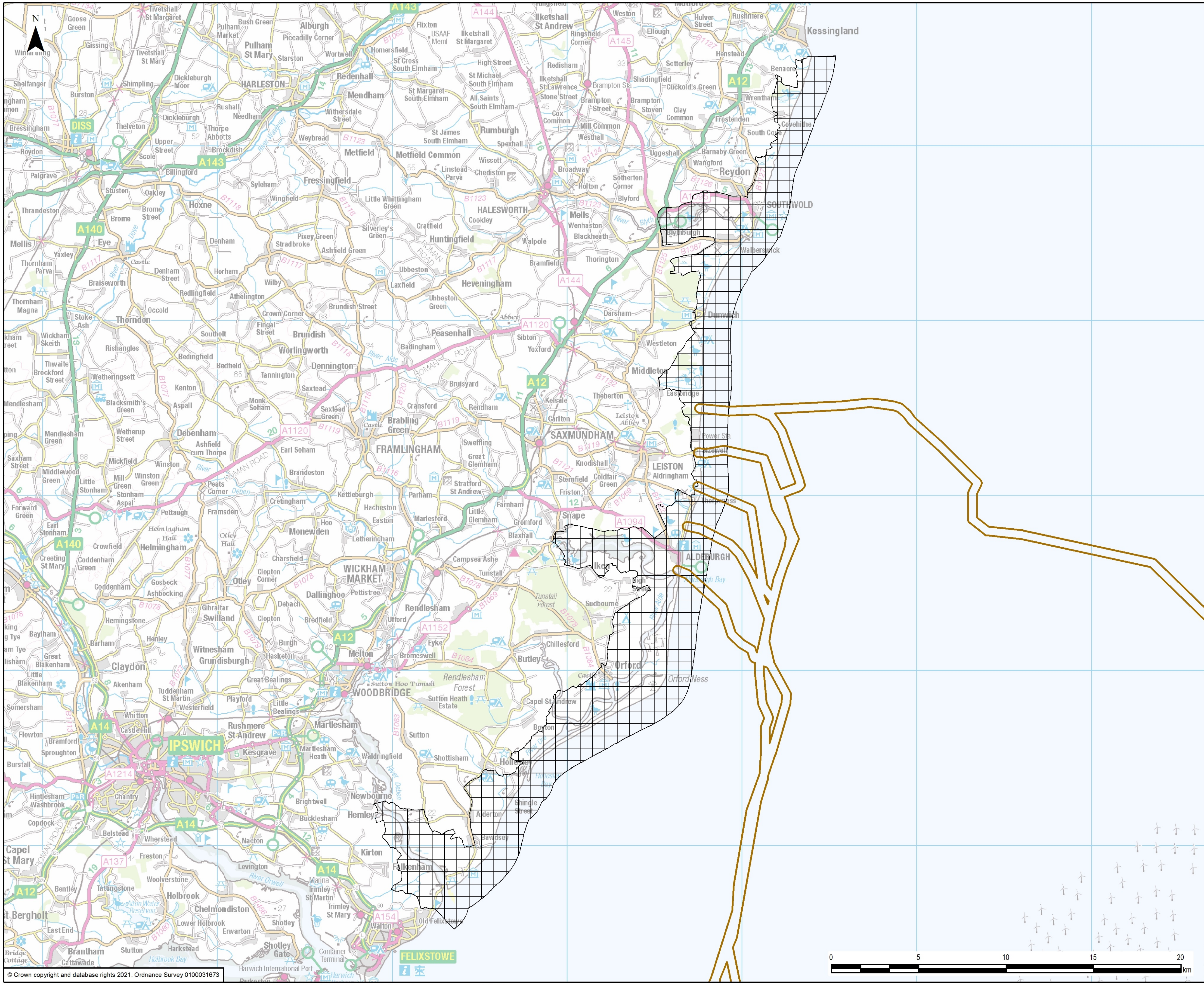
7.2.4 All marine alignment sections (500m wide corridor sections) shown on **Figure 7-1** have been appraised with regards to potential interactions with locations of historic importance in the marine environment (up to MHWS).

7.2.5 There is no direct or indirect interaction with any of the indicative marine alignment sections and protected wrecks.

7.2.6 All marine corridors and landfalls on the Suffolk coast intersect with the Suffolk Heritage Coast area (**Figure 7-8**).

7.2.7 Further consideration will be given to the potential interaction between the Suffolk Heritage Coast and the Project route that is taken forward to EIA Screening/Scoping and statutory consultation (see **Chapter 12**), however; due to the buried nature of the cable in the marine and coastal environment this interaction is not considered to present a significant constraint.

Figure 7-8 Marine Alignments and the Suffolk Heritage Coast Area



Legend

- Suffolk Heritage Coast
- Marine Alignments - 250m Buffer

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Document Title: MARINE ALIGNMENTS AND THE SUFFOLK HERITAGE COAST AREA

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Figure 7-8	Scale: 1:200,000	Format: A3	Sheets: 1	Rev: 0

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7.3 Physical Environment

7.3.1 This section presents the potential constraints related to the marine alignments with regards to:

- bathymetry;
- solid geology; and
- seabed sediments.

Bathymetry

7.3.2 The bathymetry along the proposed marine alignments is greatly influenced by geology and geological processes. The deposition of large volumes of sediment during glacial times and its subsequent movement by the sea has created large features, such as sand banks and sandwave fields. The water depth along the proposed marine alignments varies from 0m to 46m. In the outer Thames Estuary, the bathymetry is dominated by the positions of the large mobile sandbanks and the associated channels (**Figure 7-9**).

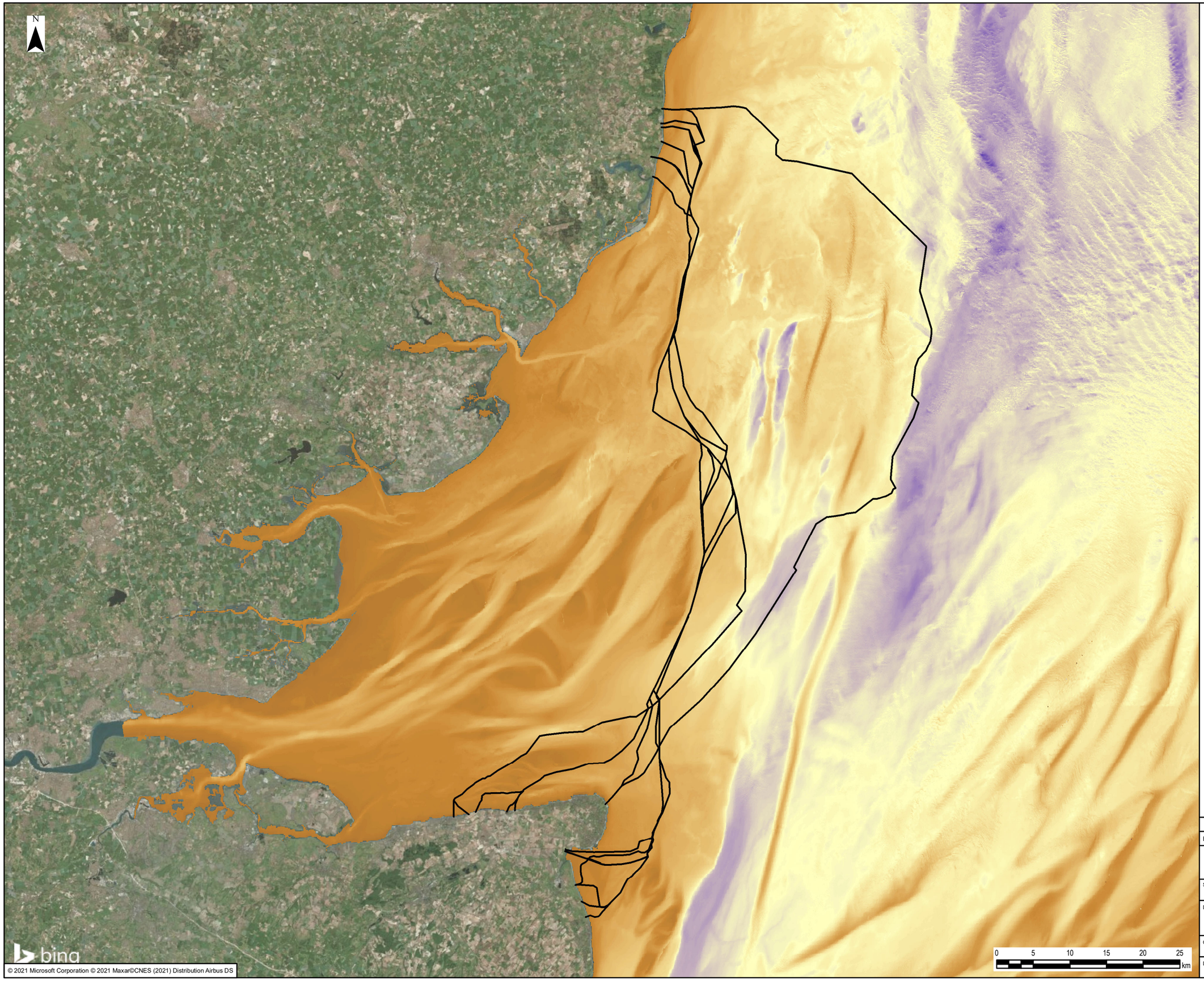
7.3.3 Further offshore, and towards the east, frequent sandwave fields and rare but extensive sandbanks (Greater Gabbard and Galloper) are encountered, mainly developing as northeast- southwest trending features.

7.3.4 Approaching the coast of Suffolk, the seabed has fewer large-scale features nevertheless, minor features like small sandbanks and sandwaves are present on the approach to Sizewell where there is also present a sub-cropping paleo reef on the approach to the potential landfalls.

Solid Geology and Seabed Sediments

7.3.5 A simplified geological map of the area is presented in **Figure 7-10** below. This shows that the solid geology is very simple and comprises Upper Cretaceous (C), Palaeocene (P), Eocene (E) and Pliocene (PL) bedrocks. Over large parts of the wider Project study area the older rocks are overlain by Quaternary deposits the thickness of which can vary from <1m to 50m (**Figure 7-12**). The Quaternary superficial deposits are mainly composed of Sand, Gravel and Mud (**Figure 7-11**). The gravels are generally comprised of flint or calcareous concretions derived from the underlying London Clay (E).

Figure 7-9 Bathymetry of the Study Area and Marine Alignments



Legend

Marine Alignments

Bathymetry

High : 29.4

Low : -103.85

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Document Title: BATHYMETRY OF THE STUDY AREA AND MARINE ALIGNMENTS

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FIGURE 7-9	1:475,000	A3	1	0

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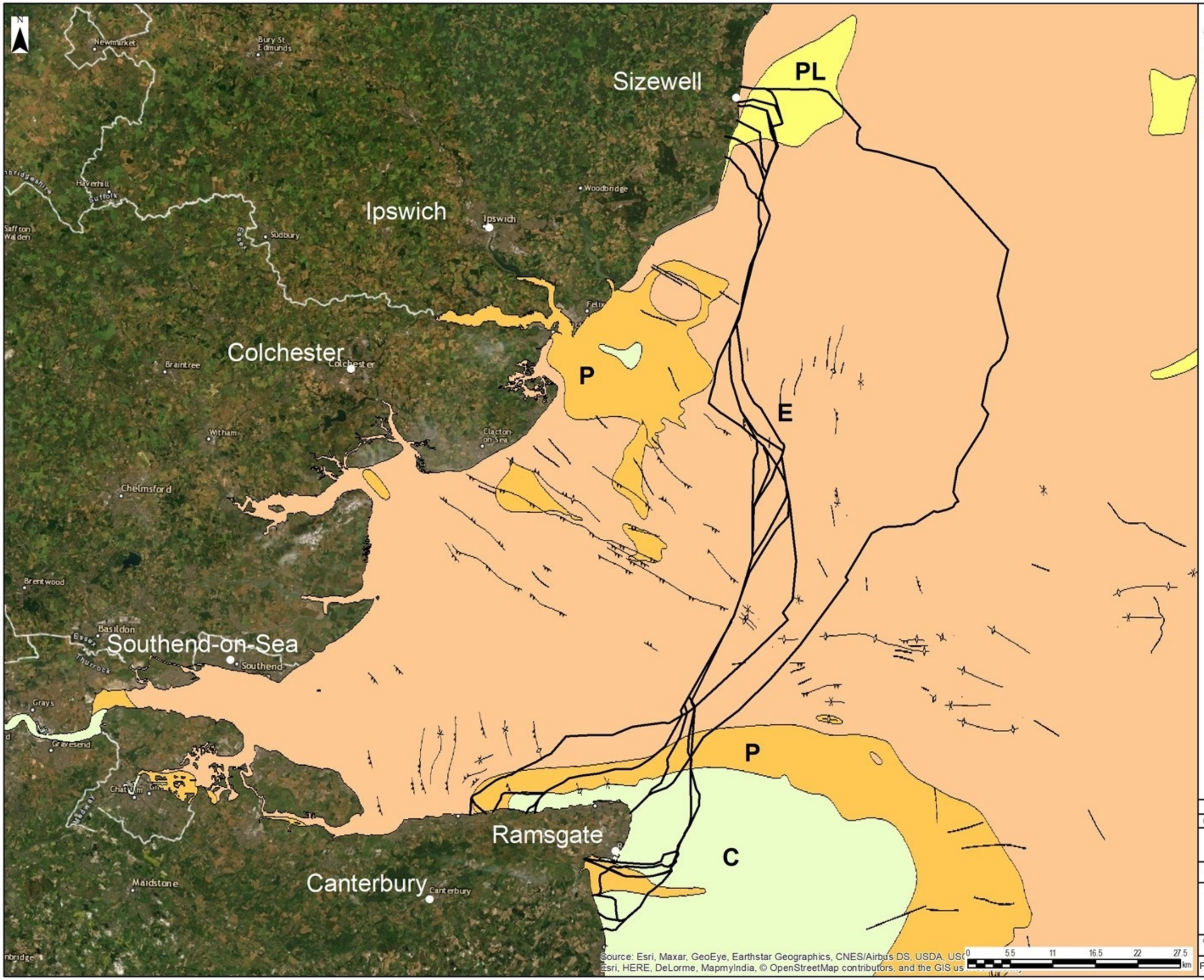
Figure 7-10 Thames Estuary Solid Geology - Bedrocks (British Geological Society)



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Thames Estuary Solid Geology - Bedrocks (British Geological Society)

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Figure 7-10

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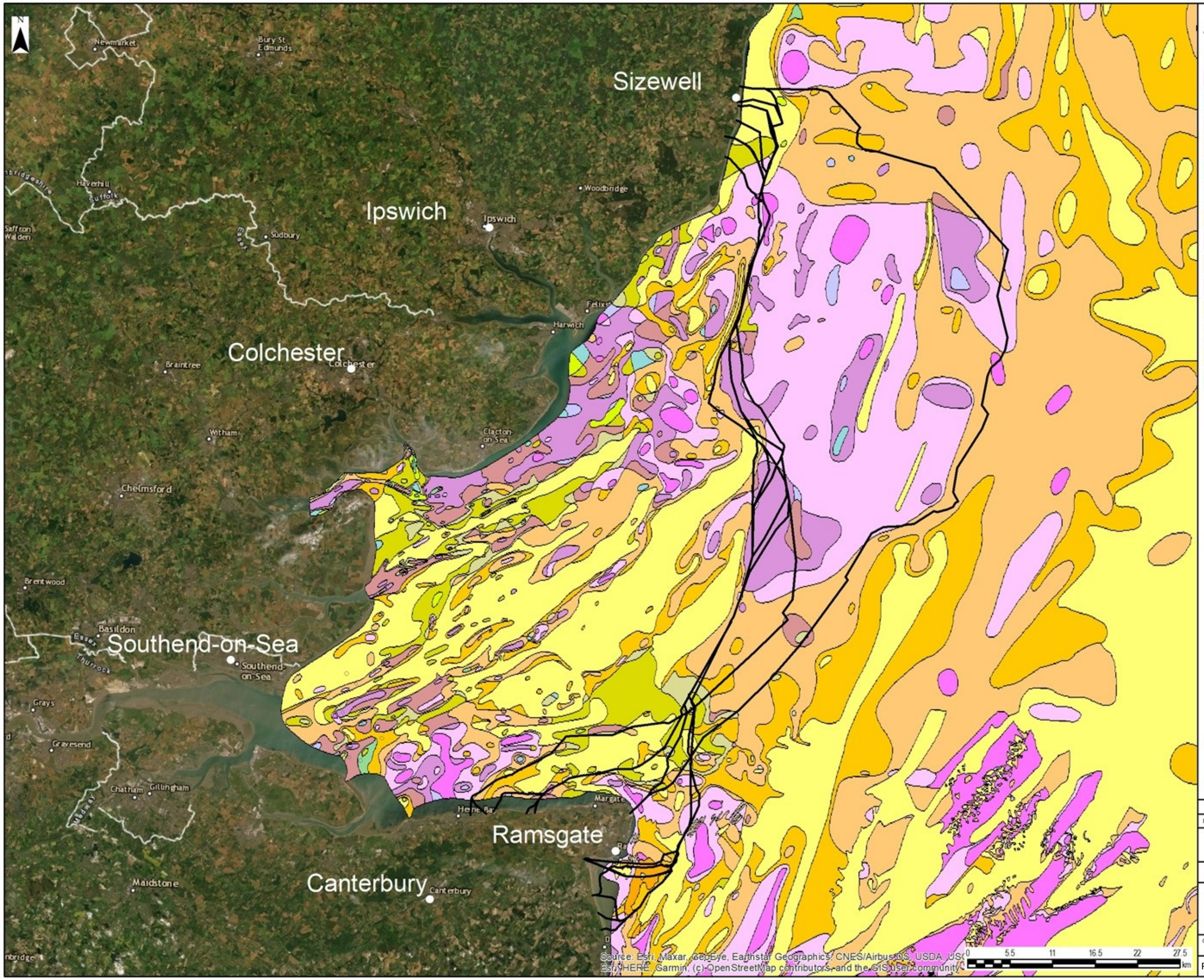
Figure 7-11 Thames Estuary Quaternary Sediments (British Geological Society)



LEGEND

Marine Alignments

Sea Bed Sediment

- GRAVEL
- GRAVELLY MUD
- GRAVELLY MUDDY SAND
- GRAVELLY SAND
- MUD
- MUDDY GRAVEL
- MUDDY SAND
- MUDDY SANDY GRAVEL
- SAND
- SANDY GRAVEL
- SANDY MUD
- SLIGHTLY GRAVELLY MUDDY SAND
- SLIGHTLY GRAVELLY SAND
- SLIGHTLY GRAVELLY SANDY MUD

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Thames Estuary Quaternary Sediments (British Geological Society)

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Figure 7-11

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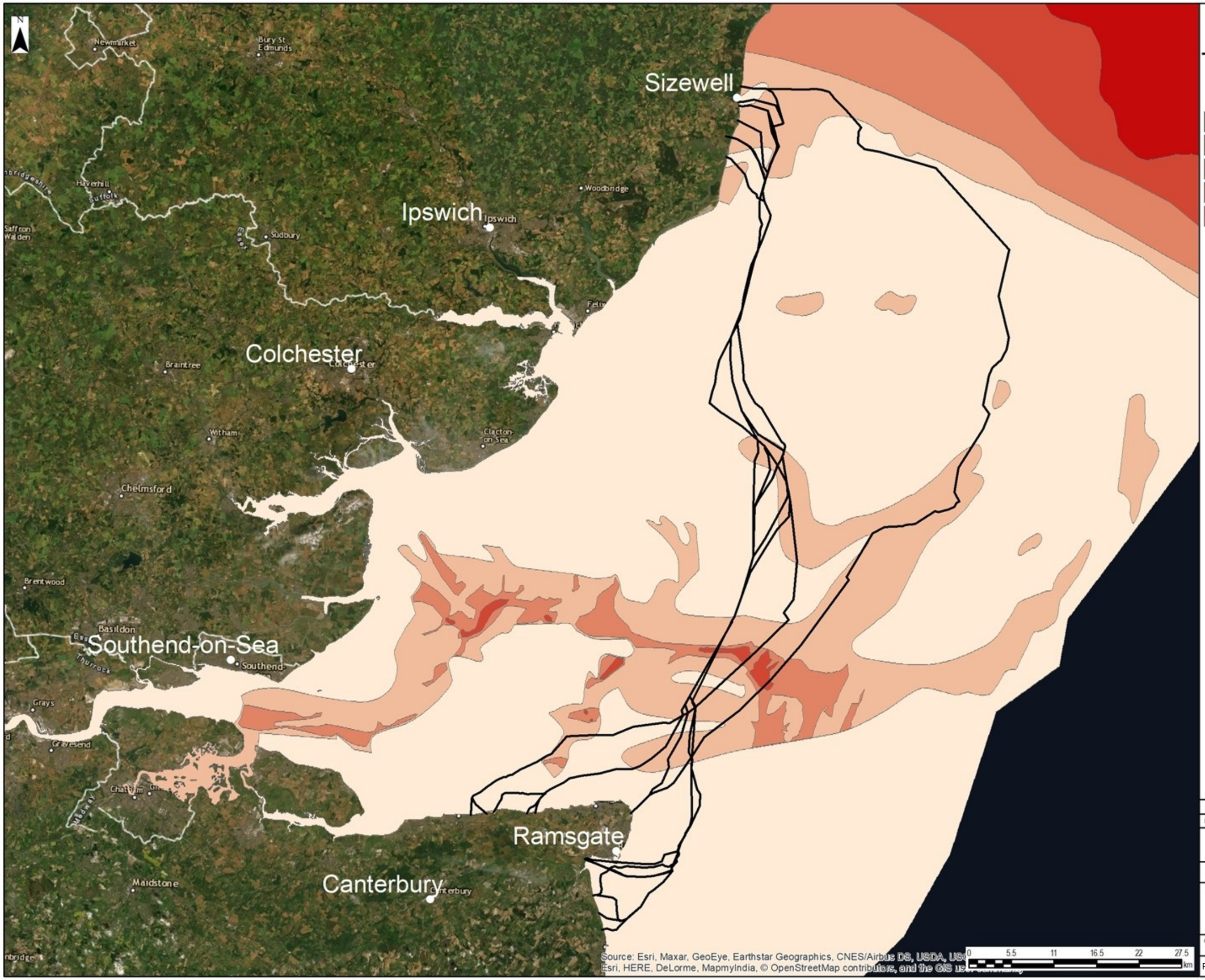
Figure 7-12 Thames Estuary Quaternary Sediments Thickness (British Geological Society)



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Thames Estuary Quaternary Sediments Thickness (British Geological Society)

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Figure 7-12

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7.4 Socio-Economic

Infrastructure

7.4.1 The marine environment within the Project study area is characterised by numerous cables and renewable energy infrastructure as shown in **Figure 7-13**.

7.4.2 From north to south there are two main areas that have a higher density of subsea cables: one in the Sizewell/Aldeburgh area in Suffolk and one in Broadstairs/Pegwell Bay area in east Kent.

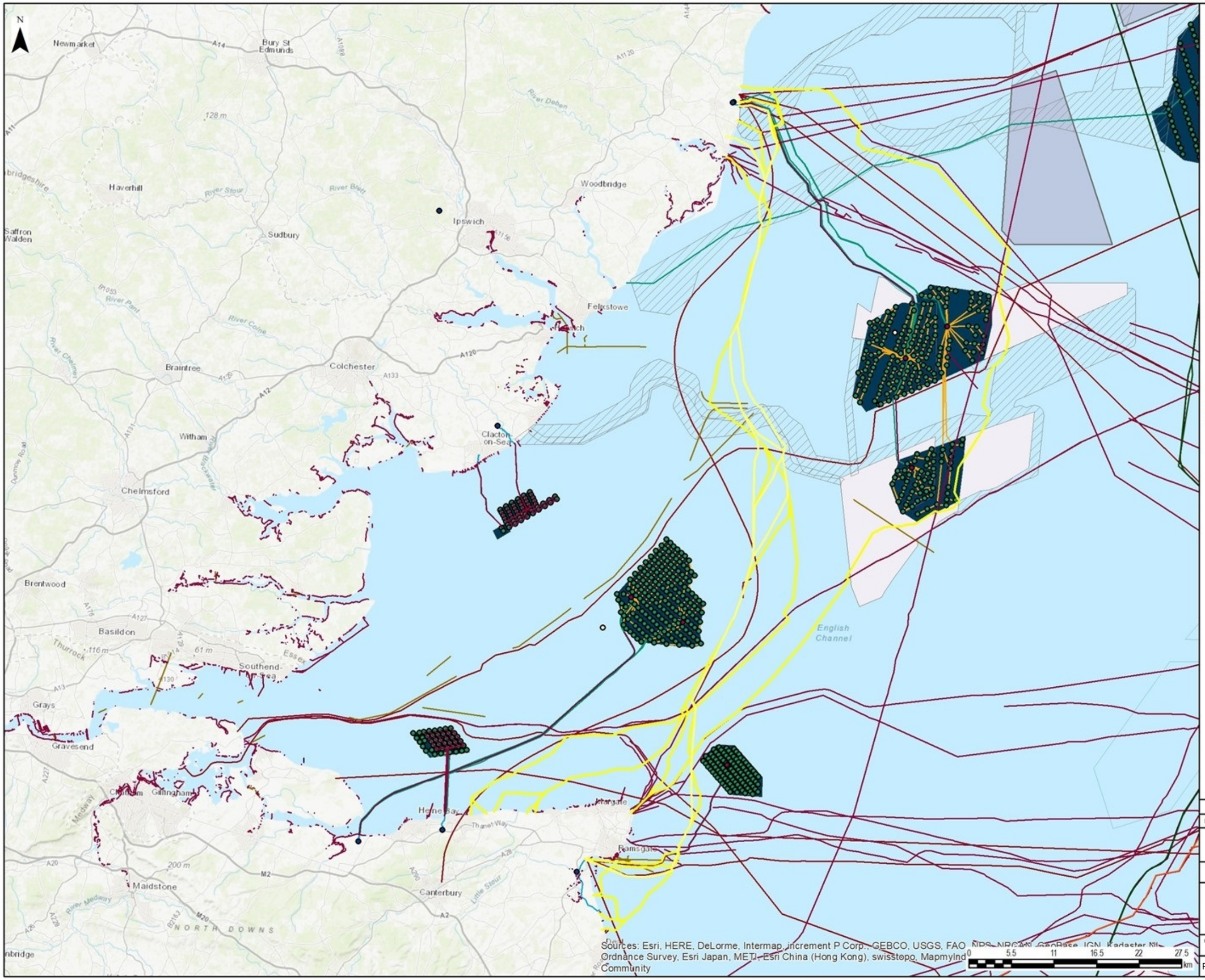
7.4.3 In the northern higher density area are the landings of the East Anglia One windfarm export cables (north of Felixstowe), three Greater Gabbard windfarm export cables, two Galloper windfarm export cables, and seven telecommunications cables, of which four are currently in use, namely Farland North, Hermes North, Concerto 1S and Concerto 1N. It should be noted that additional windfarm export cables may be installed in this area in the future as a result of projects currently in the planning phase, such as East Anglia One North, East Anglia Two and East Anglia Three.

7.4.4 The southern higher density area has historically been the preferred landing point for cables heading to north-west Europe, such as the Nemo Link interconnector and several telecommunications cables, of which only the Pan European Crossing (PEC) and the Tangerine cables remain in use. In addition, the Thanet windfarm export cables make landfall in Pegwell Bay. The Thanet windfarm extension export cable was also due to make landfall in this location, however the application for a Development Consent Order (DCO) was rejected (though not for reasons relating to the export cable). In this area two more additional developments are planned namely GridLink, a power cable connecting UK to France, and Mercator a telecommunication cable developed by British Telecom.

7.4.5 In the central part of the wider Thames Estuary is the London Array windfarm which does not have direct interactions with the marine alignments and the BritNed interconnector, which connects England to the Netherlands and would require crossing. Further developments are planned, including the NeuConnect interconnector and the Five Estuaries and North Falls offshore wind farms and associated export cables.

7.4.6 There is no oil and gas infrastructure present in the area.

Figure 7-13 Infrastructure in the Wider Thames Estuary



LEGEND

- Marine Alignments
- UK Fibre Cables
- SIGCables Submarine Cables Routes
- BSH CONTIS Cables
- MTF Industrial Lines
- MTF Obstructions Lines
- MTF Transport Lines
- Offshore Substation
- Onshore Substation
- Turbine
- Met Mast
- Export Cable Corridor
- Export Cable
- Infield Cable
- Interconnectors
- Onshore Cable
- Transmission Cable

Offshore Windfarm

Status

- Concept/Early Planning
- Consent Application Submitted
- Consent Authorised
- Pre-Construction
- Under Construction
- Partial Generation/Under Construction
- Fully Commissioned
- Decommissioned
- Development Zone

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Infrastructure in the Wider Thames Estuary

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Figure 7-13

Shipping and Navigation

7.4.7 Shipping activity around the world is monitored in real time by the Automatic Information System (AIS). All international voyaging ships with a gross tonnage of 300 or more tonnes and all passenger ships, regardless of size, are required to have AIS on board, according to the International Maritime Organisation (IMO) and the International Convention for the Safety of Life at Sea (SOLAS). The vessel density for the marine study area, as provided by European Marine Observation and Data Network (EMODnet) (https://www.emodnet-humanactivities.eu/view-data.php) is based on this AIS data, and is presented in **Figure 7-14**.

7.4.8 The North Sea contains some of the busiest shipping routes in Europe, fishing activities and leisure sailing also takes place, as well as construction and maintenance vessels that move to and from offshore wind farms.

7.4.9 To enhance safety of navigation within the North Sea every merchant vessel and passenger ship over 10,000 tons had to meet the IMO's mandatory carriage requirements for Electronic Chart Display and Information System (ECDIS) by mid-2018. Due to the high traffic in the North Sea all ports have elaborate vessel traffic services to monitor and direct ships into and out of ports. Traffic Separation Schemes (TSS) (**Figure 7-15**) are also used, these areas are where ships are highly regulated. These schemes are meant to create lanes in the water where ships are travelling in the same direction.

7.4.10 Within the study area there are two key Vessel Traffic Schemes (VTS): one to the north, the Sunk Precautionary Area (the 'Sunk') and one further south to access the Queen channel, off the coast of north-east Kent (**Figure 7-15**).

7.4.11 The Sunk can be considered as an offshore roundabout in which the access is via one of the TSS, or by the recommended ferry route. The Sunk North TSS and Sunk South TSS offer vessels on north/south passage access to the outer precautionary area, while the Sunk East TSS is provided for vessels on east/west passage (noting the majority of east/west bound traffic would be expected to be associated with mainland Europe).

7.4.12 Access to Queen channel and Margate Road is via The North East Spit area in between Broadstairs and Thanet offshore wind farm. In a similar way to the Sunk, this area is used for vessel traffic coming from the English Channel and the southern North Sea. Additionally, it is used as weather shelter, especially in the area around Margate Road.

7.4.13 It should be noted that the Thanet Extension Application (ExA) was refused by the SoS mainly due to the impact on shipping and navigation activities, it was stated 'The conclusion of the ExA is that the Applicant failed to demonstrate sufficient mitigation of risks to safety of navigation to make them As Low As Reasonably Practicable (ALARP)'. The major effects were impacting sea room and safe navigation, pilot transfer operations, shipping routes, ports and port operations. It is understood that the impacts on navigation are mainly related to the wind farm array area posing a permanent impact on shipping and navigation. Further south, high-density vessel activities are present again in vicinity of Ramsgate Port.

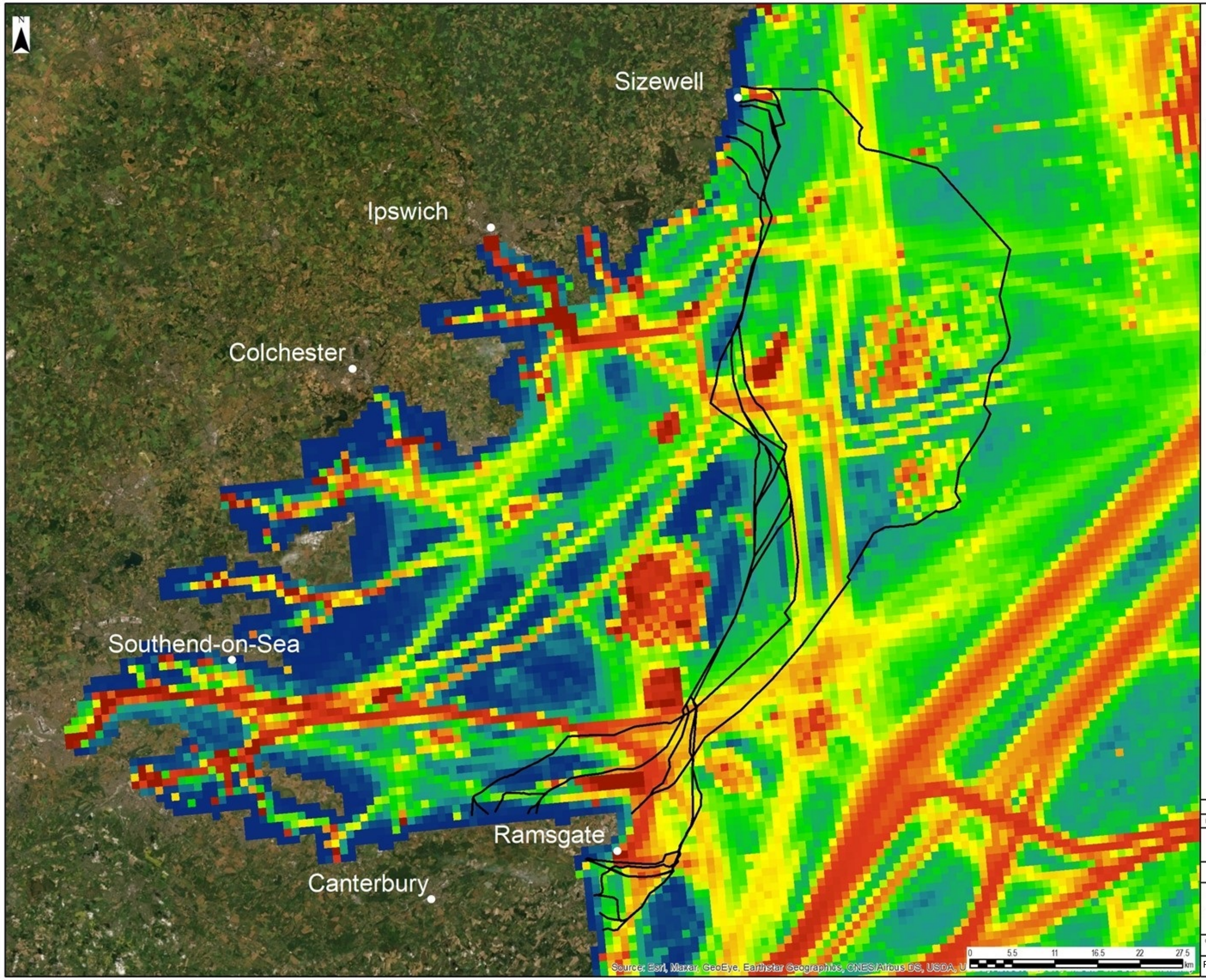
7.4.14 Charted anchorage areas are presented in **Figure 7-15**, however many ships anchor in a traditional anchorage off Margate Roads which is north of Margate.

Restricted Areas

7.4.15 Several dumping grounds for dredged materials (from navigation dredging) and aggregate extraction areas are present in the study area, as shown by the latest Crown Estate data in **Figure 7-16**. These areas have been carefully considered and avoided by the marine alignments.

7.4.16 Multiple military Practice and Exercise Areas (PEXA) are located within the study area (**Figure 7-16**); however, in general these areas are not considered a limitation to the project. Military exercises are usually announced several days prior to the activity (https://www.gov.uk/government/collections/firing-notice). The warning will indicate the location, the nature and restrictions regarding sailing, anchoring and offshore activities within the restricted area.

Figure 7-14 Area of Interest (AOI) EMODnet Vessels Density (2019)



LEGEND

Marine Alignments

EMODnet Vessel Density Human Activities 2019

100+
20
10
5
2
0.5

Hours per Square Km per Month

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Area of Interest (AOI) EMODnet Vessels Density (2019)

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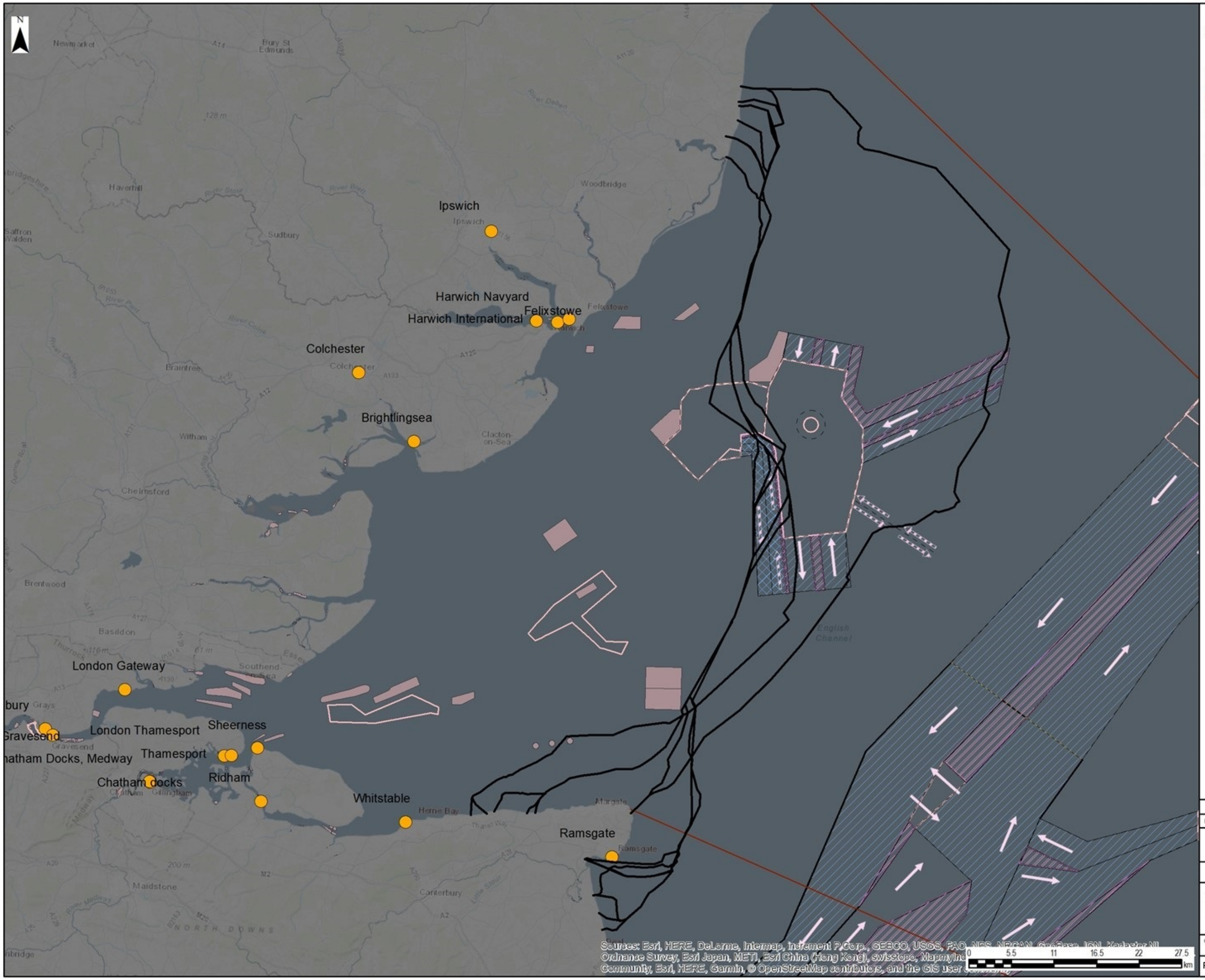
VP	25/08/2021	RH	25/08/2021	KS	25/08/2021

Figure 7-14	Scale: 1:450,000	Format: A3	Sheets:	Rev: 1

Figure 7-15 AOI Traffic Separation Scheme



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AOI Traffic Separation Scheme

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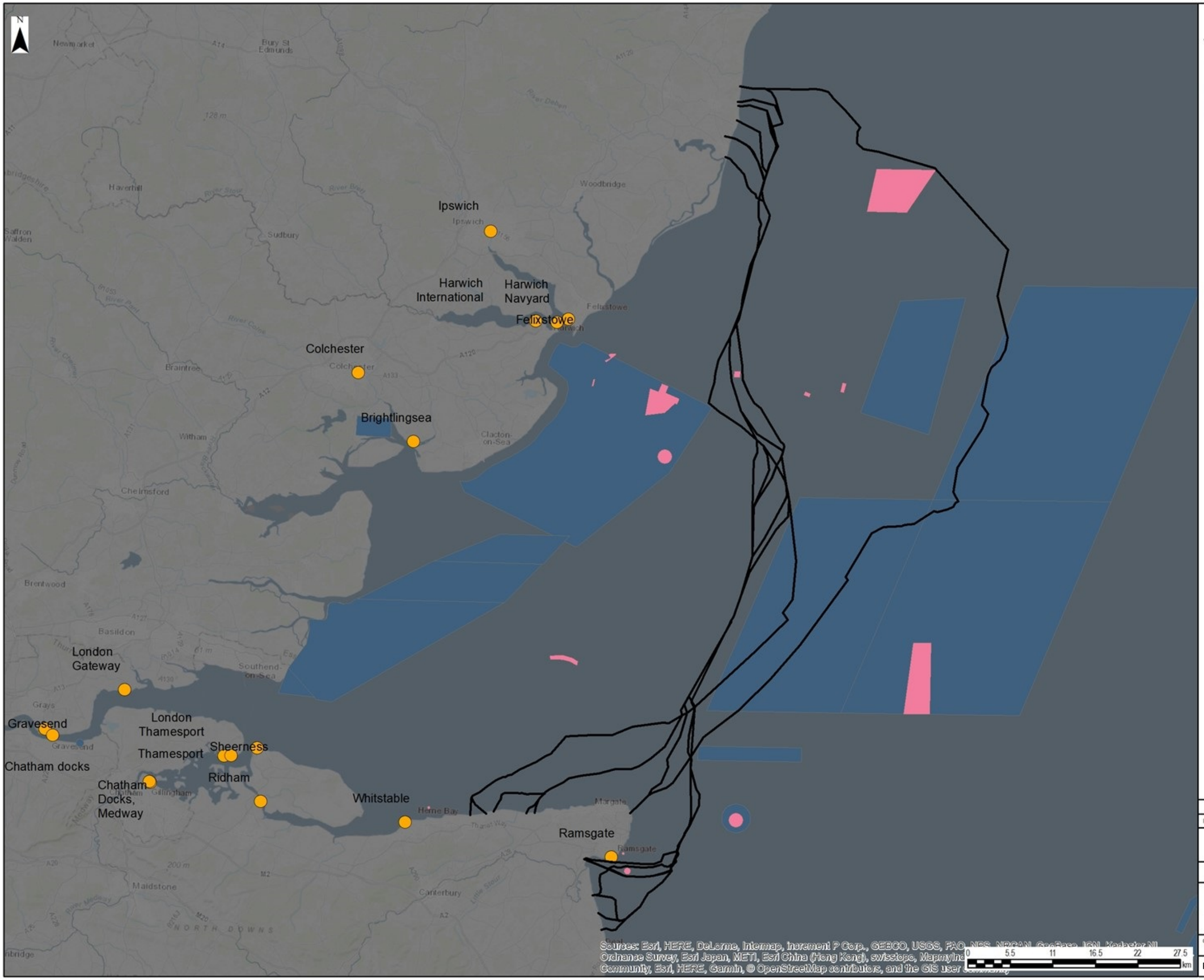
Figure 7-15	Scale: 1:450,000	Format: A3	Sheets:	Rev: 1

Figure 7-16 AOI Restricted Areas



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AOI Restricted Areas

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	Scale:	Format:	Sheets:	Rev:
Figure 7-16	1:450,000	A3		1

Commercial Fisheries

7.4.17 Commercial fishing activities occur throughout the Project study area. The marine alignments have the potential to intersect with areas of shellfish production and the spawning and nursery grounds of a number of commercially fished species. The potential for these interactions exist across the Project study area. The Project has a dedicated Fisheries Liaison Officer (FLO) who will engage with all commercial fisheries stakeholders and if necessary suitable mitigation will be identified and agreed and Notice to Mariners issued.

Other Sea Users

7.4.18 Other sea users, such as recreational watercraft, utilise the waters throughout the Project study area, however, densities are highest in nearshore/coastal waters. Potential impacts will be temporary in nature and the project will engage with all stakeholders to ensure disruption to recreational vessels is kept to a minimum where possible and Notice to Mariners issued.

Marine Planning

7.4.19 During the appraisal, consideration has been given to relevant marine plans which the Project falls within, these being:

- East Inshore Marine Plan, and;
- South East Inshore Marine Plan

7.4.20 In addition, the following proposed major projects have been considered when looking at all potential interactions with the marine alignments:

- Sizewell C
- Gridlink Interconnector
- NeuConnect Interconnector
- Nautilus Interconnector
- Eurolink Interconnector
- Thanet Offshore Windfarm Extension
- North Falls Offshore Windfarm
- Five Estuaries Offshore Windfarm
- Proposed Aggregate Extraction Areas
- East Anglia One North Offshore Windfarm
- East Anglia Two Offshore Windfarm
- East Anglia Three Offshore Windfarm

7.4.21 Effective and meaningful engagement for the preferred marine route option will help to ensure that potentially affected parties are informed about potential disturbance, however minor.

7.4.22 Site-specific engagement with the licensed aggregate exploration/ extraction areas and offshore wind farms will help to minimise disruption.

7.4.23 Therefore, in terms of marine planning, constraints to the Projects marine routeing element and the associated potential impacts will be addressed via engagement with other developers and the consenting process including early engagement with the Marine Management Organisation (MMO) to draw on their marine plan review process and by means of the conflicts check undertaken by the Crown Estate received when processing the Projects seabed survey licence application (summer 2021).

7.5 Marine Options Appraisal Summary

7.5.1 The development of the marine alignments has considered the cables that have to be crossed, the burial/cable protection activities that may be required, the preparation of the route for installation, the seafloor geology, geomorphology, and geohazards, military exercise areas, aggregate extraction activities, harbour approaches, vessel traffic separation zones, and exclusion zones, anchorages, historical munitions dumping areas, and the protections afforded to certain areas of nature conservation interest.

7.5.2 As discussed in **Chapter 5**, Element 2, in order to perform a meaningful appraisal in the extensive marine environment, 500m wide alignments were identified, which were informed by the marine routeing criteria detailed in **Chapter 5**. All options appraised are considered viable from an engineering perspective with the exception of K1a – S9 (**Figure 7-1**); this option was discounted due to the extensive engineering risks and cost implications associated with moving further east into the offshore environment. This option is not considered any further in this report.

7.5.3 As described in **Chapter 6**, to help determine the emerging preferred reinforcement elements that make up the Project a further review of the marine alignment section options was undertaken by each topic lead.

7.5.4 This review was applied to each section of marine alignment as well as the associated landfall areas of search (**Figure 5-3** and **Figure 5-4**). A further review was then undertaken to identify an ‘on balance’ preferred option. The key considerations and differentiators are discussed below.

Marine Alignments and Landfalls (up to MHWS) - Kent

7.5.5 As shown in **Figure 7-6** and **Figure 7-7** and listed in **Table 7-2** the section of the Kent coast within the Project study area has a number of national and international nature conservation designations, with all potential marine alignment options interacting with several of these designations, to varying degrees, on approach to landfall.

Table 7-2 Sites Designated for their Nature Conservation Value with which the Kent Marine Alignments Interact

Landfall Area	Marine Alignment Section(s)	Designation	Proximity
K1	K1b/K1c/K1d/K1e/K1f/K1g	Sandwich Bay to Hacklinge Marshes SSSI	Intersects
		Sandwich & Pegwell Bay NNR	Intersects
		Sandwich Bay SAC	Intersects
		Thanet Coast & Sandwich Bay SPA	Intersects
		Thanet Coast & Sandwich Bay Ramsar	Intersects
		Goodwin Sands MCZ	Intersects
K1a	K1a	Thanet Coast SAC	Intersects
		Thanet Coast MCZ	Intersects
		Thanet Coast SSSI	Intersects
		Thanet Coast & Sandwich Bay SPA	Intersects
		Thanet Coast & Sandwich Bay Ramsar	Intersects
K2	K2	Thanet Coast SAC	Intersects
		Thanet Coast MCZ	Intersects
		Thanet Coast SSSI	Intersects
		Thanet Coast & Sandwich Bay SPA	Intersects
		Thanet Coast & Sandwich Bay Ramsar	Intersects
		Outer Thames Estuary SPA	Intersects
		Margate and Long Sands SAC	Intersects
K3	K3	Thanet Coast MCZ	Intersects
		Thanet Coast SSSI	Intersects
		Thanet Coast & Sandwich Bay SPA	Intersects
		Thanet Coast & Sandwich Bay Ramsar	Intersects
		Outer Thames Estuary SPA	Intersects
		Margate and Long Sands SAC	Intersects

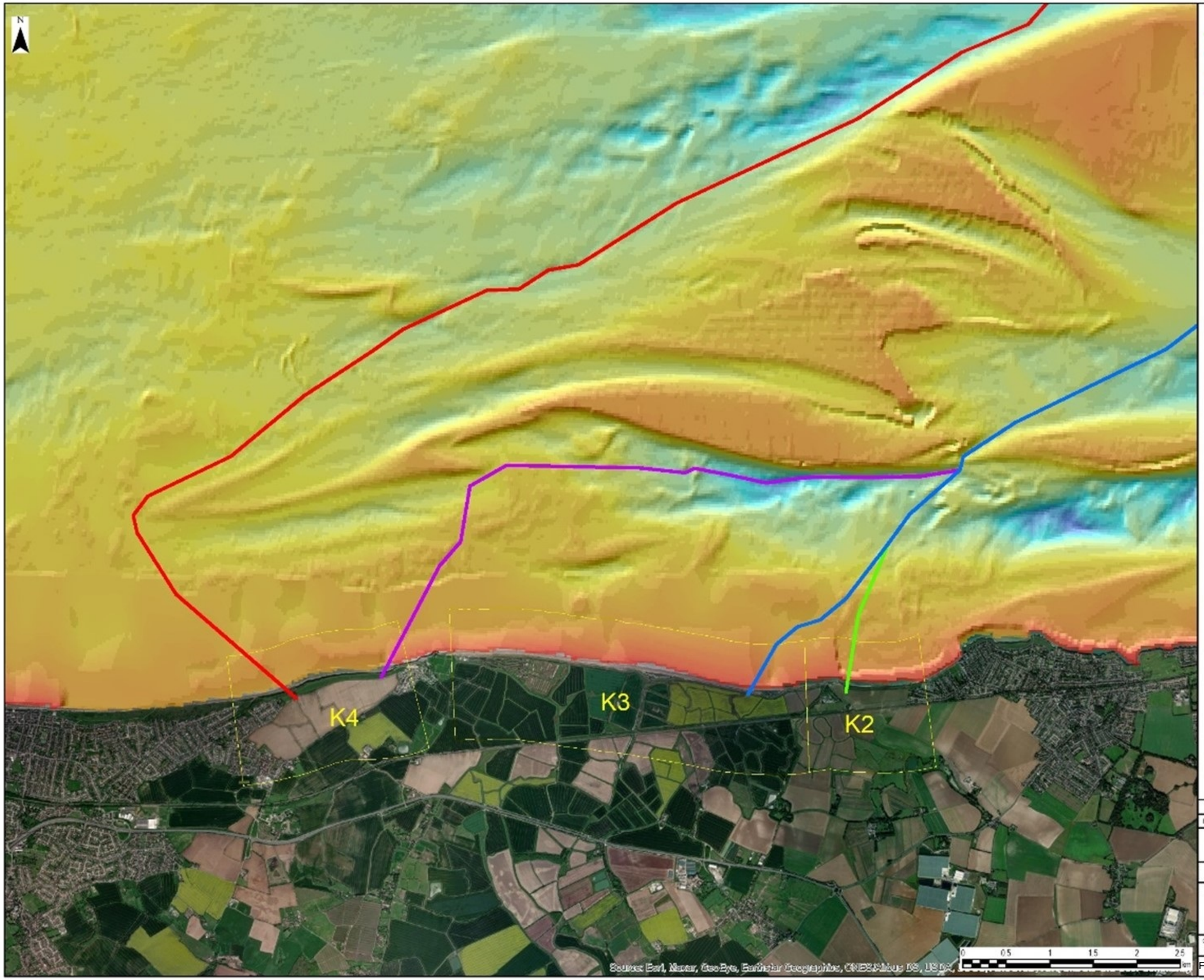
Landfall Area	Marine Alignment Section(s)	Designation	Proximity
K4	K4a/K4b	Thanet Coast MCZ	Intersects
		Thanet Coast SSSI	Intersects
		Thanet Coast & Sandwich Bay SPA	Intersects
		Thanet Coast & Sandwich Bay Ramsar	Intersects
		Outer Thames Estuary SPA	Intersects
		Margate and Long Sands SAC	Intersects
		Bishopstone Cliffs LNR	Intersects

7.5.6 Detailed consideration has therefore been given to the potential activities associated with cable installation and operation on the type of features for which the sites are designated, the distribution of the features within the sites and the sensitivity and recoverability of the features. The extent of interaction and potential for mitigation were also considered.

7.5.7 Marine alignment sections K2, K3, K4a, and K4b (**Figure 7-4**) were determined to be the least preferred options from a nature conservation perspective due to the length of interaction with the Margate and Long Sands SAC in particular and also the interaction with the Thanet Coast MCZ and Thanet Coast SAC (**Figure 7-6**).

7.5.8 Several significant constraints were also identified around the marine alignment sections K2, K3 and K4b approaching landfalls on the North Kent coast from a physical environment perspective. It is unlikely that mobile sandbanks could be avoided, some of which may be exposed at low tide (**Figure 7-17**) which presents a considerable exposure and engineering risk. It is also likely that there would be some interaction with key anchorage areas offshore of Margate.

Figure 7-17 Mobile Sandbanks along the North Kent Coast



LEGEND

- K2
- K3
- K4a
- K4b
- Landfall Areas

Bathymetry

Value

High : 5

Low : -20

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Mobile Sandbanks along the North Kent Coast

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DS	16/08/2021	DF	16/08/2021	CC	16/08/2021

Figure 7-17	Scale: 1:40,000	Format: A3	Sheets:	Rev: 1

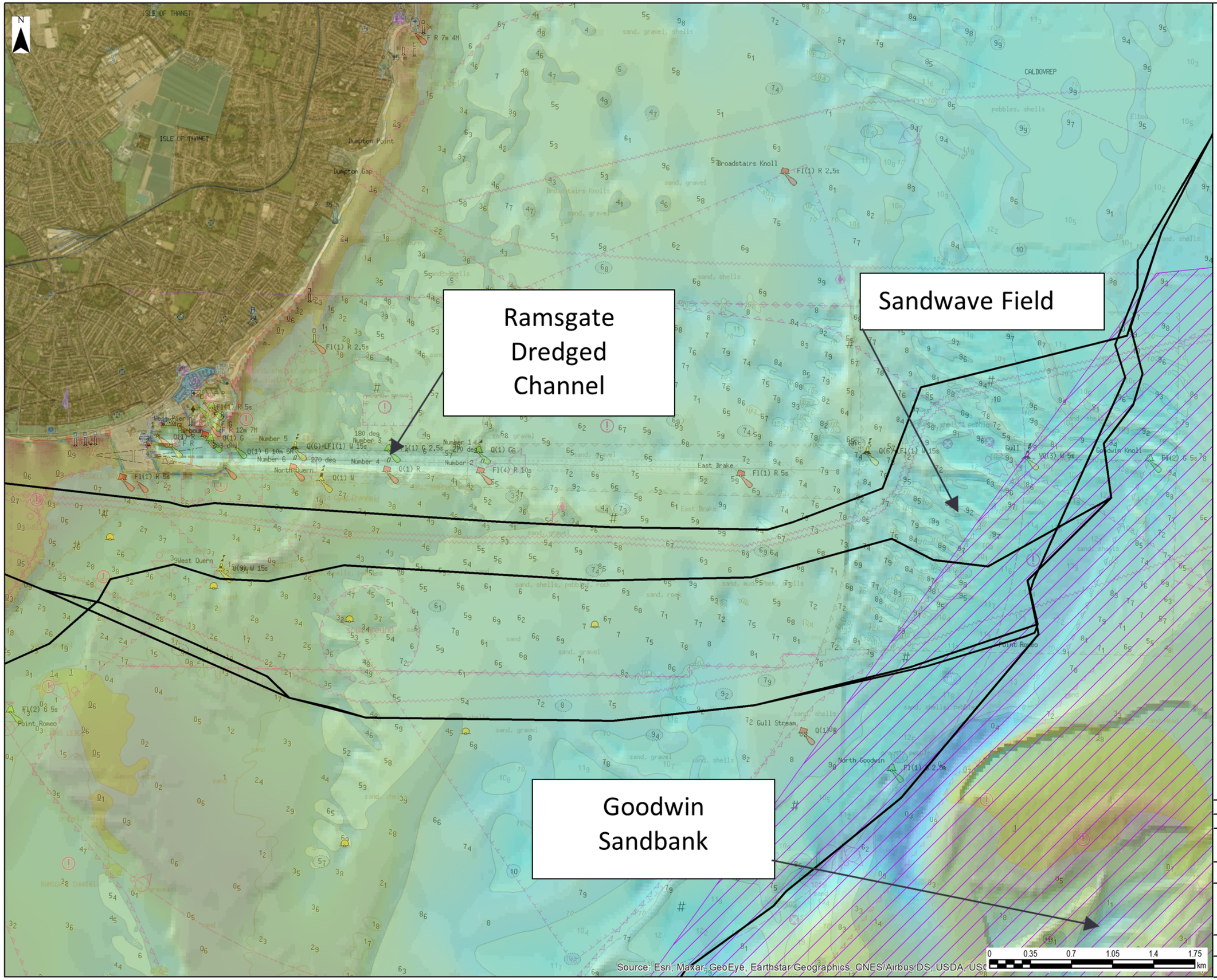
7.5.9 All routes making landfall at K1 in Pegwell Bay and K1a at Broadstairs also interact with areas designated for their nature conservation value (**Table 7-2**). Although these marine approaches and landfalls are all constrained from a biological environment perspective, there is a slight preference for K1a at Broadstairs because the extent of interaction with the designated sites is smaller and it would also be possible to avoid the Goodwin Sands MCZ in the offshore environment (**Figure 7-6**) and for marine alignments K1d/K1e/K1f and K1g in Pegwell bay as the extent of interaction with the designations is reduced towards the south of landfall area K1 (**Figure 7-6** and **Figure 7-7**). Potential impacts during construction, operation and maintenance within these coastal designations would be temporary and would not result in any permanent habitat loss.

7.5.10 Goodwin Sands MCZ cannot be avoided by the identified marine alignments connecting to landfalls in Pegwell Bay, although marine alignment K1b would require a shorter interaction with this designation than all others. This interaction is due to the routeing in this area being constrained, to the east, by the Goodwin Sandbank - routeing over the Goodwin Sandbank would increase the risk of cable exposure during the lifetime of the cable and subsequently would likely result in the requirement for additional rock protection associated with any remedial works to be put in place potentially resulting in permanent habitat loss - and to the west by the Ramsgate dredged channel and an area of sandwave fields (**Figure 7-18**).

7.5.11 Additionally, when routeing east out from Pegwell Bay, in order to head north the route must cross the Nemo Link cable and the Thanet Offshore Wind Farm export cables, requiring the placement of rock protection on the seabed at these locations potentially resulting in permanent habitat loss including within the Goodwin Sands MCZ. The water depths in this area are very shallow, slowly gaining depth moving to the east (**Figure 7-18**). In order to avoid unacceptable reductions in water depths that could pose a hazard to marine vessels (reduction of no more than 5% of water depth – advice from Maritime Coastal Agency[9]) proposed crossings locations should therefore be located in areas with a suitable water depth.

[9] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/980898/MGN_654_-_FINAL.pdf

Figure 7-18 Key Constraints on Approach to K1



LEGEND

Marine Alignments

Marine Conservation Zones

Goodwin Sands

Bathymetry

Value

High : 5

Low : -20

Charts provided by
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source C-Map Data.

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Key Constraints on Approach to K1

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Figure 7-18	Scale: 1:30,000	Format: A3	Sheets:	Rev: 1

7.5.12 Considering the factors described above (dredged areas, acceptable navigational depths and seabed features) routeing within the northwest corner of the Goodwin Sands MCZ has been unavoidable due to there being no alternative route options available.

7.5.13 Marine routeing into Broadstairs (K1a) would require fewer marine cable crossings than the routes connecting into Pegwell Bay as there would be no requirement to cross with Thanet Offshore Windfarm export cables and the Nemo Link interconnector. However, K1a is located at a popular recreational beach location, meaning there could be a greater temporary recreational impact during construction at this landfall location.

7.5.14 A number of marine alignments approaching landfall at Pegwell Bay have been appraised (K1b- K1f shown on **Figure 7-4**). All these options interact with designations of nature conservation to some varying degree or another with marine sections to the south intersecting with these designations for a shorter distance than those to the north (**Figure 7-6** and **Figure 7-7**).

7.5.15 Although landfalls in Pegwell Bay would interact with designated sites these could be largely mitigated by using non-open cut techniques, such as HDD. This would avoid the need to trench across areas of saltmarsh and intertidal habitat, which could potentially result in greater habitat loss and water quality effects.

7.5.16 For marine alignment sections K1b and K1c (**Figure 7-4**) it has been assumed that access to the seaward end of the HDD in the intertidal area will be from the sea by a marine vessel or limited terrestrially to the site of the disused hoverport located in the bay, to avoid impacts to the sensitive saltmarsh habitat in the northern part of the bay (see Image below).

Summary

7.5.17 Taking into account all of the factors set out above the preferred option from a marine routeing perspective is K1a, which makes landfall at Broadstairs. Whilst K1a is preferred

routes connecting into Pegwell Bay at landfall K1 are preferred to any of the options which route to the North Kent Coast.

Marine Alignments and Landfalls (up to MHWS) – Suffolk

7.5.18 As shown in **Figure 7-6** and **Figure 7-7**and listed in **Table 7-3** the section of the Suffolk coast within the Project study area has a number of nature conservation designations, with all potential marine alignment options interacting with these designations, to varying degrees, on approach to landfall.

Table 7-3 Sites Designated for their Nature Conservation Value with which the Suffolk Marine Alignments Interact

Landfall Area	Marine Alignment Section(s)	Designation	Proximity
S1	S1	Outer Thames Estuary SPA	Intersects
		Southern North Sea SAC	Intersects
		Alde-Ore & Butley Estuaries SAC	Possible Intersection*
		Alde-Ore Estuary SSSI	Possible Intersection*
		Alde-Ore Estuary SPA	Possible Intersection*
		Alde-Ore Estuary Ramsar	Possible Intersection*
S2	S2	Outer Thames Estuary SPA	Intersects
		Southern North Sea SAC	Intersects
		Leiston-Aldeburgh SSSI	Intersects
S3	S3	Outer Thames Estuary SPA	Intersects
		Southern North Sea SAC	Intersects
		Leiston-Aldeburgh SSSI	Intersects
S3	S3N	Outer Thames Estuary SPA	Intersects
		Southern North Sea SAC	Intersects
S5	S5	Outer Thames Estuary SPA	Intersects
		Southern North Sea SAC	Intersects
		Minsmere-Walberswick Heaths and Marshes SSSI	Intersects
		Minsmere-Walberswick Heaths and Marshes SAC	Intersects
		Minsmere-Walberswick SPA	Intersects
		Minsmere-Walberswick Ramsar	Intersects

*Routeing at landfall avoids intersecting with this site, however the wider marine corridor could interact

7.5.19 Of the marine alignment options that make landfall in the Sizewell area (**Figure 7-2**) S5 is considered to be more constrained than the other options due to the additional number of offshore crossings that would be required (**Figure 7-13**) and the potential for interaction with the Sizewell C development (see **Figure 9-2**) in **Chapter 9**.

7.5.20 Marine alignment option S3 (**Figure 7-2**) is also considered significantly constrained due to the rocky reefs comprised of cemented limestone rich shells in the immediate offshore environment.

7.5.21 Marine alignment option S5 (**Figure 7-2**) intersects with the Leiston-Aldeburgh SSSI and The Haven, Aldeburgh LNR both of which extend onto the foreshore (**Figure 7-7**), however the use of a trenchless technique, if feasible, at the landfall would mitigate impacts.

7.5.22 Marine alignment S1 (**Figure 7-2**) is not significantly constrained in the offshore environment.

Summary

7.5.23 Considering the above factors, the preferred options are landfalls S1, S2 or S3 with associated marine alignments S1, S2 and S3N.

Marine Alignments – Central Section

7.5.24 As shown on **Figure 7-1** the central section of the offshore route is common to both the Kent and Suffolk alignment options.

7.5.25 As shown in **Figure 7-5** and listed in **Table 7-4** the central section of the Project study area has a number of nature conservation designations with all potential marine alignment options interacting with these designations to varying degrees.

Table 7-4 Sites Designated for their Nature Conservation Value with which the Central Marine Alignments Interact

Landfall Area	Marine Alignment Section(s)	Designation	Proximity
S1	S1	Margate and Long Sands SAC	Intersect
		Outer Thames Estuary SPA	Intersect
		Southern North Sea SAC	Intersect
N/A	C2	Outer Thames Estuary SPA	Intersect
		Southern North Sea SAC	Intersect
N/A	C3	Kentish Knock East MCZ	Intersect
		Outer Thames Estuary SPA	Intersect
		Southern North Sea SAC	Intersect
N/A	C4	Margate and Long Sands SAC	Intersect
		Outer Thames Estuary SPA	Intersect

Landfall Area	Marine Alignment Section(s)	Designation	Proximity
		Southern North Sea SAC	Intersect
N/A	C5	Outer Thames Estuary SPA	Intersect
		Southern North Sea SAC	Intersect
N/A	C6	Outer Thames Estuary SPA	Intersect
		Southern North Sea SAC	Intersect
N/A	C7	Outer Thames Estuary SPA	Intersect
		Southern North Sea SAC	Intersect
N/A	C8	Outer Thames Estuary SPA	Intersect
		Southern North Sea SAC	Intersect

7.5.26 There is a particularly constrained area within the central section where the north-eastern extent of the Margate and Long Sands SAC abuts the Sunk TSS (**Figure 7-1**). Also present are several aggregate extraction areas and deep-water shipping channels.

7.5.27 In addition, there are three proposed projects in this area, namely the NeuConnect Interconnector and the proposed Five Estuaries and North Falls Offshore Wind Farms (export cable corridors unknown at this stage of routing and siting), as well as the existing Greater Gabbard and Galloper Offshore Wind Farms (**Figure 7-1**).

Figure 7-19 Key Constraints in the Central Section of the Project Study Area

N

Margate and Long Sands SAC

SUNK TRAFFIC SEPARATION SCHEME NORTH

SUNK OUTER PRECAUTIONARY AREA (see Note)

SUNK TRAFFIC SEPARATION SCHEME EAST

SUNK OUTER (see Note)

SUNK TRAFFIC SEPARATION SCHEME SOUTH

Long Sand Head Two-way Route (see Note)

KENTISH KNOCK

NORTH FALLS

Legend

- NeuConnect
- Aggregate Areas
- Offshore Wind Site Agreements
- Special Area of Conservation (SAC)

0 5 10 15 20 km

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0	07/06/2022	CPRSS REPORT	EB	DF	KS

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Key Constraints in the Central Section of the Project Study Area

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EB	07/06/2022	DF	07/06/2022	KS	07/06/2022

Figure 7-19 | Scale: 1:150,000 | Format: A3 | Sheets: 1 | Rev: 0

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Summary

7.5.28 Considering the potentially conflicting constraints relating to the biological environment, shipping and navigation and existing and proposed new infrastructure in this central section it was agreed to discuss the emerging marine routeing preferences with stakeholders to obtain their feedback to help inform decision making.

7.6 Stakeholder Engagement

7.6.1 The draft outputs of the marine options appraisal were presented to stakeholders to help inform the decision making and reduce potential for consenting risk. This was undertaken in advance of the planned project specific marine survey (summer 2021), to ensure the most likely route was surveyed.

7.6.2 The stakeholders engaged with at this stage are listed in **Table 7-5** below.

Table 7-5 Marine Stakeholders

Developers	Statutory Bodies	Port Authorities	Industry Bodies
Sizewell C - SZC	MMO	Port of London Authority	National Federation for Fisherman's Organisations
Sizewell B - EDF	The Crown Estate	Harwich Haven Authority	
Nautilus/Euro link/BritNed/ Nemo Link - NG Ventures	Environment Agency	Port of Felixstowe	
EA1, EA1N EA2 – Scottish Power Renewables (SPR)	Natural England	Port of Lowestoft	
Galloper OWF - Innogy	Historic England	Port of Ramsgate	
Galloper Export Cable – Diamond Transmission	Inshore Fisheries and Conservation Authorities		
Greater Gabbard Export Cable - Equitix	Maritime And Coastguard Agency		
GridLink	Trinity House		
Thanet OWF- Vattenfall			
Thanet Export Cable – Balfour Beatty			

Developers	Statutory Bodies	Port Authorities	Industry Bodies
NeuConnect			
Five Estuaries OWF-RWE			
North Falls OWF RWE, SSE			
Telecoms Cables – BT/GTT/Lumen			
Aggregate Operators – Cemex/Hanson/ Tarmac/Britannia Aggregates			

7.6.3 The most significant marine survey route refinements based on stakeholder feedback were in the following areas:

- North east of the Margate and Long Sands SAC
- South west of Thanet Offshore Wind Farm

Northeast of the Margate and Long Sands SAC

7.6.4 The original proposed marine alignments in this area are the black routes shown on **Figure 7-20**. These routes provided suitable seabed conditions for cable installation (geology and topography), whilst also being the most direct route to the Suffolk landfalls.

7.6.5 The route was refined as a result of feedback from:

- Natural England;
- Maritime and Coastguard Agency;
- Trinity House;
- PLA;
- Harwich Haven Authority;
- Port of Felixstowe;
- North Falls Offshore Windfarm;
- Five Estuaries Offshore Windfarm; and
- the aggregate extraction operators of Areas 508, 509/3,510/1 and 510/2.

7.6.6 Natural England expressed concerns regarding the potential impacts of crossing the proposed NeuConnect cable within the Margate and Long Sands SAC as the material required for the crossing would introduce hard substrate into a naturally sandy environment, which could permanently change the protected features in this site.

Natural England also advised that their preference was for the project to avoid any cable installation in the protected site.

7.6.7 The navigational bodies also expressed concerns regarding the cable routeing in this area, specifically in relation to the potential for a reduction of navigable depths because of rock protection at the potential crossing with NeuConnect. Concerns were also raised relating to cable installation in this area, due to the high shipping density caused by the Long Sands Head Deep shipping channel; however, it was agreed that the implementation of a robust vessel management plan during installation would address this issue.

7.6.8 The aggregate operators advised that their preference was for the route to be located to the east of Area 510/2 to minimise interaction with their operations.

7.6.9 Based on the above stakeholder feedback the black marine alignment furthest to the to the east (C8) was identified as this alternative:

- routes to the East of aggregate extraction Area 510/2; and
- crosses NeuConnect in deep waters outside Margate and Long Sands SAC and Long Sands Two Way Shipping Channel.

7.6.10 However, following consultation with the developers of North Falls Offshore Wind Farm it was established that they had identified the same area for their proposed export cables (**Figure 7-20**) and that they were undertaking their offshore survey imminently. As such the route was reviewed again to try to avoid potential complications regarding crowding and installation and an alternative C8A (**Figure 7-20**) was identified.

7.6.11 Discussions with Five Estuaries Offshore Windfarm highlighted potential constraints of the C8A alternative with their proposed export cable route.

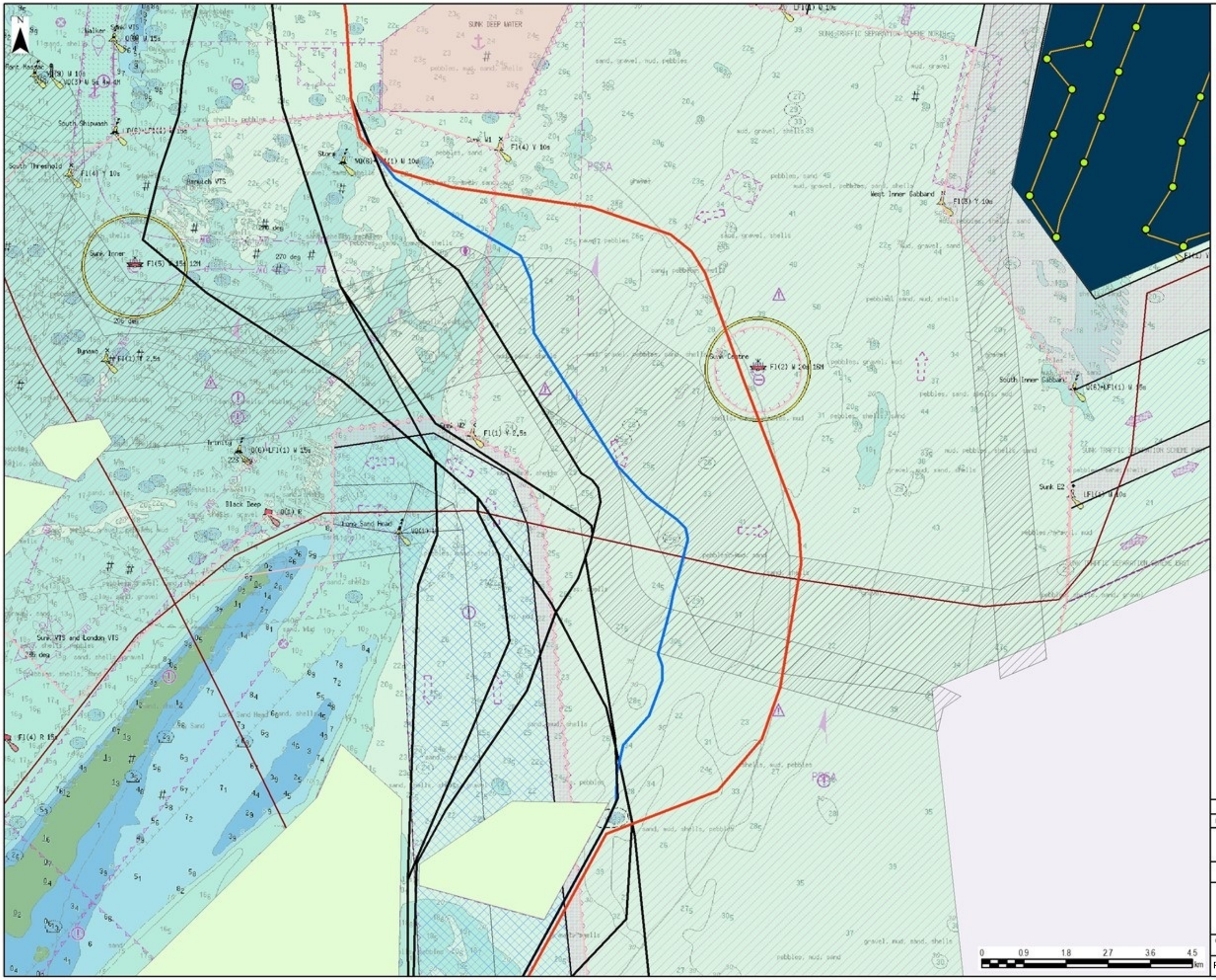
7.6.12 Due to the proximity to the Sunk TSS and the associated high shipping density to the north and east of these proposed export cable corridors and the shallower waters and sensitive benthic habitats of the Margate and Long Sands SAC to the west, it was determined that a further deviation needed to be identified.

7.6.13 Factoring in the parameters (shipping density and water depth) provided by the navigational bodies, an additional marine alignment section, referred to as C8B (**Figure 7-20**) was identified. This refined route:

- avoids the higher density shipping areas in the Sunk TSS;
- keeps the crossings of the proposed NeuConnect cable and North Falls and Five Estuaries offshore windfarms export cables in deeper water and out of the busy shipping lanes; and
- avoids the Margate and Long Sands SAC.

7.6.14 This results in a route deviating east to the centre of the Sunk TSS approach channels, where the shipping density is lower (**Figure 7-21**) and the crossings could be in deeper water (**Figure 7-22**), routeing north through the centre of the Sunk TSS, where the shipping density is again lower, before routing west, north of the Harwich and Port of Felixstowe approach channel to avoid the higher shipping density in this area. The revised route received the support of the navigational bodies.

Figure 7-20 Potential Interaction with other Proposed Developments



LEGEND

- C8B
- C8A
- Marine Alignments
- Aggregate Extraction Area
- Anchorage area
- Wind Turbines
- Array Cables
- Interconnectors
- Export Cable Corridor

Offshore Windfarm

Status

- Concept/Early Planning
- Consent Application Submitted
- Consent Authorised
- Pre-Construction
- Under Construction
- Partial Generation/Under Construction
- Fully Commissioned
- Decommissioned
- Development Zone

MTF Administrative Areas

- Precautionary area
- Traffic separation, Lane part
- Traffic separation, Zone
- Two-way route part

Charts provided by
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source C-Map Data.

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Potential Interaction with other Proposed Developments

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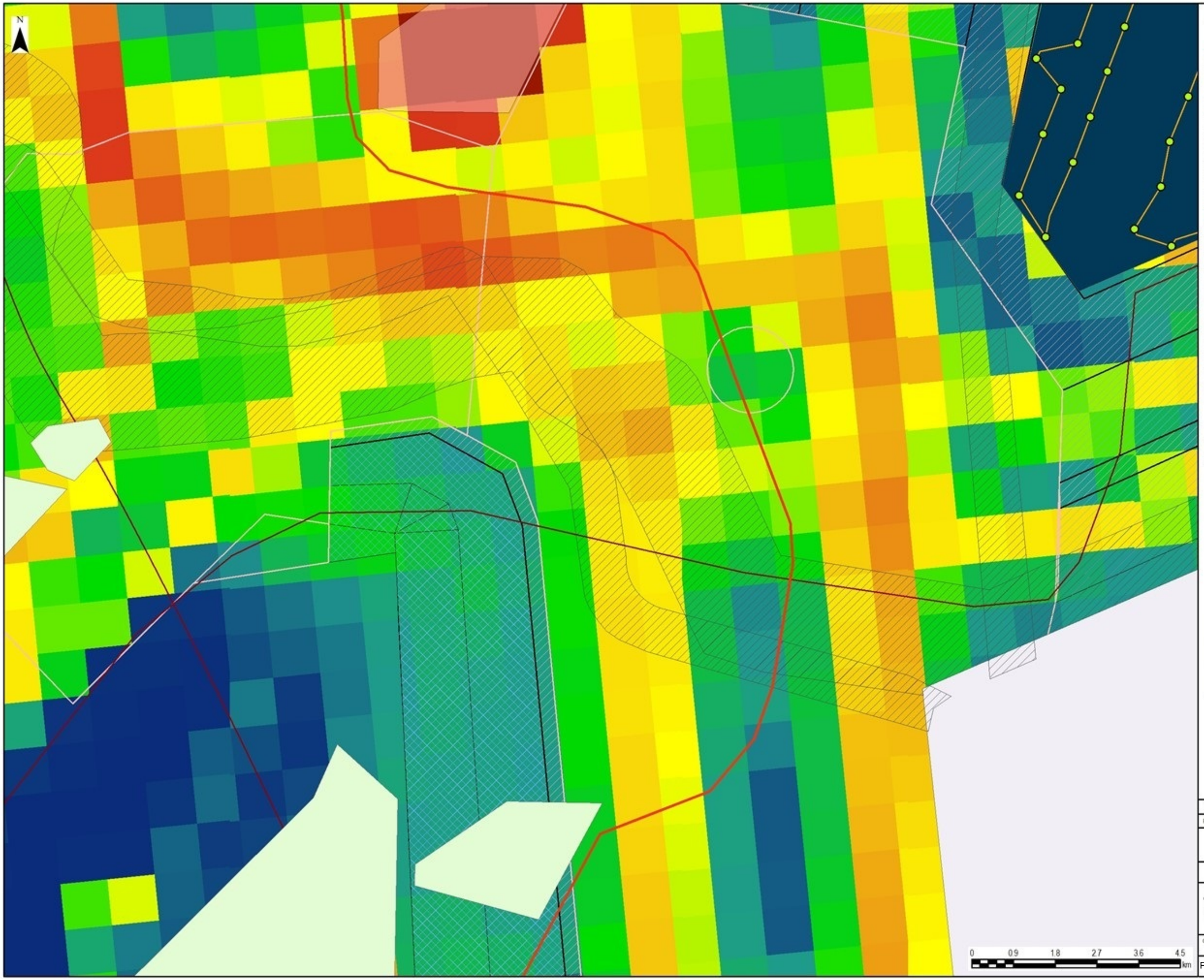
EB	26/08/2021	DF	26/08/2021	CC	26/08/2021

Figure 7-20 | Scale: 1:75,000 | Format: A3 | Sheets: | Rev: 1

Figure 7-21 Other developments and Shipping Density



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1	26/08/2021	STUDY AREA	EB	DF	CC

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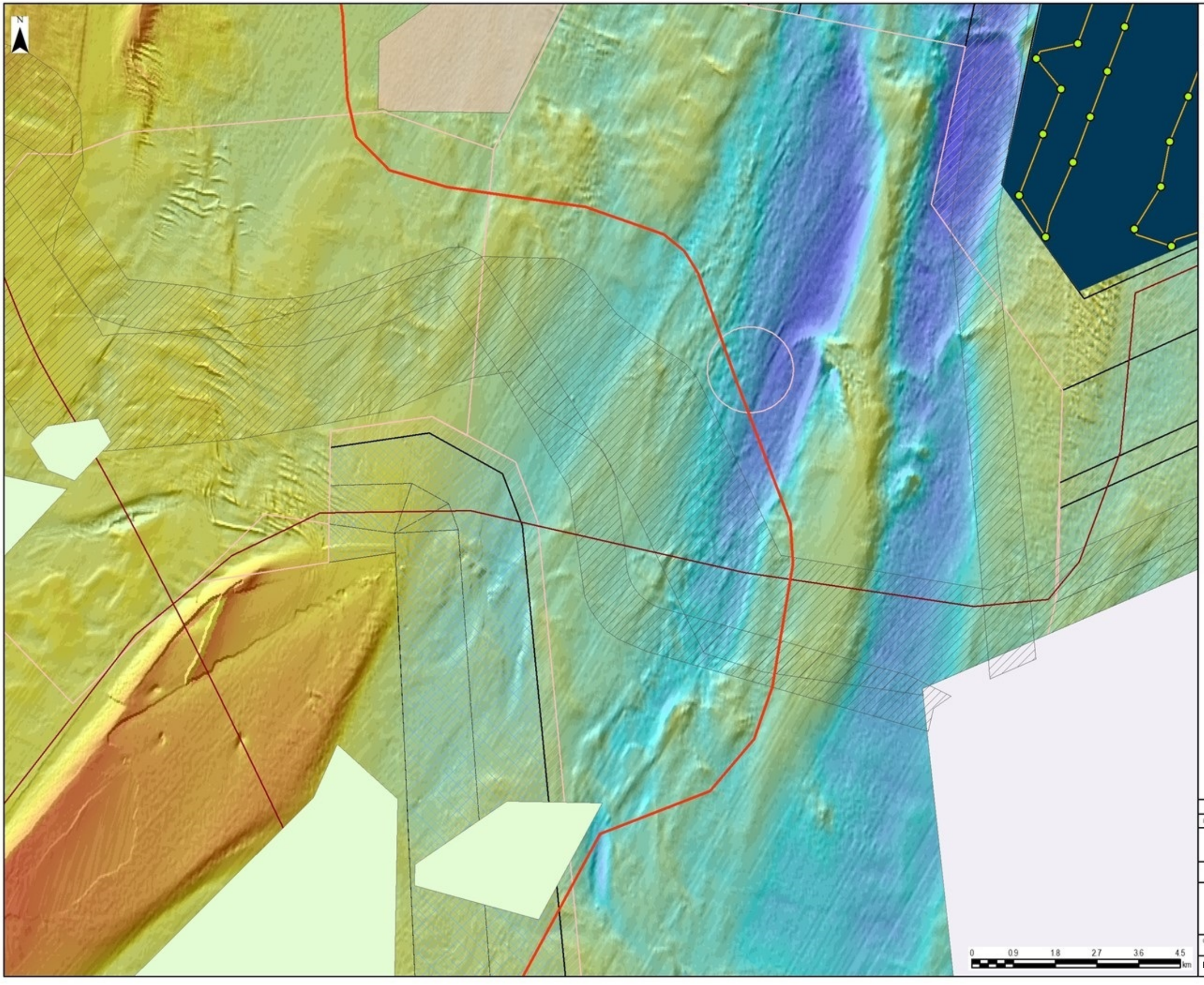
Other Developments and Shipping Density

Creator:	Date:	Checker:	Date:	Approver:	Date:
EB	26/08/2021	DF	26/08/2021	CC	26/08/2021

Figure 7-21 | Scale: 1:75,000 | Format: A3 | Sheets: | Rev: 1

Figure 7-22 Other Developments and Water Depth



LEGEND

- C8B
- Aggregate Extraction Area
- Wind Turbines
- Array Cables
- Interconnectors
- Export Cable Corridor

Offshore Windfarm

Status

- Concept/Early Planning
- Consent Application Submitted
- Consent Authorised
- Pre-Construction
- Under Construction
- Partial Generation/Under Construction
- Fully Commissioned
- Decommissioned
- Development Zone
- Anchorage area

MTF Administrative Areas

- Precautionary area
- Traffic separation, Lane part
- Traffic separation, Zone
- Two-way route part

Bathymetry

High : 5

Low : -75

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Other Developments and Water Depth

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EB	26/08/2021	DF	26/08/2021	CC	26/08/2021

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Figure 7-22	1:75,000	A3		1

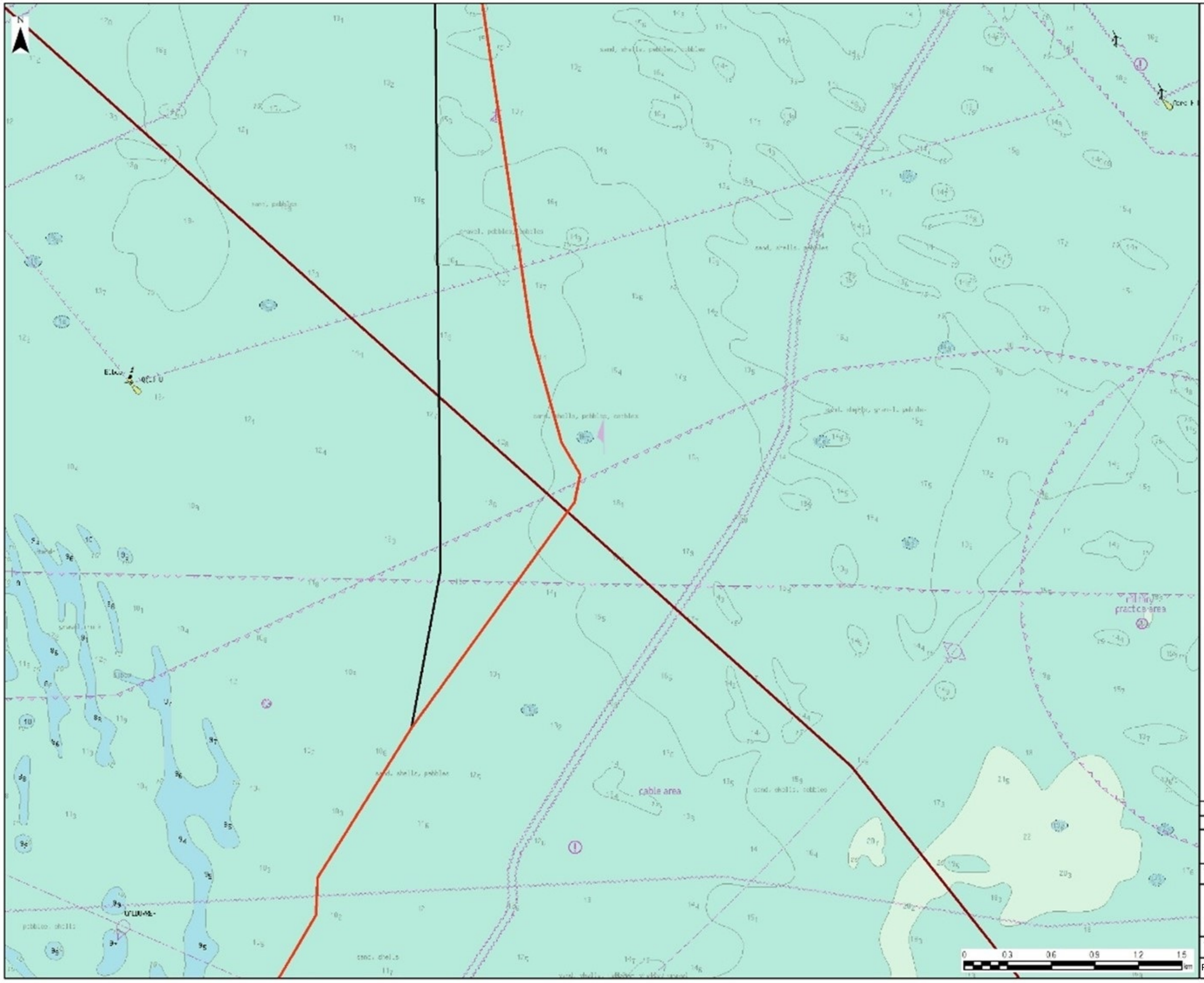
Southwest of Thanet Offshore Windfarm

7.6.15 The original preferred marine routeing in this area was the black route shown on **Figure 7-23** (marine alignment section C4). This route provided suitable seabed conditions for cable installation (geology and topography). However, following stakeholder engagement the route needed to be refined because of feedback from the PLA who expressed significant concerns regarding the potential decrease in water depths that would occur where the route would cross the GridLink interconnector.

7.6.16 The PLA advised that because this area is an important area for shipping, and water depths are too shallow, and they would not be able to support the routeing as originally proposed. They also advised that the Thanet Extension Offshore Wind Farm DCO application, the export cable for which was also proposed to be in this area, was refused by the SoS due to potential impacts on shipping and navigation.

7.6.17 An alteration to the route was established, that has required a slight deviation to the original marine alignment section C4, referred to as C4A (**Figure 7-23**) to increase the water depth of the crossing by an additional 3.5m. The PLA and other navigational bodies were consulted on the refined route and have advised that they are satisfied with the modification made to the route.

Figure 7-23 Route Refinement at Proposed GridLink Crossing



Charts provided by
ChartWorld International Ltd
Chartserver Hosting.
source C-Map Data.

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1	16/09/2021	STUDY AREA	CD	DF	CC

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Route Refinement at Proposed GridLink Crossing

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CD	16/09/2021	DF	16/09/2021	CC	16/09/2021

Figure 7-23

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8. Options Appraisal – Terrestrial – Kent

8.1.1 This chapter presents the environmental and socio-economic, technical and cost constraints that have been key differentiators for decision making with regards to routeing and siting in the onshore environment in Kent (from MHWS).

8.1.2 Whilst the overall approach to the onshore options appraisal is the same as that taken when appraising the marine alignments (as outlined in **Chapter 6**) the findings are presented slightly differently in the terrestrial option appraisal. When considering the extent and contiguous nature of the constraints under consideration in the extensive offshore Project study area, it makes sense to present the marine appraisal by topic whereas the geographically separate onshore elements appraisal findings are considered best presented by geographical area and have been divided into **Chapter 8** for Kent and **Chapter 9** for Suffolk.

8.1.3 Another difference in the terrestrial appraisal chapters is that whereas marine alignments were produced for the extensive offshore environment, the onshore appraisal has been undertaken on shorter but more defined corridors without identifying specific alignments within those corridors at this appraisal stage. This is because the appraisal of numerous potential route alignments within multiple corridors across multiple zones and regions would result in a disproportionate and impracticable approach. Once a preferred corridor was identified potential routeing options within this corridor were then progressed (see **Chapter 11**).

8.1.4 The topics and associated criteria listed in **Table 8-1** below were considered when undertaking all the onshore options appraisal from MHWS to the final network connection point. Please note that where coastal nature conservation designations cover the intertidal area (down to Mean Low Waters Springs- MLWS) these have been considered in the marine appraisal (**Chapter 7** - **Figure 7-6** and **Figure 7-7**).

Table 8-1 Onshore Appraisal Criteria

Onshore Topics	Criteria for Consideration
Landscape and Visual	• Potential to affect the special qualities and landscape character of Areas of Outstanding Natural Beauty (AONB) and Heritage Coast • Proximity to local level landscape designations e.g. Special Landscape Areas (SLA) • Potential to affect protected/ valued landscape features • Landscape Character: opportunities for siting in more open farmland • Proximity to Sensitive Visual Receptors - Residential / Settlement

Onshore Topics	Criteria for Consideration
	• Proximity to other existing/ future development that may result in potential cumulative visual effects
Historical Environment	• Proximity to World Heritage Sites • Proximity to Conservation Areas • Proximity to Scheduled Monuments • Proximity to Listed Buildings • Proximity to Registered Park and Gardens • Proximity to Registered Battlefields and military remains • Consideration of potential buried archaeology
Biological Environment	• Proximity to designated sites of European/International value • Proximity designated sites of national value • Proximity designated sites of local value • Proximity to ancient woodland or native plantation woodland • Proximity to protected species and features likely to support protected species • Potential value of habitat
Physical Environment	• Proximity to flood risk zone 2 or 3 • Proximity to groundwater SPZ • Presence of areas of historic landfill • Groundwater (superficial and bedrock) – principal aquifer • Proximity to main rivers
Settlement and Population	• Proximity to urban regions • Proximity to main settlements • Proximity to allocation and growth areas • Residential density (people per hectare)
Tourism and Recreation	• Number of Public Right of Way (PRoW) crossings/ diversions • Number of National Trail crossings/ diversions • Number of National Cycle Routes crossings/ diversions

Onshore Topics	Criteria for Consideration
	• Proximity to tourist attractions
Infrastructure	• Transmission network • Gas transmission network • Ports and Harbours • Aerodromes • Motorways /Trunk Roads • Railways
Land Use	• Agricultural Land Classification (ALC)
Traffic and Transport	• Proximity to roads/rail • Potential limitations to access
Planning	• Current planning applications • Conformance with National Policy Statements - EN1 and EN5 • Conformance with the National Planning Policy Framework (NPPF) and Local Development Plan (LDP) spatial policies

8.1.5 As described in **Chapter 6** and applied during the marine options appraisal described in **Chapter 7**, to help determine the emerging preferred elements a review was undertaken of each of the element options.

8.1.6 This review was applied to each terrestrial corridor assuming an underground HVDC route with a 40m wide working corridor as explained in **Chapter 3**, the convertor site areas of search identified and also the potential for an overhead or underground HVAC connection from the convertor site to the final connection point.

8.1.7 The converter site option areas (**Figure 5-9**) and the terrestrial corridors shown (**Figure 5-11**) were brought forward for detailed option appraisal. The following sections discuss the key constraints in relation to the identified converter site option areas and onshore terrestrial corridors in Kent.

8.2 Environmental and Socio-Economic Appraisal – Terrestrial Corridors

8.2.1 The Kent terrestrial corridors appraised are shown on **Figure 8-1** below.

Figure 8-1 Kent Terrestrial Corridors

N

K1

K2

K3

K4

K5

LEGEND

- Richborough Substation
- 400 kV Overhead Line
- Landfall Area of Search
- North Kent Coast - Richborough Zone
- Blue Corridor
- Red Corridor
- Green Corridor

0 1 2 3 4 km

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Scheme: SEA LINK

Document Title: KENT TERRESTRIAL CORRIDORS SHEET 1 OF 3

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EB	18/08/2022	DF	18/08/2022	KS	18/08/2022

Document Ref:	Scale:	Format:	Sheets:	Rev:
FIGURE 8-1	1:50,000	A3	1	0

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N

LEGEND

- Richborough Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Broadstairs - Richborough Zone
- Green Corridor

0 1 2 3 4 km

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Scheme: SEA LINK

Document Title: KENT TERRESTRIAL CORRIDORS SHEET 2 OF 3

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FIGURE 8-1		A3	1	0

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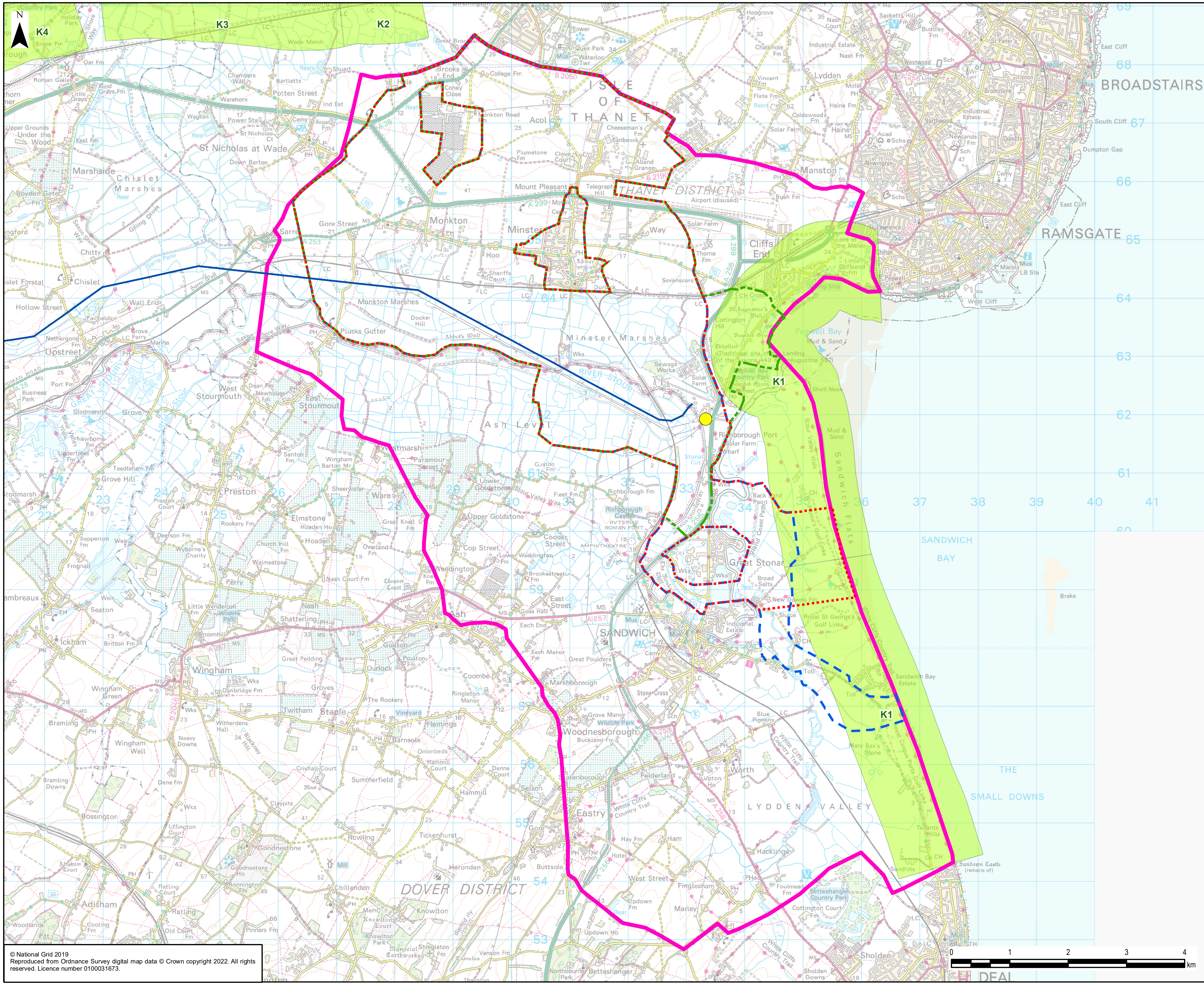

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Document Title: KENT TERRESTRIAL CORRIDORS SHEET 3 OF 3

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EB	23/08/2022	DF	23/08/2022	KS	23/08/2022

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FIGURE 8-1	1:60,000	A3	1	0

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North Kent Coast

8.2.2 Key constraints relating to the North Kent Coast terrestrial corridors relate primarily to the following topics.

- biological environment (coastal designations that extend below MHWS have been considered in **Chapter 7**);
- physical environment;
- historic environment;
- traffic and access; and
- planning (future developments).

8.2.3 The three corridors connecting the landfall areas of search located on the north Kent coast to the Richborough substation (**Figure 8-1**) were all significantly constrained from a traffic and access perspective. There is no direct access across the railway line to the landfall areas of search within the red and blue corridors. Whilst there is access into the green corridor, this corridor is also constrained particularly for Abnormal Indivisible Load (AIL) vehicles and Heavy Goods Vehicles (HGV) due to weight restricted bridge, sensitive receptors, and carriageway widths that are inadequate to allow two-way HGV movements. It is likely that extensive mitigation would be required, even during temporary construction work to facilitate safe access and to minimise other environmental effects (congestion, delays) that could arise as a consequence of additional HGV construction traffic on poorly suited roads. Careful routing of the cables could avoid access issues around the Minster Marshes. Use of a trenchless technique may be required to minimise impacts on other A roads not considered within the embedded mitigation.

8.2.4 The green and red corridors interact extensively with flood zones 2 and 3 and both had a high number of water crossings in comparison to the blue corridor (**Figure 8-2**).

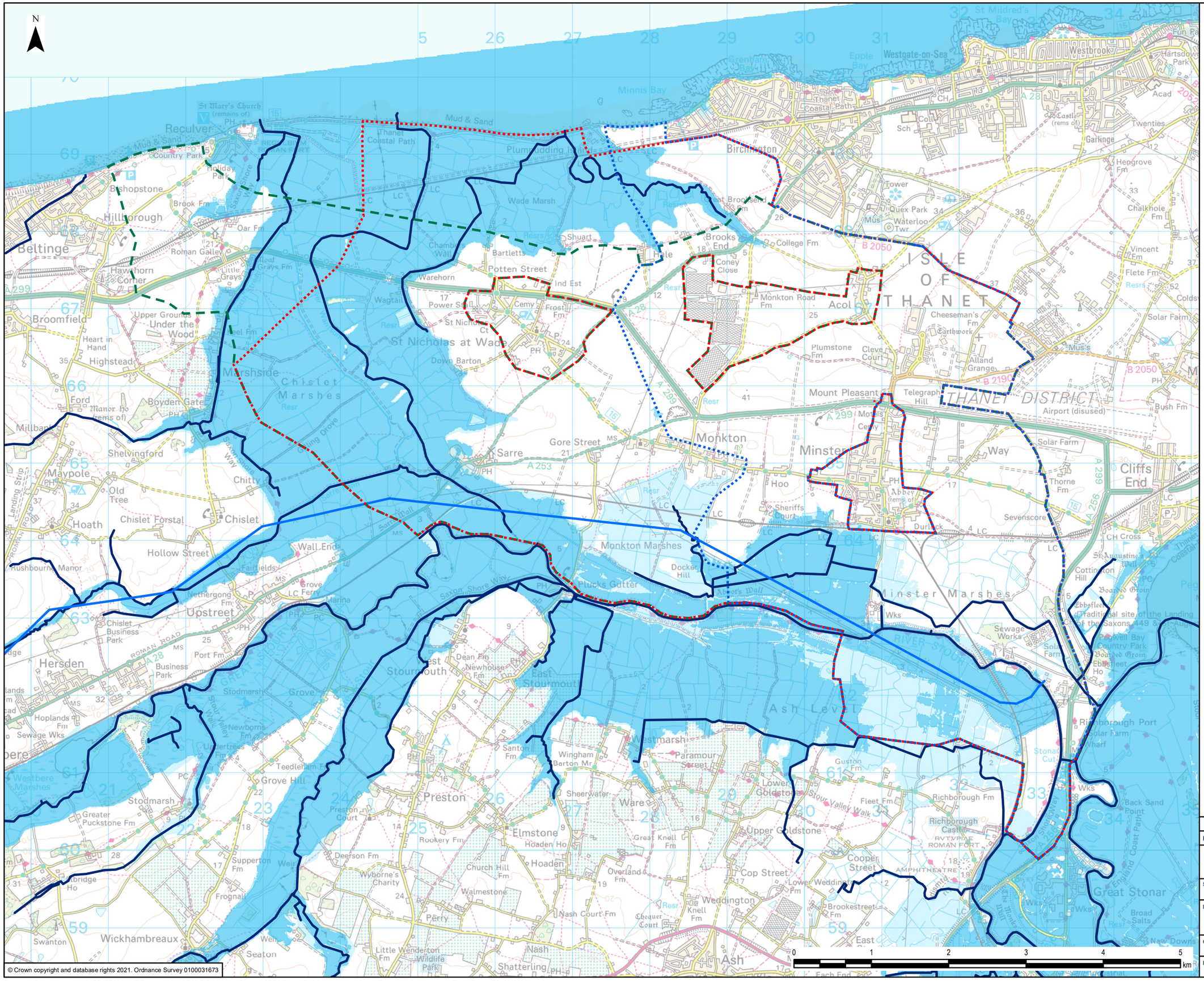
8.2.5 There are several scheduled monuments located within all three corridors (**Figure 8-3**) however the blue corridor is considered to be the most constrained with a combination of scheduled monuments and a proposed planning allocation in the south of Birchington (**Figure 8-4**) creating a pinch point that reduces the ability to route away from and around these sites.

8.2.6 With regards to the other constraints considered (listed in **Table 6-1**) all three corridors performed similarly.

Summary

8.2.7 All three corridor options are significantly constrained and no one corridor is preferred over another.

Figure 8-2 North Kent Coast Terrestrial Corridors and Flood Zones



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Document Title: NORTH KENT TERRESTRIAL CORRIDORS AND FLOOD ZONES

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Document Ref:	Scale:	Format:	Sheets:	Rev:
FIGURE 8-2	1:45,000	A3	1	0

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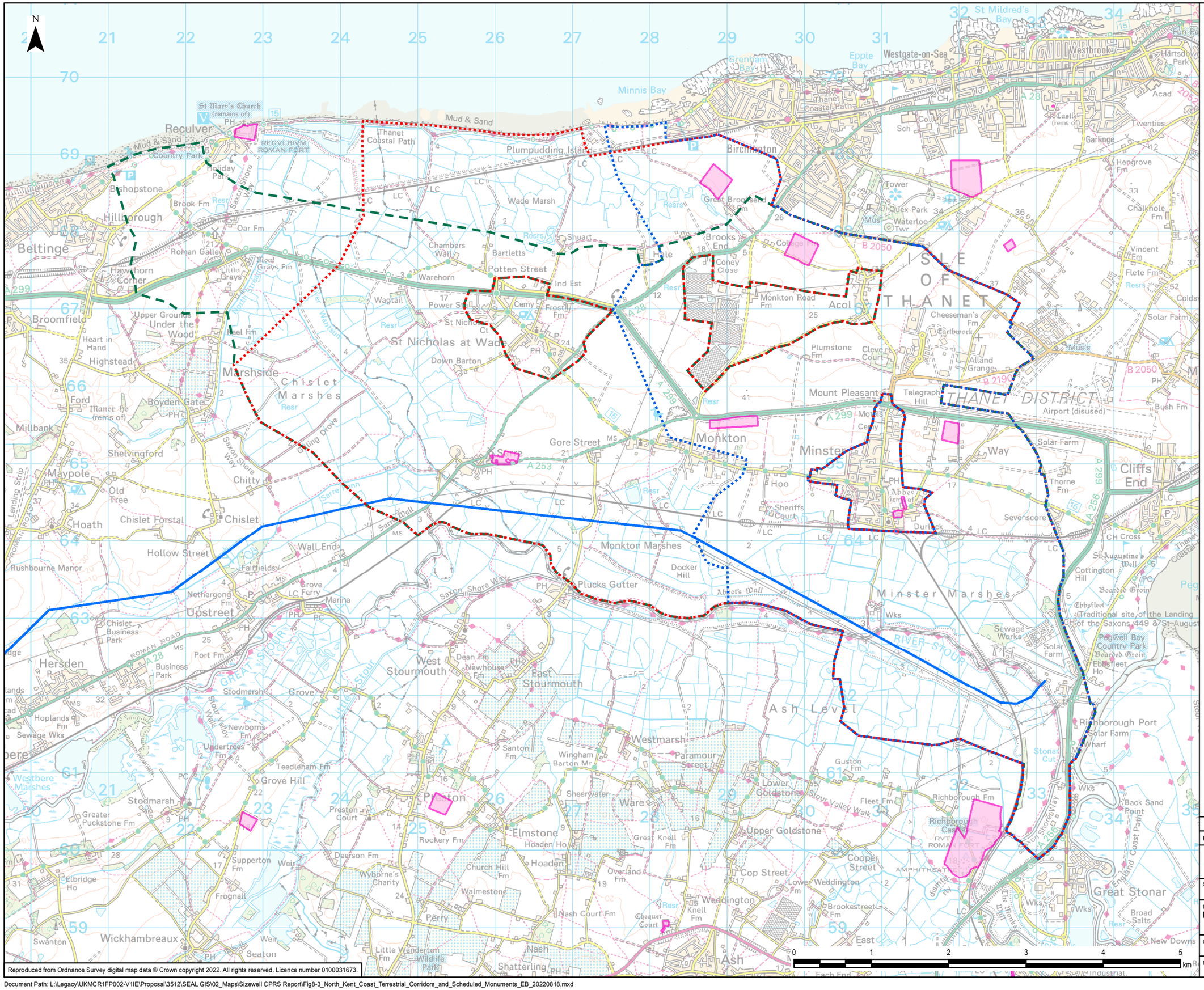
Figure 8-3 North Kent Coast Terrestrial Corridors and Scheduled Monuments



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Document Title: NORTH KENT COAST TERRESTRIAL CORRIDORS AND SCHEDULED MONUMENTS

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EB	18/08/2022	DF	18/08/2022	KS	18/08/2022

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FIGURE 8-3	1:45,000	A3	1	0

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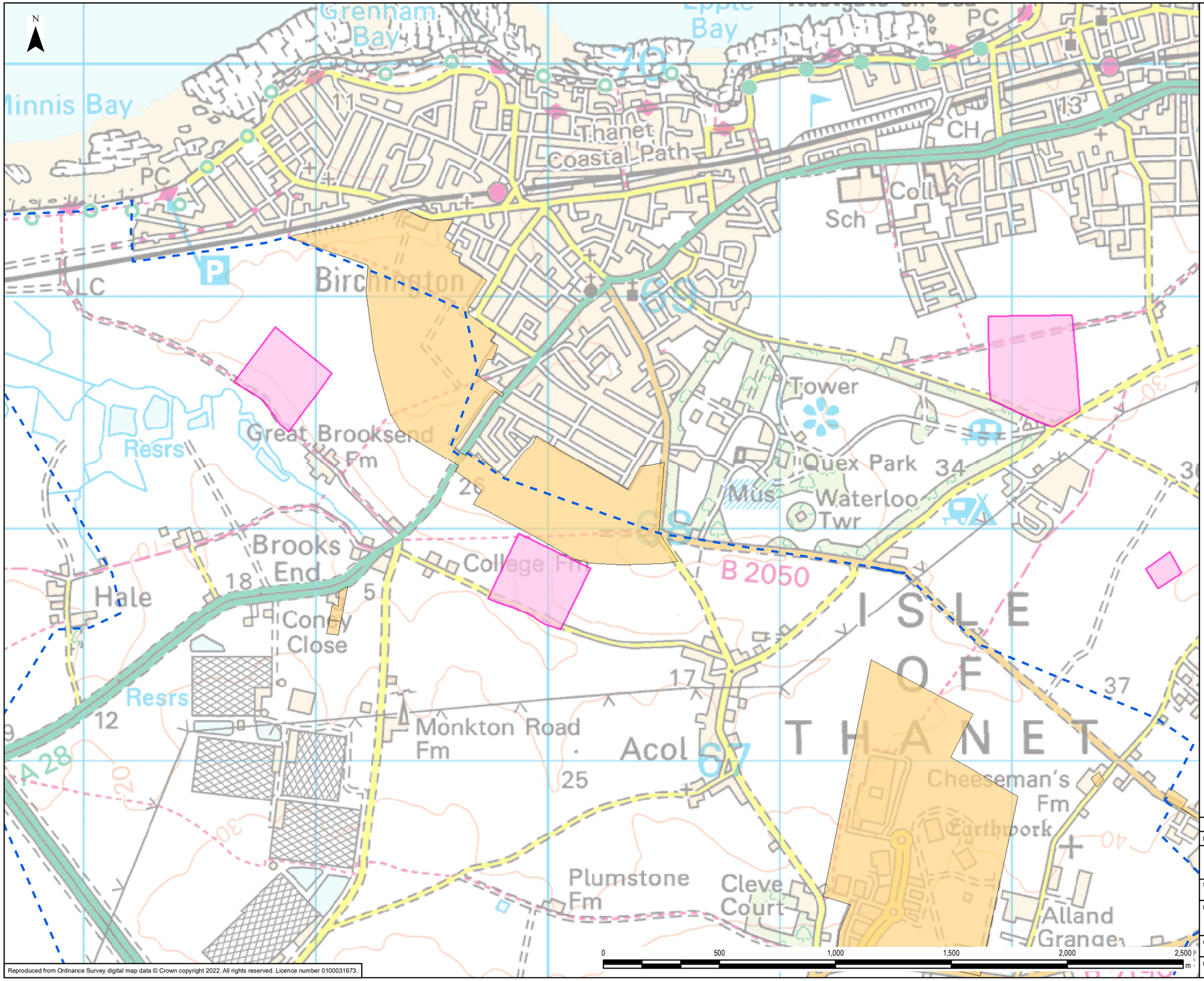
Figure 8-4 North Kent Coast Blue Corridor Pinch Point



Legend

- Blue Corridor
- Local Plan Allocations (Digitised)
- Scheduled Monuments

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Document Title: NORTH KENT COAST BLUE CORRIDOR PINCH POINT

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FIGURE 8-4	1:15,000	A3	1	0

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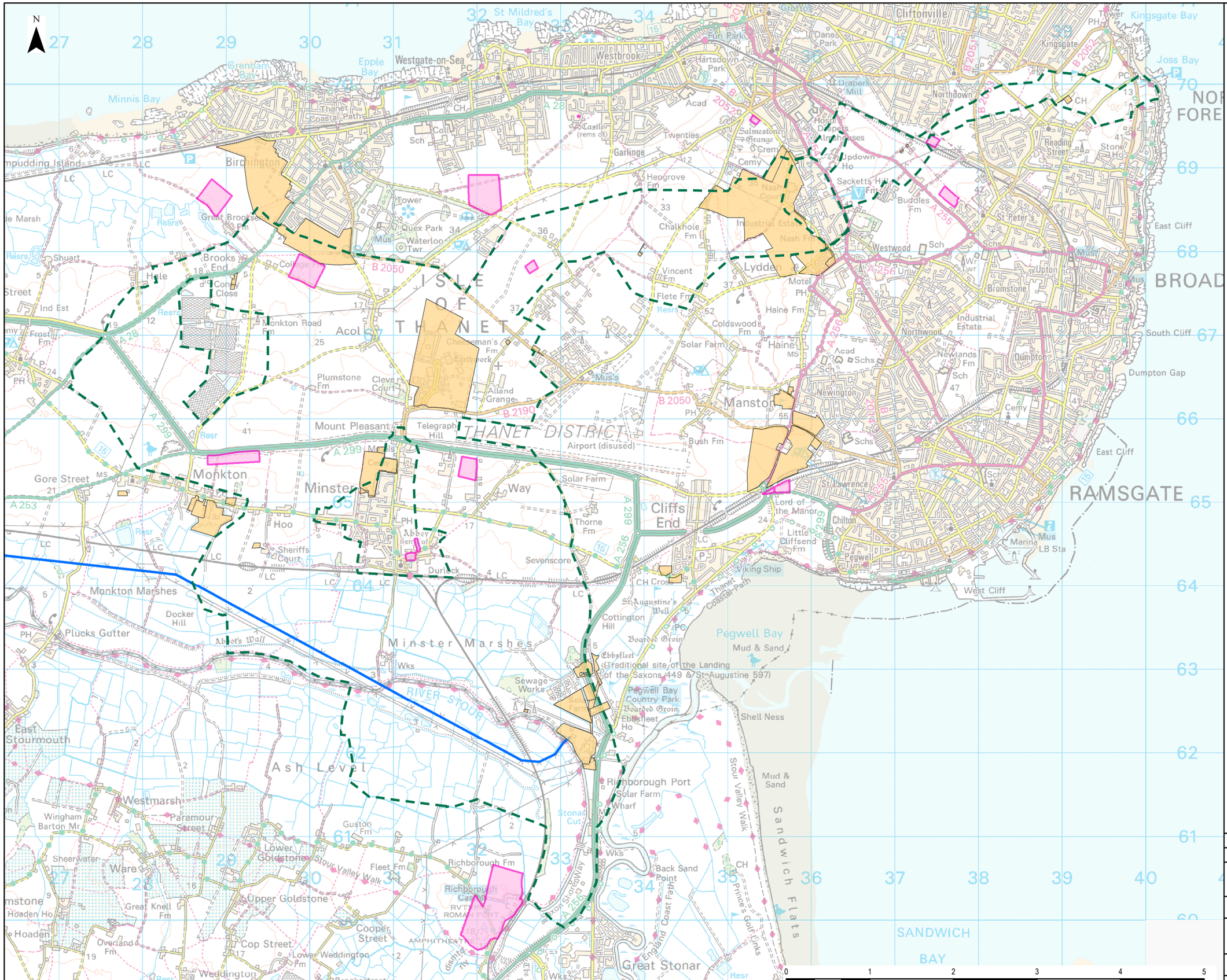
Broadstairs

8.2.8 There was only one terrestrial corridor identified to connect the landfall area at Broadstairs to converter site option areas A or B. The appraisal work identified significant constraints relating to:

- traffic and access;
- settlement; and
- planning.

8.2.9 The corridor must cross the settlement of Broadstairs. There are two ways to do this, either at Star Lane or Farley Road and both are constrained by several connected planning allocations for housing as well as a proposed extension to the cemetery. These constraints span the entire corridor west of the Westwood Industrial Estate (**Figure 8-5**) and these factors significantly constrain this corridor.

Figure 8-5 Broadstairs Terrestrial Corridor Key Constraints



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Document Title: BROADSTAIRS TERRESTRIAL CORRIDOR KEY CONSTRAINTS

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FIGURE 8-5	1:42,500	A3	1	0

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Pegwell Bay

8.2.10 Key constraints relating to the Pegwell Bay terrestrial corridors relate primarily to the following topics.

- biological environment;
- physical environment;
- traffic and access; and
- recreation and tourism.

8.2.11 Three terrestrial corridors were identified to connect landfall area K1 in Pegwell Bay to the converter site option areas A and B As discussed in **Chapter 7**, all three of these options interact with a number of coastal nature conservation designations at the landfall (**Figure 8-6**) with the blue corridor having the smallest direct interaction.

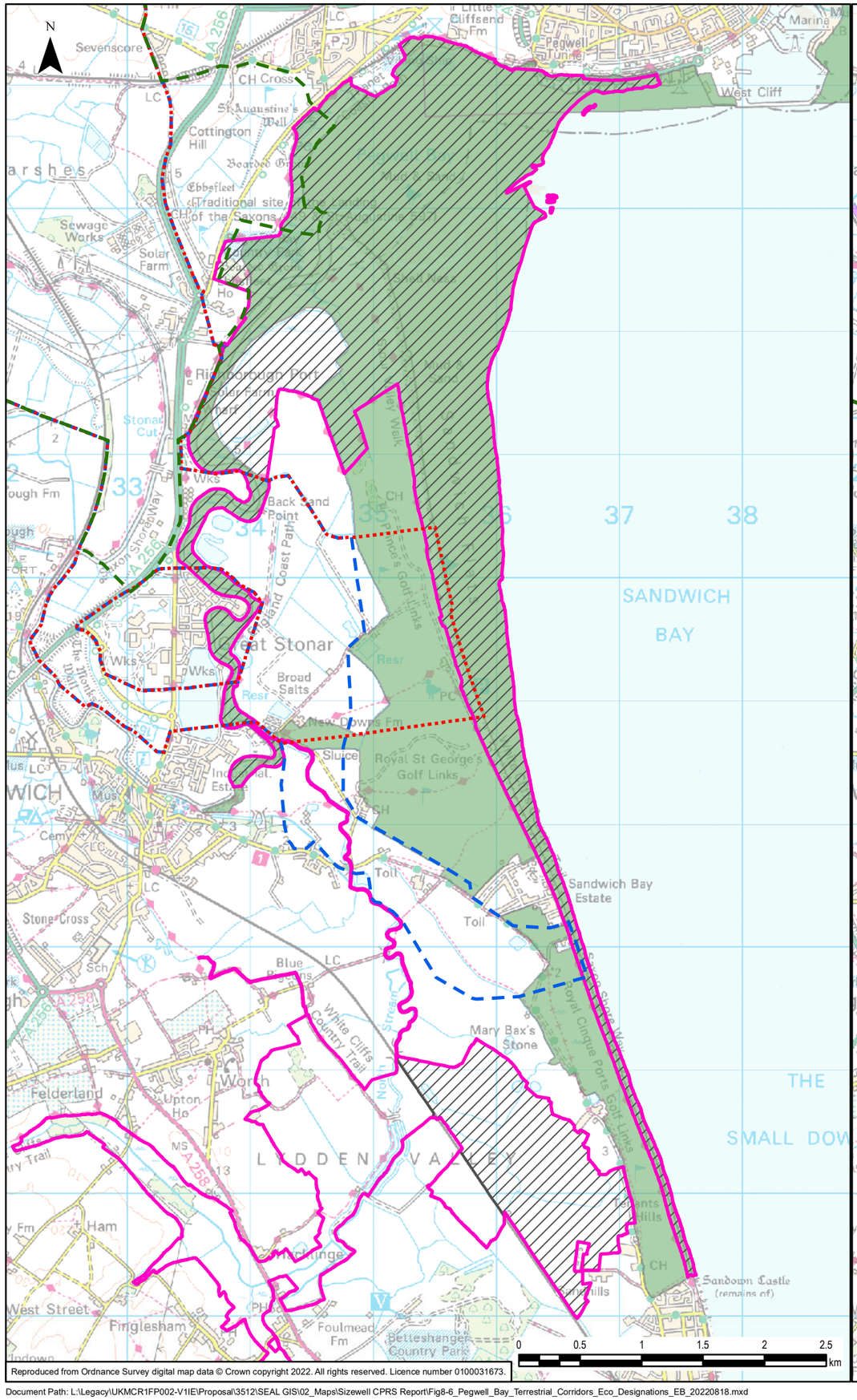
8.2.12 The red and blue corridors are significantly constrained from a traffic and access perspective, with key issues including access to the east of the River Stour and weight restrictions on local roads around the Sandwich Bay Estate and Royal St George and Royal Cinque Ports golf courses (**Figure 8-7).**

8.2.13 With regards to physical environmental constraints both the red and the blue corridors extend across a large area of flood zone (**Figure 8-8**) and would require a number of watercourses associated with the River Stour to be crossed. The blue corridor would require crossing the River Stour at a point where is it designated as a Ramsar, SAC, SPA and SSSI. Although if feasible it could be crossed using trenchless techniques, most likely HDD, there could be effects related to disturbance and, although highly unlikely, breakout of drilling fluids.

8.2.14 Both the green and red corridors intersect with golf courses just inland of the proposed landfalls (**Figure 8-9**), however, again if feasible, it is proposed that a trenchless technique would be used at these locations to minimise disturbance.

8.2.15 With regards to the other topics under appraisal all three corridors performed similarly across these topics when applying the criteria as described in **Chapter 6**.

Figure 8-6 Pegwell Bay Terrestrial Corridors and Ecological Designations



Legend

- Green Corridor
- Red Corridor
- Blue Corridor
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Ramsar
- Site of Special Scientific Interest (SSSI)
- National Nature Reserve (NNR)

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Document Title: PEGWELL BAY TERRESTRIAL CORRIDORS AND ECOLOGICAL DESIGNATIONS

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FIGURE 8-6	1:40,000	A3	1	0

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Figure 8-7 Pegwell Bay Terrestrial Corridors River and Rail constraints

Legend

- Green Corridor
- Red Corridor
- Blue Corridor
- Railway Track
- River

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Document Title: PEGWELL BAY TERRESTRIAL CORRIDORS RIVER AND RAIL CONSTRAINTS

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FIGURE 8-7	1:27,500	A3	1	0

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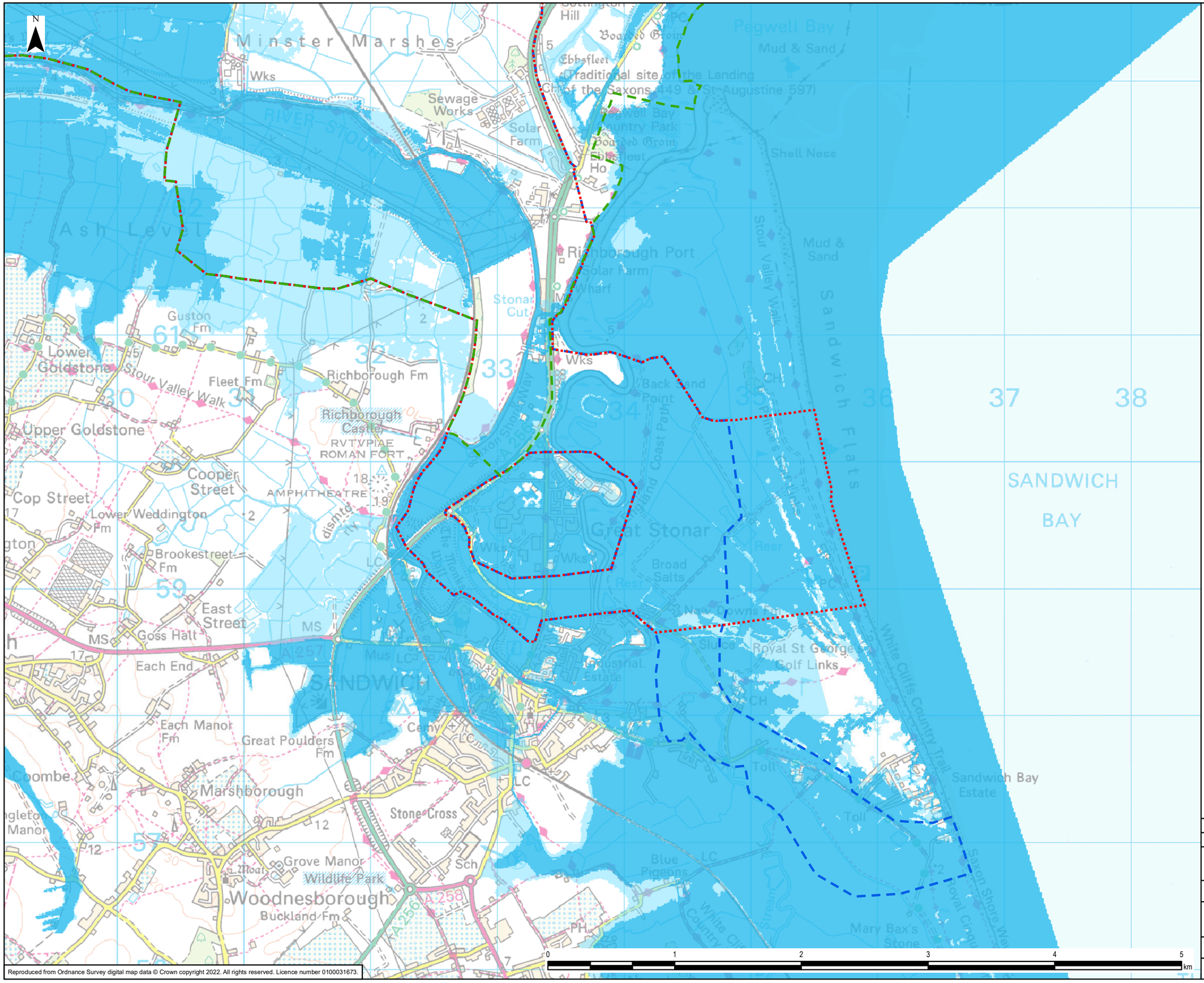
Figure 8-8 Pegwell Bay Terrestrial Corridors and Flood Zones



Legend

- Green Corridor
- Red Corridor
- Blue Corridor
- Flood Zone 2
- Flood Zone 3

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Document Title: PEGWELL BAY TERRESTRIAL CORRIDORS AND FLOOD ZONES

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FIGURE 8-8	1:27,500	A3	1	0

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Figure 8-9 Pegwell Bay Terrestrial Corridors and Golf Courses

Legend

- Green Corridor
- Golf Course

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Document Title: PEGWELL BAY TERRESTRIAL CORRIDORS AND GOLF COURSES

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FIGURE 8-9	1:30,000	A3	1	0

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Summary

8.2.16 On balance the green corridor has less constraints than the red and blue corridors. It is also the shortest onshore connection to converter site option Area A, which would reduce potential construction related impacts and as such represents the preferred corridor option for this landfall.

8.3 Environmental and Socio-Economic Appraisal – Converter Site Option Areas

8.3.1 Potential converter site option areas with locations capable of supporting the infrastructure parameters detailed in **Chapter 5**, were identified within 5km of the potential connection points (**Figure 5-9**) as a distance greater than 5km would trigger the need for additional reactive compensation equipment.

8.3.2 The identification of converter site option areas was based on the potential to site adjacent to similar infrastructure, avoidance of designated sites as far as possible, landform, opportunities for natural screening and to minimise visual impacts on settlements.

8.3.3 The HVAC connections back to the identified connection points were appraised using the same criteria listed in **Table 8-1**. A construction corridor of 100m was assumed for underground HVAC connections back to the identified connection point as explained in **Chapter 3**.

8.3.4 Key findings of the appraisal of the converter site option areas are listed below:

- Area A is located adjacent to Richborough substation therefore minimising the length of the HVAC connection back to the connection point.
- Richborough Energy Park and Richborough Port are located within Area A which provides the opportunity to site a converter station within an area adjacent to similar infrastructure.
- Part of Sandwich Bay to Hacklinge Marshes SSSI is located within Area A (**Figure 8-10**) that would potentially need to be crossed for a connection into Richborough.
- Areas of flood zone within Area A (**Figure 8-12**), opportunities to avoid in the north and south of the area.
- Both areas are within BMV agricultural land, Area A is predominately Grade 2 and Area B Grade 1 (**Figure 8-13**).
- Planning allocations within both areas.

Summary

8.3.5 Richborough Energy Park and Richborough Port are located within Area A which provides an opportunity to site the converter station within an area adjacent to similar infrastructure or industrial land uses. Part of the Sandwich Bay to Hacklinge Marshes SSSI (**Figure 8-10**) extends into this area but converter station siting could avoid this designation. Part of this area is within the flood zones 2 and 3 (**Figure 8-12**) but there are opportunities to site a converter station outside of these zones. The network

connection point (Richborough substation) is located within this area therefore minimising the length of HVAC connection back to the network.

8.3.6 There is one designated site within Area B, an Anglo-Saxon cemetery and associated remains at Monkton Scheduled Monument (**Figure 8-11**); this is located immediately adjacent to the south of the A299, to the north of Monkton. The area contains Manston Business Park, Columbus Avenue Industrial Estate, and an area with larger scale agricultural buildings. Manston airport is located to the southeast. Whilst the existing development in this area is not related to energy there are opportunities to site a converter station adjacent to these other industries. Area B is located further from the network connection point at Richborough substation and development of a converter station site in this area would require approximately 5km of HVAC connection.

8.3.7 When considering all receptors, constraints and opportunities the preferred converter site option area for the Richborough Substation connection point is converter site option Area A.

8.3.8 Converter site option Area A is the closest to the connection point at Richborough substation, therefore would require a shorter AC connection than option Area B. The AC connection was assessed as being either OHL or underground cable. As converter site option Area A covers a much broader area than the siting parameters for a converter station, the environmental and socio-economic appraisal has not identified a preference in terms of technology choice, as it is dependent on the location of the site within the option area. This will be appraised in conjunction with the future siting of a converter station within the option area.

Figure 8-10 Kent Converter Site Option Areas in relation to SSSIs

Legend

- 400kV Overhead Line
- Site of Special Scientific Interest (SSSI)
- Proposed Converter Site Option Areas

A

B

0 1 2 3 4 5 km

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Document Title: KENT CONVERTER SITE OPTION AREAS IN RELATION TO SSSIs

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FIGURE 8-10	1:50,000	A3	1	0

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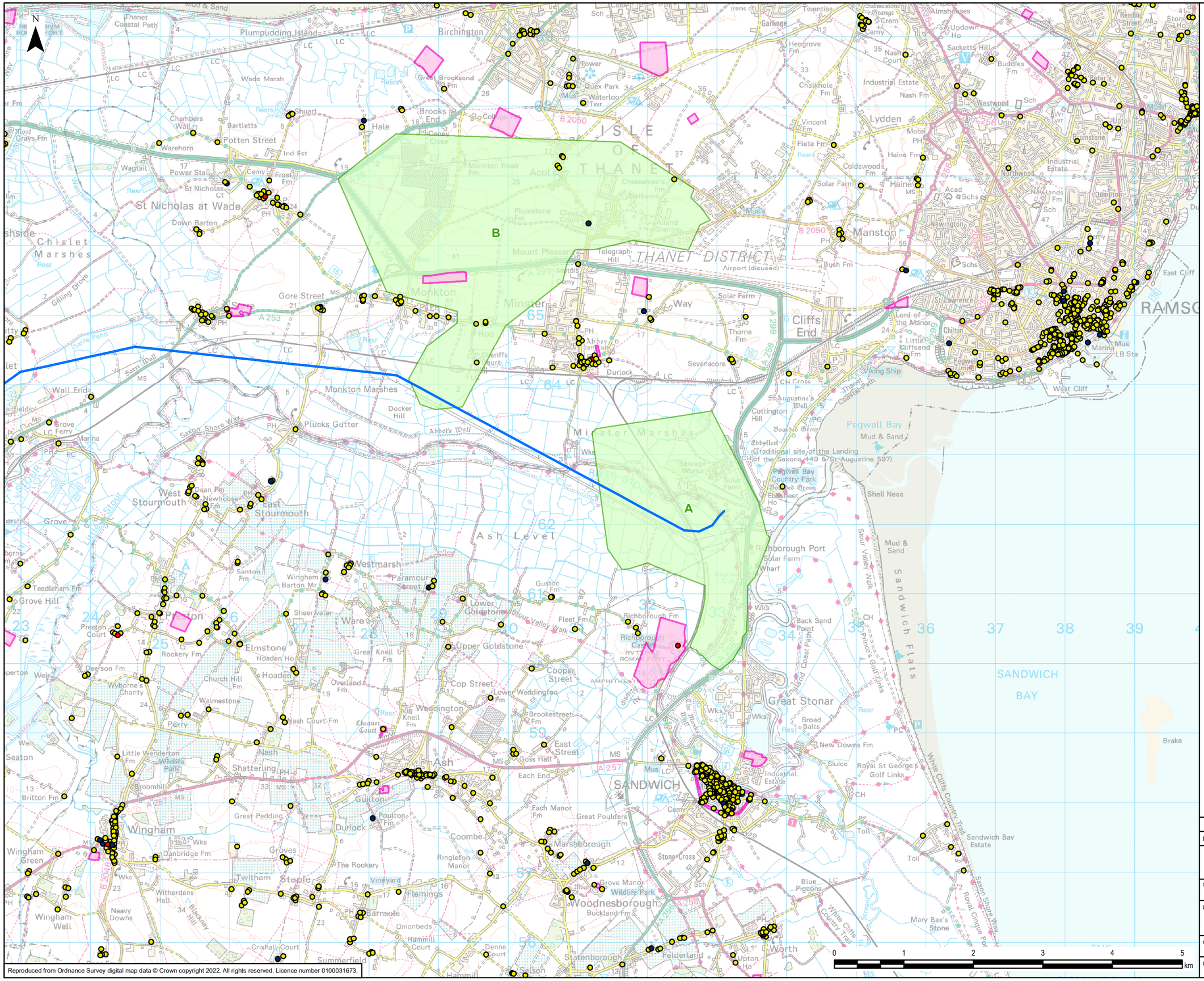
Figure 8-11 Kent Converter Site Option Areas in relation to Scheduled Monuments and Listed Buildings



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Document Title: KENT CONVERTER SITE OPTION AREAS IN RELATION TO SCHEDULED MONUMENTS AND LISTED BUILDINGS

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FIGURE 8-11	1:50,000	A3	1	0

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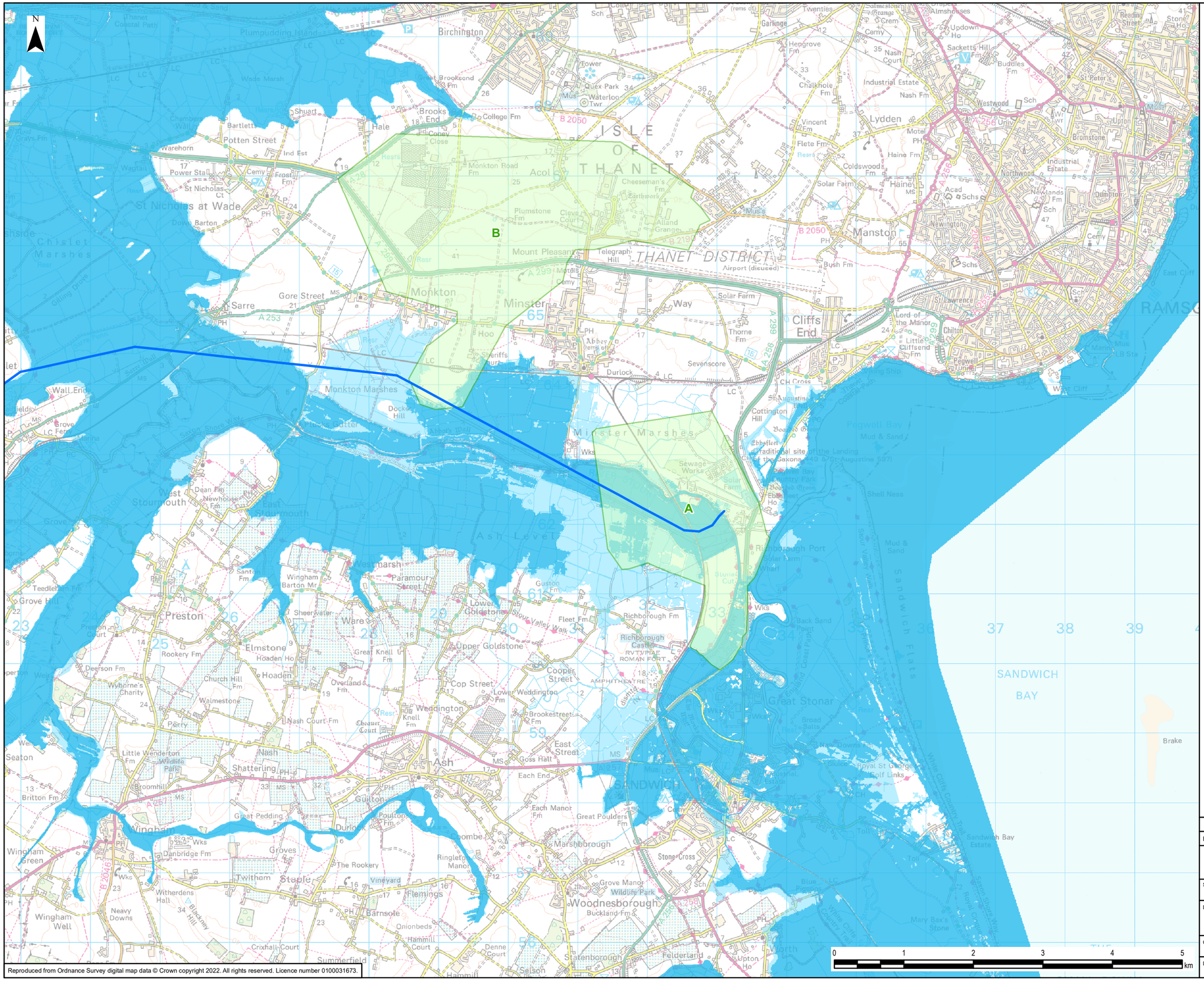
Figure 8-12 Kent Converter Site Option Areas in relation to Flood Zones 2 and 3



Legend

- 400kV Overhead Line
- Proposed Converter Site Option Areas
- Flood Zone 2
- Flood Zone 3

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Document Title: KENT CONVERTER SITE OPTION AREAS IN RELATION TO FLOOD ZONES 2 & 3

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FIGURE 8-12	1:50,000	A3	1	0

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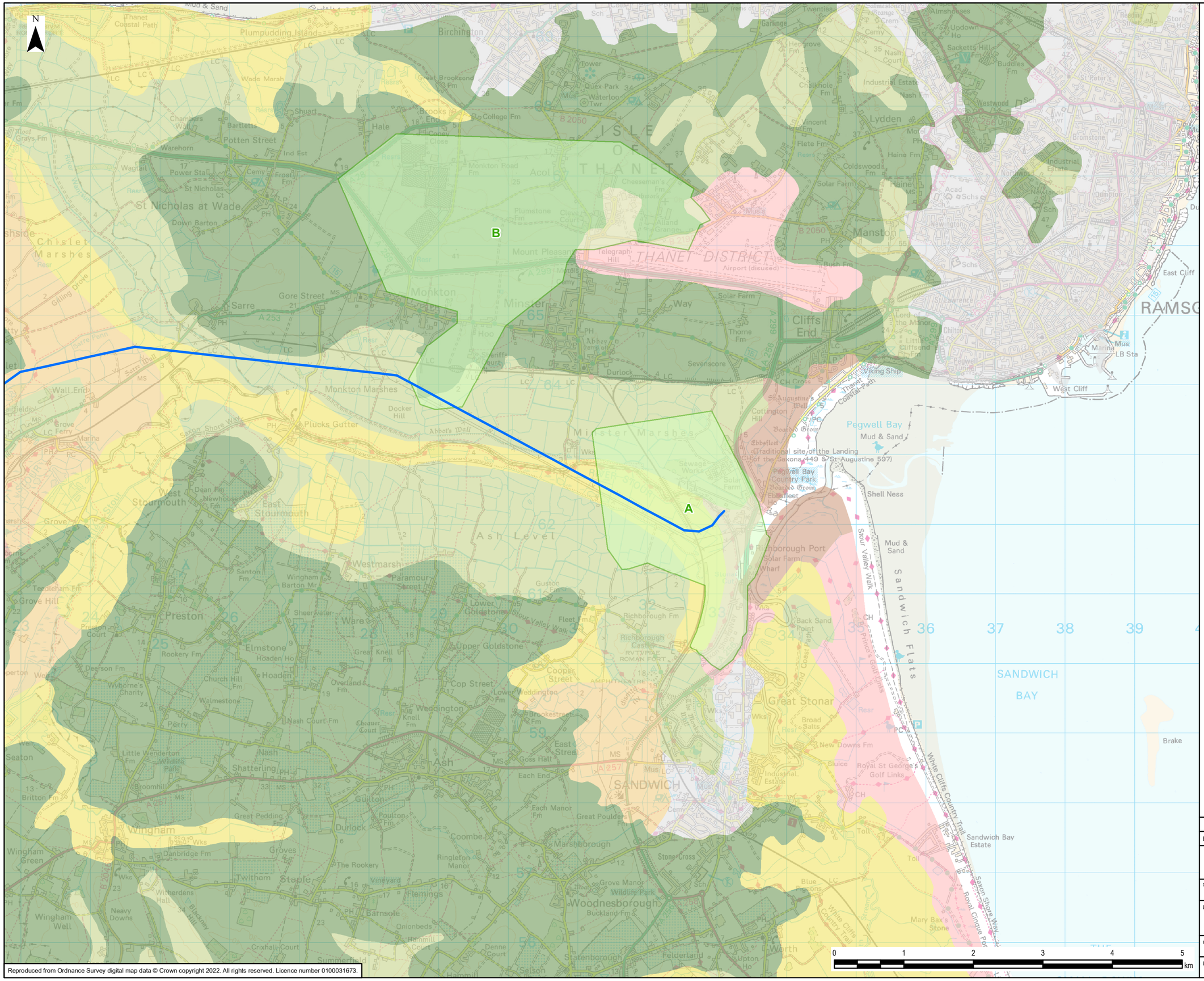
Figure 8-13 Kent Converter Site Option Areas in relation to Agriculture Land Classification



Legend

- 400kV Overhead Line
- Proposed Converter Site Option Areas

Agricultural Land Classification

- Grade 1
- Grade 2
- Grade 3
- Grade 4
- Grade 5
- Non Agricultural
- Urban

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Document Title:
KENT CONVERTER SITE OPTION AREAS
IN RELATION TO AGRICULTURAL LAND CLASSIFICATION

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FIGURE 8-13	1:50,000	A3	1	0

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8.4 Technical Appraisal

8.4.1 When undertaking the environmental and socio-economic appraisal, discussions were ongoing with the terrestrial engineering team to ensure that all sites and corridors being considered, could support a viable engineered solution.

8.5 Converter and AC Connection

8.5.1 The technical appraisal of the converter option area and AC connection gave consideration to the following criteria:

- Ground Conditions
- Site Access
- Topography
- Connectivity between Project Infrastructure
- Grid Connection Technical Performance

8.5.2 No significant technical constraints were identified that differentiated between converter site option areas. Option area A is the closest to the Richborough Substation and as such would reduce engineering risks and cost associated with the HVAC connection.

8.6 HVDC Corridors

8.6.1 The technical appraisal of the HVDC corridors gave consideration to the following criteria:

- Ground Conditions
- Site Access
- Topography
- Crossing Points

8.6.2 Key technical constraints identified were:

8.6.3 When considering the Broadstairs green corridor the HVDC cable would need to pass north of Westwood where the area is constrained by settlement and an industrial estate. To avoid these constraints the cables would have to run through the existing road network. Based on the current trench width parameters, and the assumed presence of existing utilities in the roads, there is considered insufficient clear width within the carriageway to install the cables which therefore makes this route unviable. However, based on experience of similar projects, following system design there may be an opportunity to reduce the cable trench width sufficiently to allow the cables to run through the carriageway or split the cables across multiple road routes to produce a viable option. There are still a limited number of roads that can be used and the number, size and location of existing utilities is unknown therefore this is a highly constrained option from a technical perspective. In addition,

there is proposed development across the whole corridor, the potential blockers created by this development are unknown and increase the risk associated with this option.

8.6.4 The North Kent corridors all have access constraints associated with access to the landfall sites and the northern HVAC connections, due to the railway, urban/residential areas and the unsuitability of the existing highways network for significant construction traffic.

8.6.5 The Pegwell Bay Red and Blue corridors have significant access constraints due to the urban/residential areas on the approach and the unsuitability of the existing highways network for significant construction traffic.

8.7 Preliminary Findings

8.7.1 Considering the information presented above the following combination of elements in Kent identified as preferred were:

- Connection Point: Richborough Substation
- Landfall Area of Search: K1
- HVDC Corridor: Pegwell Bay Green Corridor
- Converter Site Option Area: Area A (AC connection either overhead or underground cable)

8.7.2 Additional ground investigations will be required to inform the feasibility of trenchless installation techniques at the landfall.

8.8 Stakeholder Engagement

8.8.1 Stakeholder engagement has been undertaken to help understand potential impacts/constraints. As part of this process the Project engaged with Sheaf Energy. Sheaf Energy are developing new battery storage farms at Richborough Energy Park and are proposing a solar farm.

8.8.2 Discussions included the potential for constraints on the Sea Link HVAC underground cable or OHL from the preferred converter option area (Area A) to the substation at Richborough given the forthcoming and proposed development by Sheaf Energy potentially resulting in technical/spatial challenges connecting into the existing Richborough Substation.

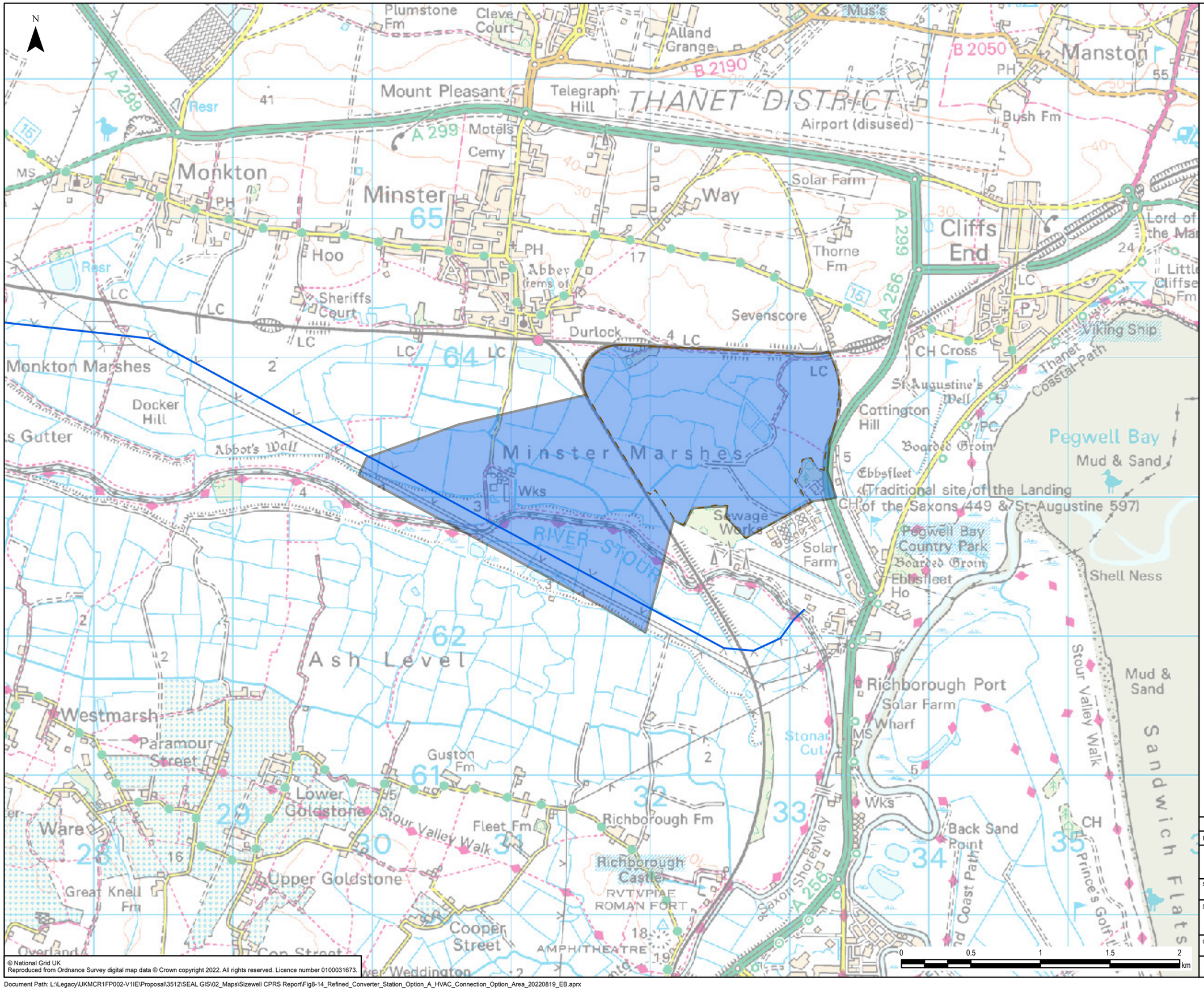
8.8.3 Constraints highlighted also include a 10m deep sewage or water pipe located within option Area A close to the connection point at Richborough substation.

8.8.4 Discussions to date have prompted a backcheck and review of the onshore elements in Kent and a review of potential alternative connection points and associated HVAC route options.

8.8.5 After backcheck and review the Pegwell Bay land fall (K1) and associated green terrestrial corridor remain the preferred options in line with the preliminary findings. However, considering the above stakeholder feedback and the extensive area of flood zone within the preferred converter site option Area A south of the River Stour

(**Figure 8-8**), the potential technical constraints associated with crossing the River Stour and the presence of the Sandwich Bay to Hacklinge Marshes SSSI (**Figure 8-6**) converter site option Area A has been refined and an additional HVAC connection option area added to allow for the potential to connect directly into the existing Richborough to Canterbury OHL to the northwest of the existing Richborough Substation (**Figure 8-14**).

Figure 8-14 Refined Converter Site Option Area A and HVAC Connection



Legend

- National Grid Overhead Line - 400kV
- Kent AC Connection Option Area
- Kent Converter Site/Substation Option Area

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Document Title: REFINED CONVERTER STATION SITE OPTION AREA A AND HVAC CONNECTION

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FIGURE 8-14	1:25,000	A3	1	0

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9. Options Appraisal – Terrestrial – Suffolk

9.1.1 This section presents the environmental and socio-economic, technical and cost constraints that have been key differentiators for decision making with regards to routeing and siting in the onshore environment in Suffolk (from MHWS).

9.2 Environmental and Socio-economic Appraisal – Terrestrial Corridors

9.2.1 Multiple corridors were appraised that could connect landfalls S1-S5 to either the Sizewell substation, the proposed Sizewell substation, the proposed Friston substation or a new substation along the existing 4Z OHL as shown in **Figure 9-1**.

Figure 9-1 Suffolk terrestrial corridors

EAST SUFFOLK DISTRICT

S5

S4

S3

S2

S1

SAXMUNDHAM

LEISTON

ALDEBURGH

Theberton

Knodishall

Aldringham

Thorpeness

Snape

Iken

Tunstall

Blaxhall

Sternfield

Kelsale

Carlton

Rendham

Farnham

Stratford St Andrew

Slaughden

Martello Twr

Minsmere Haven

ALDEBURGH BAY

0 1 2 3 4 km

LEGEND

- Sizewell Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Sizewell - Sizewell Zone
- Purple Corridor
- Blue Corridor
- Orange Corridor
- Red Corridor
- Green Corridor

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Document Title: SUFFOLK TERRESTRIAL CORRIDORS SHEET 1 OF 3

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FIGURE 9-1	1:50,000	A3	1	0

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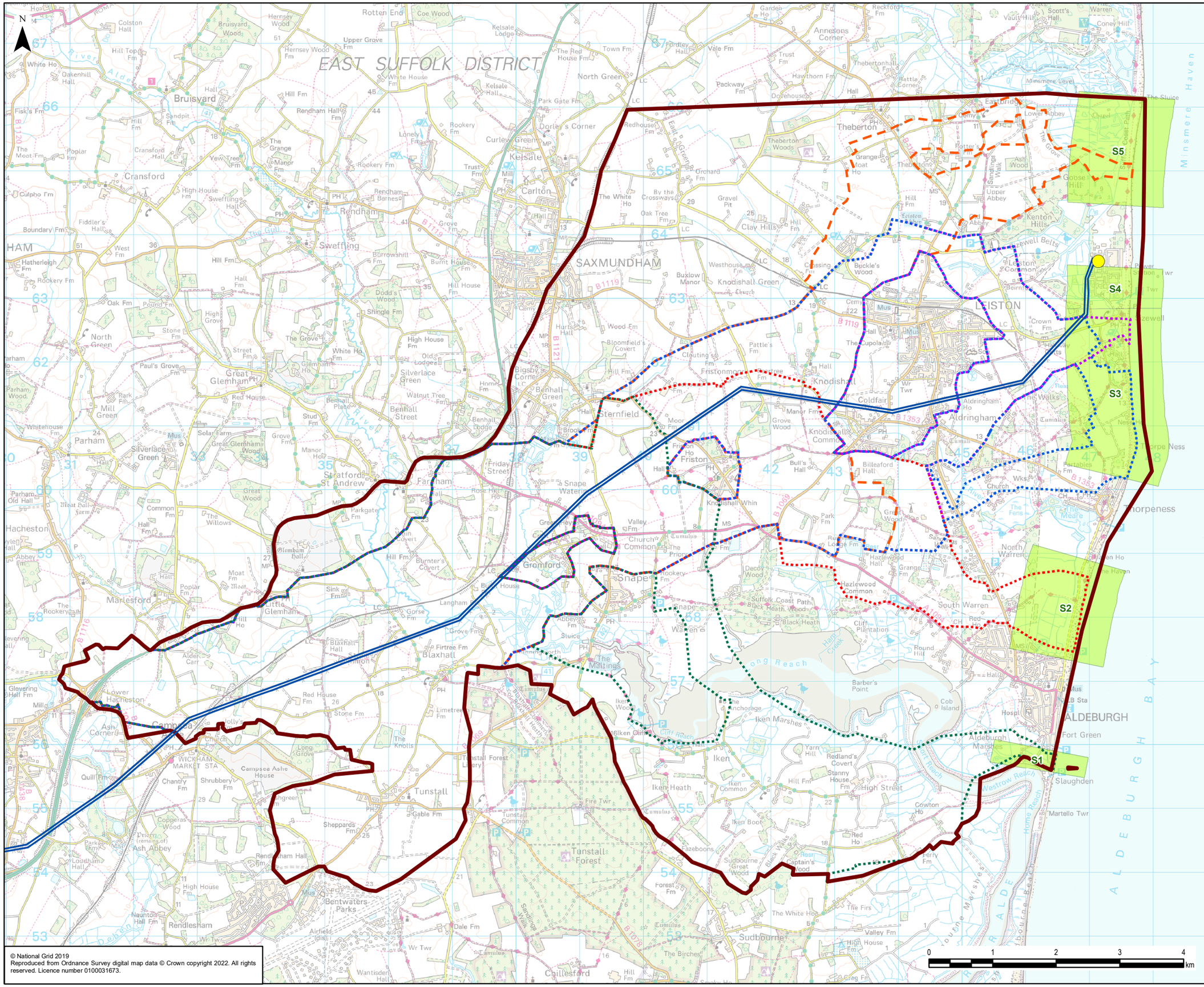

LEGEND

- Sizewell Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Sizewell - 4Z Area 1 Zone
- Green Corridor
- Blue Corridor
- Purple Corridor
- Red Corridor
- Orange Corridor

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EAST SUFFOLK DISTRICT

N

LEGEND

- Sizewell Substation
- 400 kV Overhead Line
- Landfall Area of Search
- Sizewell - Friston Zone
- Green Corridor
- Orange Corridor
- Purple Corridor
- Red Corridor
- Blue Corridor

S1 S2 S3 S4 S5

SAXMUNDHAM LEISTON ALDEBURGH

0 1 2 3 4 km

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Document Title: SUFFOLK TERRESTRIAL CORRIDORS SHEET 3 OF 3

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FIGURE 9-1	1:46,549	A3	1	0

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9.2.2 Key constraints relating to the Sizewell Area terrestrial corridors relate primarily to the following topics:

- biological environment
- physical environment
- landscape and visual
- traffic and access
- planning

9.2.3 The green, red and blue options for all connections (Sizewell (existing and proposed), Friston, 4Z Area) are considered more constrained from a biological environment perspective (above MHWS) due to the intersection with the following nature conservation designations (**Figure 9-3** and **Figure 9-4**):

- Alde-Ore & Butley Estuaries SAC (green corridor)
- Alde – Ore Estuary SPA/Ramsar/SSSI (green corridor)
- Leiston – Aldeburgh SSSI (red and blue corridor)
- Sandlings SPA (red and blue corridor)

9.2.4 The green corridors from landfall S1 to Sizewell and Friston are the most constrained as they would require crossing the Alde-Ore Estuary SSSI at three locations (**Figure 9-4**) and the Alde-Ore and Butley Estuaries SAC at two locations (**Figure 9-3**). Mitigation in the form of trenchless crossing techniques could avoid or reduce risks to the SAC/SSSI; however, it may not be possible to eliminate all potential effects, including disturbance.

9.2.5 The red corridors that connect landfall S2 to all connection points intersect with the North Warren RSPB Reserve (**Figure 9-5**). Although it is likely that direct effects could be minimised through use of trenchless techniques there would likely be a requirement to undertake ground investigation surveys along the length of any proposed HDD to cross this area and there would likely be indirect effects such as disturbance during installation.

9.2.6 The blue corridors that connect to landfall S3 are less constrained due to the increased potential to avoid designations. Beyond the landfall area the section of corridor that passes to the south intersects with the SSSI and RSPB reserve and the Sandlings SPA (**Figure 9-3** to **Figure 9-5**). The northern part of this corridor potentially could avoid these sites depending on the location of the other developments as shown on **Figure 9-2**.

9.2.7 The orange corridors all intersect at the landfall (S5) with the Minsmere to Walberswick Heaths and Marshes SAC/SSSI, Minsmere – Walberswick SPA/Ramsar (**Figure 9-3** and **Figure 9-4**) and Minsmere RSPB reserve (**Figure 9-5)**. As described in **Chapter 7** mitigation by means of a trenchless technique is proposed at these locations to reduce impacts.

9.2.8 The purple corridors connect to the S3 landfall and only intersect with a small area of the North Warren RSPB Reserve close to the landfall; however, when considered in

isolation this area could be avoided to prevent any potential effects on the site (**Figure 9-5**).

9.2.9 All green corridors are considered significantly constrained from a physical environment perspective due to the landfall area falling wholly within flood zone 2 or 3 and a significant proportion of the corridor also crossing flood zone. Immediately beyond landfall is the area of Aldeburgh Marshes.

9.2.10 All red and all orange terrestrial corridors also have overlap with flood zones at landfall (S6 and S9 respectively) (**Figure 9-6**).

9.2.11 All corridors intersect with the Suffolk Coast and Heaths AONB (**Figure 9-7**), however the green corridors overlap with the AONB for the greatest distance (approximately 8.5km) and the purple corridors have the least overlap with this AONB (approximately 1.5km).

9.2.12 The green and orange corridors are considered to be significantly constrained from a traffic and access perspective.

9.2.13 There are several proposed projects within the wider Sizewell area which would require a variety of infrastructure including underground cabling each representing its own footprint. The key projects with the potential to interact with the Project are:

- Sizewell C Nuclear Power Station (Electricite de France - EDF)
- East Anglia 1N and East Anglia 2 offshore wind farms (SPR)
- Nautilus Interconnector (National Grid Ventures - NGV)
- Euro Link Interconnector (NGV)

9.2.14 The orange and purple corridors extensively overlap the proposed order limits for the Sizewell C development and the purple and blue corridors overlap with the export cable corridors for the East Anglia One North and East Anglia Two developments.

9.2.15 **Figure 9-2** shows the order limits of these projects as available at time of writing.

9.2.16 When considering the environmental and socio-economic constraints in combination there four pinch points have been identified within the corridors these are:

- The first is at a crossing of Leiston Road close to South Warren Golf Course, which would be crossed by all three red corridors connecting to the landfall area of search S2.
- The second of these is located between the B1353 and Leiston Road and would require cable routes to cross the Sandlings SPA, the Leiston Aldeburgh SSSI, and a section of the golf course, as well as having a pinch-point at the crossing of Leiston Road. This pinch-point would affect the three corridors blue corridors connecting to landfall area of search S3.
- The third pinch-point is to the south of Aldringham at the crossing of the Hundred River. This area is constrained by the Hundred River itself, the crossing of the B1353 and the B1122, and an area of woodland and properties. In addition, the proposed cables for the SPR East Anglia One North and Two Offshore Windfarms are proposed to be routed through this same pinch-point. This area would need to be routed through (depending on which converter station site option area) by

the three purple corridors connecting to landfall area of search S3N or by all three blue corridors connecting to landfall area of search S3 to avoid the second pinch point.

- The fourth pinch-point is to the northwest of Leiston associated with the offsite works for the proposed Sizewell C Nuclear Power Station including an area which has recently been established for ecological mitigation measures related to the project. This area would need to be routed through (depending on which converter station site option area) by the three purple corridors connecting to landfall area of search S3N.

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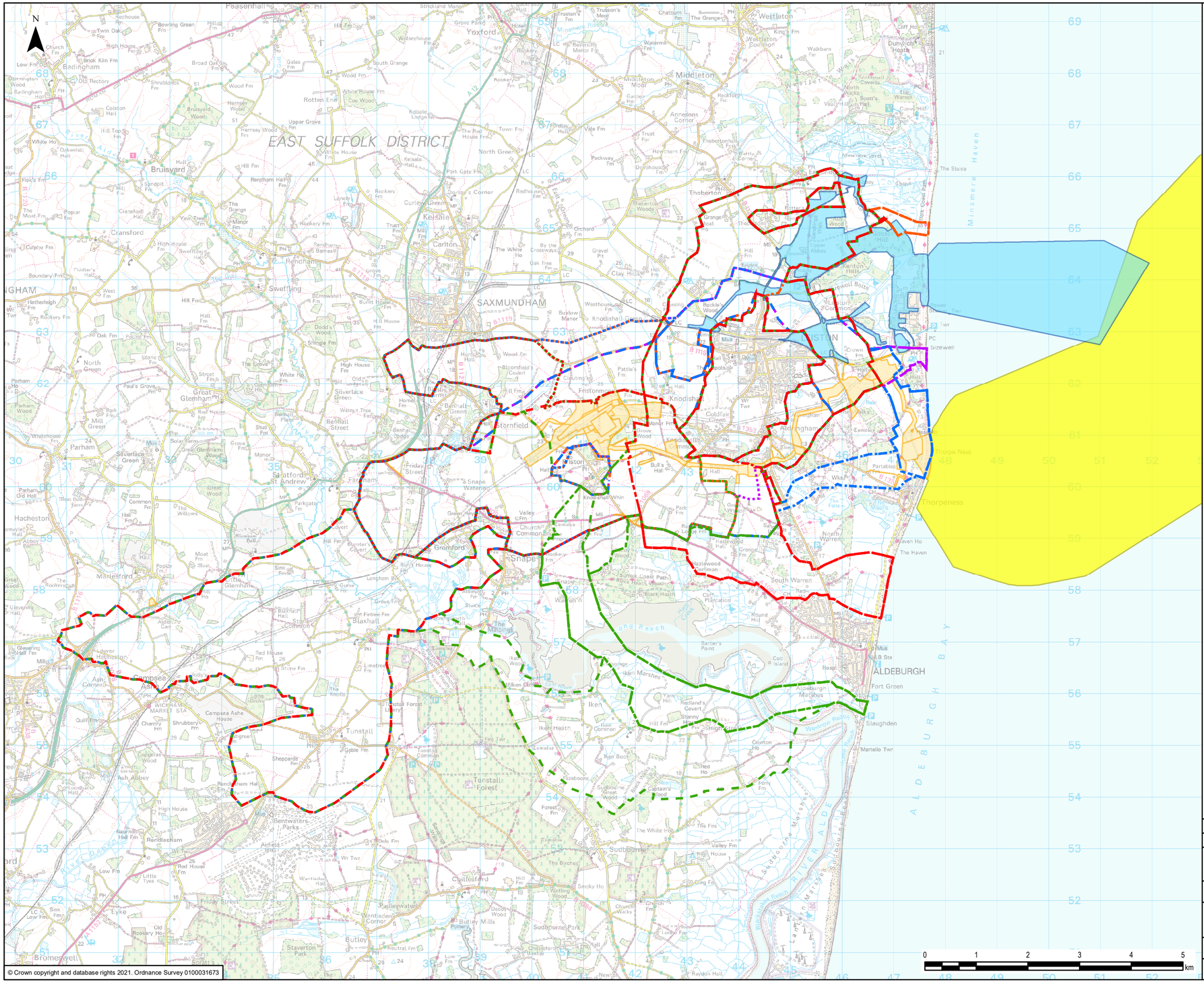
Figure 9-2 Sizewell Area Terrestrial Corridors in relation to Order Limits of Other Major Projects



Legend

Sizewell - Sizewell Terrestrial Corridors

- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - Friston Terrestrial Corridors

- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - 4Z Area 1 Zone Terrestrial Corridors

- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor
- Sizewell C
- EA1N & EA2 Onshore Order Limits
- EA2 DCO Order Limits - Offshore

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Document Title: SUFFOLK TERRESTRIAL CORRIDORS IN RELATION TO ORDER LIMITS OF OTHER MAJOR PROJECTS

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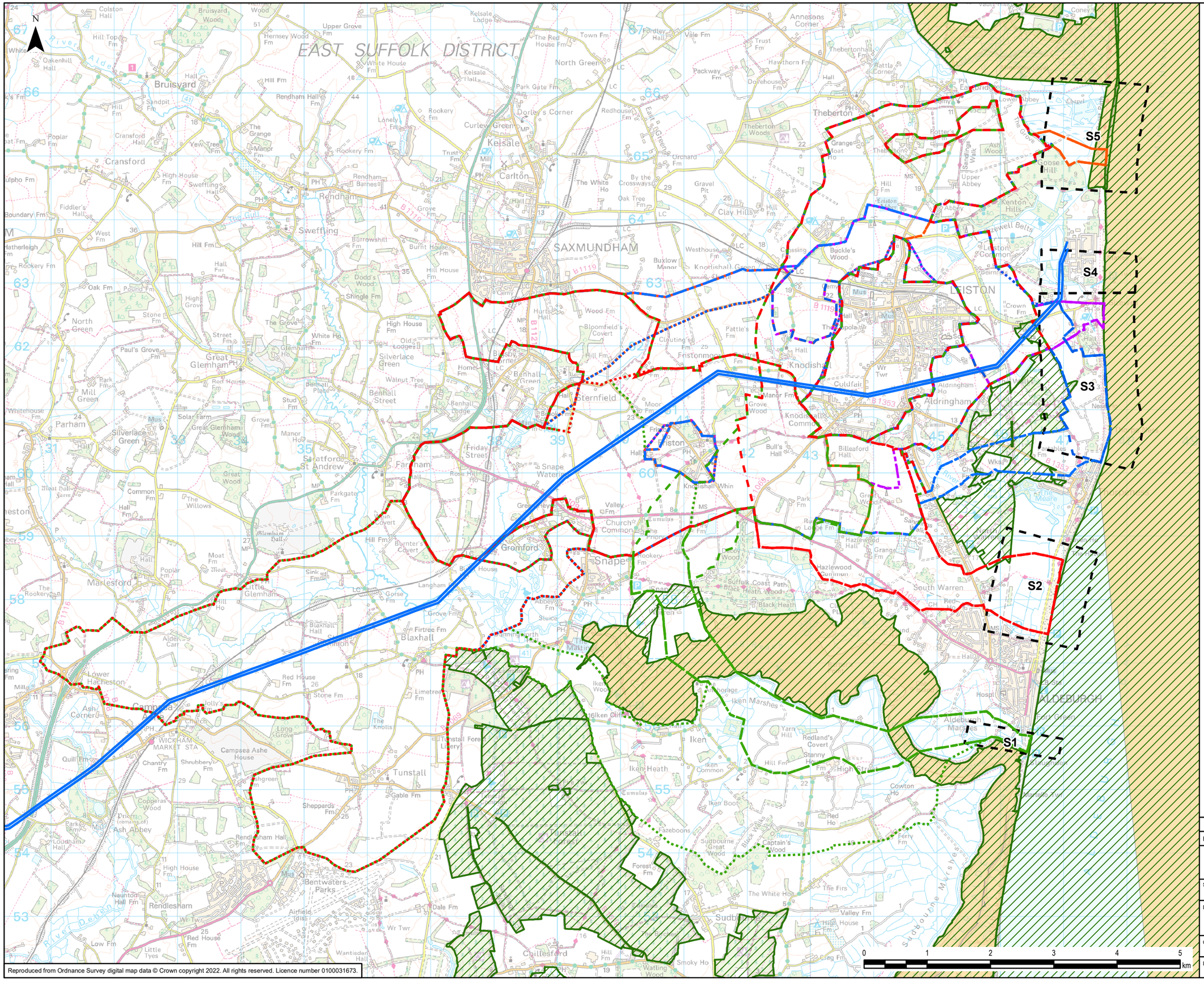
Figure 9-3 Proximity of Suffolk Corridors to SAC/SPA



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Legend

Sizewell - Sizewell Terrestrial Corridors

- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - Friston Terrestrial Corridors

- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - 4Z Area Zone Terrestrial Corridors

- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor
- 400kV Overhead Line
- Landfall Area of Search
- Special Protection Area (SPA)
- Special Area of Conservation (SAC)

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Document Title: PROXIMITY OF SUFFOLK CORRIDORS TO SAC / SPA

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Figure 9-4 Proximity of Suffolk Corridors to SSSI

EAST SUFFOLK DISTRICT

S1
S2
S3
S4
S5

Legend

Sizewell - Sizewell Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - Friston Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - 4Z Area Zone Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

- 400kV Overhead Line
- Landfall Area of Search
- Site of Special Scientific Interest (SSSI)

0 1 2 3 4 5 km

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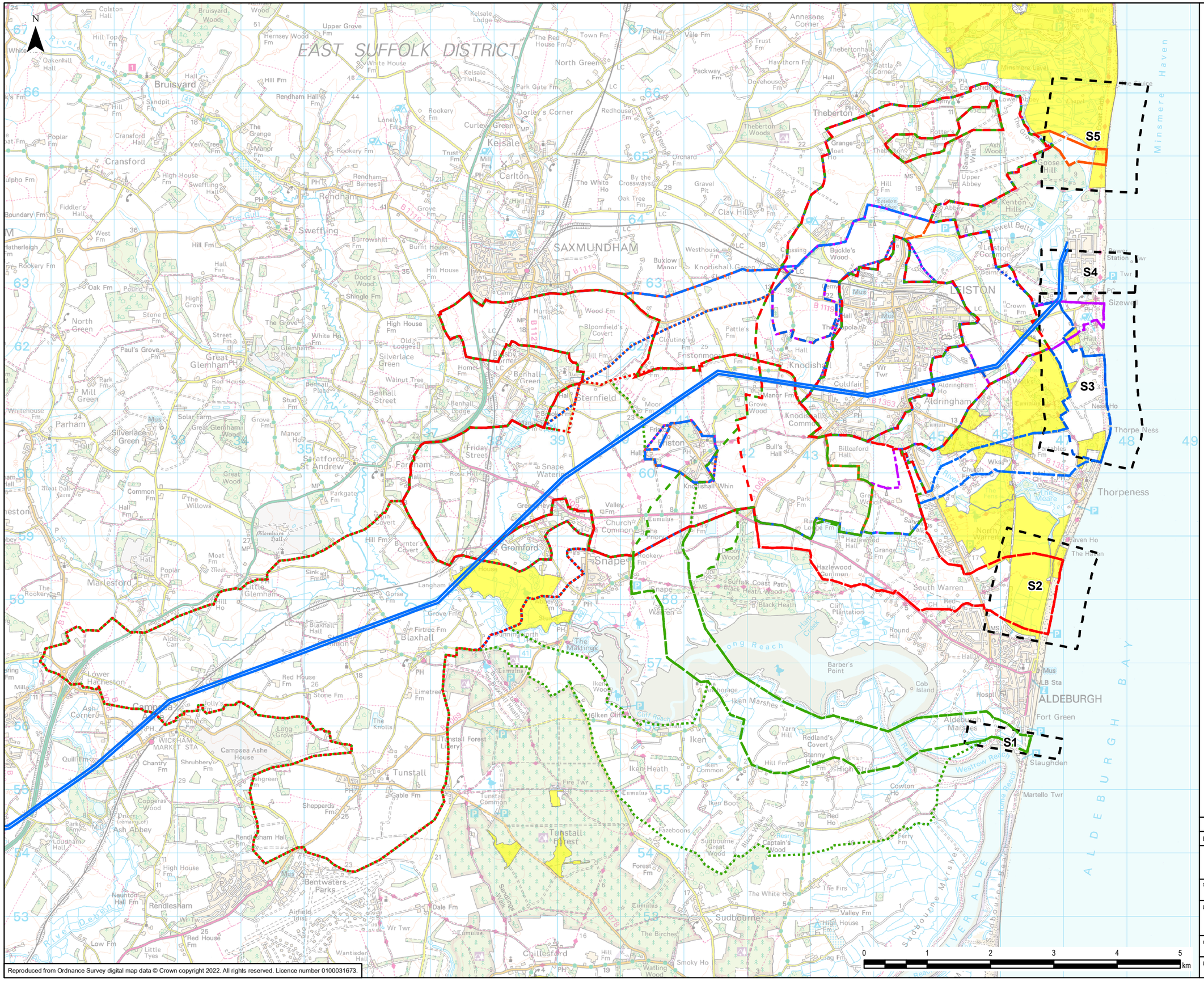
Figure 9-5 Proximity of Suffolk Corridors to RSPB Reserves



Legend

Sizewell - Sizewell Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - Friston Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - 4Z Area Zone Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor
- 400kV Overhead Line
- Landfall Area of Search
- RSPB Reserve

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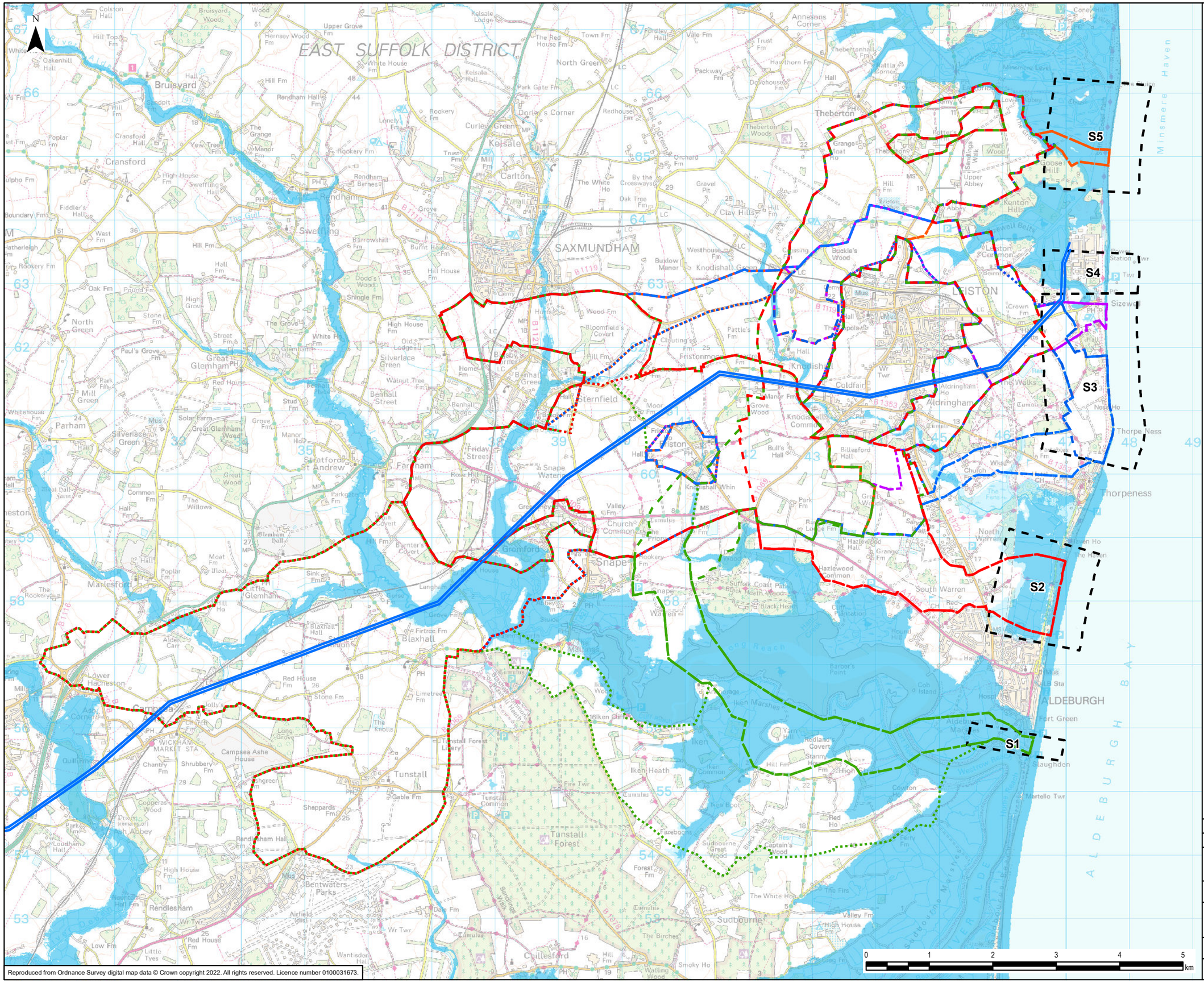
Figure 9-6 Proximity to Sizewell Corridors to Flood Zones 2 and 3



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Legend

Sizewell - Sizewell Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - Friston Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - 4Z Area Zone Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

- 400kV Overhead Line
- Landfall Area of Search
- Flood Zone 2
- Flood Zone 3

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Document Title: PROXIMITY OF SUFFOLK CORRIDORS TO FLOOD ZONES 2 & 3

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FIGURE 9-6	1:55,000	A3	1	0

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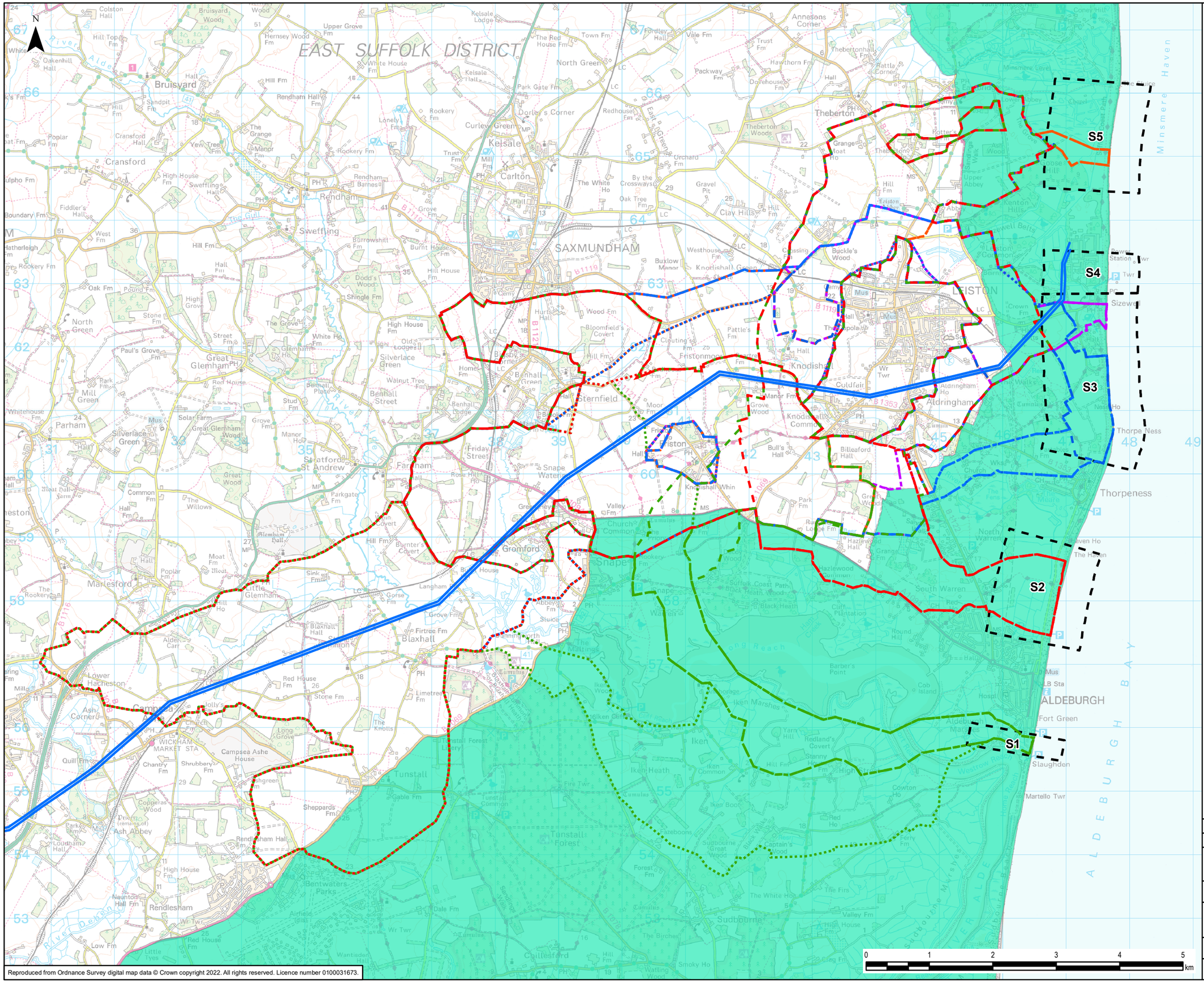
Figure 9-7 Proximity of Suffolk Corridors to AONB



Legend

Sizewell - Sizewell Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - Friston Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

Sizewell - 4Z Area Zone Terrestrial Corridors
- Red Corridor
- Green Corridor
- Blue Corridor
- Orange Corridor
- Purple Corridor

- 400kV Overhead Line
- Landfall Area of Search
- Area of Outstanding Natural Beauty (AONB)

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Document Title: PROXIMITY OF SUFFOLK CORRIDORS TO AONB

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FIGURE 9-7	1:55,000	A3	1	0

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9.3 Environmental and Socio-Economic Appraisal – Converter Site Option Areas

9.3.1 Potential converter site option areas with locations capable of supporting the infrastructure parameters detailed in **Chapter 5**, were identified within 5km of the potential connection points (**Figure 5-10**). They were identified based on their ability to support the parameters as well as factors such as existing screening, the potential for mitigation planting, and the potential for interactions with other developments in the area.

9.3.2 The HVAC connections back to the identified connection points were appraised using the same criteria listed in **Table 8-1**. A construction corridor of 100m was assumed for underground AC connections back to the identified connection points.

9.3.3 Option Area A is located to the north of Kenton and Goose Hill, to the southeast of Eastbridge. The option area is wholly within the Suffolk Coasts and Heaths AONB (**Figure 9-8**), but, was identified as a potential option area, as it is close to the existing Sizewell B Nuclear Power Station and adjacent to the proposed Sizewell C Nuclear Power Station, therefore, providing an opportunity to keep energy infrastructure close together. The option area is adjacent to the Minsmere-Walberswick Ramsar and SPA, Minsmere to Walberswick Heaths & Marshes SAC (**Figure 9-9**) and SSSI (**Figure 9-10**) and Minsmere RSPB Reserve (**Figure 9-11**).

9.3.4 Option Area B is located to the east of Leiston and west of the existing Sizewell B Nuclear Power Station. The option area is wholly within the Suffolk Coasts and Heaths AONB (**Figure 9-8**), but, was identified as a potential option area as it adjacent to the existing Sizewell B Nuclear Power Station and existing OHL, therefore, providing an opportunity to keep energy infrastructure close together. Sandlings SPA (**Figure 9-9**), Leiston – Aldeburgh SSSI (**Figure 9-10**) and North Warren RSPB Reserve (**Figure 9-11**) boarder this option area to the south.

9.3.5 Option Area C is located on the site of the former Leiston Airfield and is bordered to the south by Harrow Lane to the northwest by Theberton Woods. Moat Road runs west to east through the northern half of the option area.

9.3.6 Option Area D is located to the west of Leiston and is bordered to the northwest by the B1119 and Abbey Road and to the west by the Hundred River. There is a small parcel of Ancient Woodland (Buckles Wood) (**Figure 9-10**) located within the north of this option area adjacent to Buckleswood Road. There is an area of flood zone 2 and 3 (**Figure 9-13**) on the far western boundary of the option area associated with the Hundred River.

9.3.7 Option Area E is located to the south of Knodishall and is bounded to the east and south by the Suffolk Coasts and Heaths AONB (**Figure 9-8**), the south by the A1094 Aldeburgh Road and the B1069 (Snape Road) runs southwest to northeast through the centre of the option area. There is a small area of Ancient Woodland at Great Wood (**Figure 9-10**) located on the eastern edge of the option area and Grove Wood Ancient Woodland (**Figure 9-10**) is located adjacent to the northwest corner of the option area.

9.3.8 Option Area F is located to the southeast of Sternfield and west of Friston. An unnamed road linking Church Hill to the A1094 borders the west of the option area

and the B1121 boarders the option area to the north and northeast. Red Lane and Kiln Lane run west to east through the northern half of this option area. The existing 400kV OHL run southwest to northeast through the centre of this option area. The Suffolk Coasts and Heaths AONB (**Figure 9-8**) is located to the south of the option area, south of the A1094.

9.3.9 Option Area G is located the southwest of Saxmundham and is bordered to the east by the A12 and the west by Deadmans Lane.

9.3.10 Option Area H is located to the west of Gromford and is bounded to the south and east by a railway line the west by Langham Road, Racewalk Covert is located to the north of the site. Snape RSPB Reserve (**Figure 9-11**) is located to the southeast of the option area, south of the railway line.

9.3.11 Option Area I is located to the east of Lower Hacheston and is bounded to the north by the A12. The existing 400kV OHL and railway line cross the far southeastern boundary of the option area. A small area of flood zone 2 and 3 (**Figure 9-13**) is located in the northeastern corner of option the option area, associated with the River Ore.

9.3.12 The appraisal of the three connection points was undertaken alongside that of the converter site option areas relevant to each option area. **Table 9-1** lists the option areas appraised for each connection point

Table 9-1 Connection Points and Corresponding Converter Site Option Areas

Connection Point	Converter Site Option Areas
Existing and proposed Sizewell substations	A, B, C, D
Proposed Friston substation	B, C, D, E, F, G, H
New substation along the existing 4Z OHL	B, E, F, H, I

9.3.13 Of the possible connection points in the Sizewell area, only the Sizewell B substation is currently in existence; all the other proposed connection points would require the installation of a new substation, either proposed through another project in the area or installed as part of this Project. Connecting into the Sizewell B substation would require taking over two of the Super Grid Transformer (SGT) circuits feeding the existing Leiston 132kV substation by connecting into the 400kV circuits feeding the SGTs. This would require the installation of two new 400/132kV SGTs in the converter station site with new 400kV cables connecting into the existing Sizewell B substation and new 132kV cables connecting the SGTs in the converter station with the Leiston 132kV substation. The 400kV cable route to the substation would require either using the corridor allocated to the existing 132kV connection or routeing through Sizewell Marshes SSSI. A connection into either the existing or proposed Sizewell substation would also need to take into account the works to construct the proposed Sizewell C Nuclear Power Station as the works would overlap. This could have programme implications for the delivery of this Project in line with the needs case.

9.3.14 At the time of the routeing and siting appraisal the DCO that would deliver Friston substation was advanced in the consenting process.

9.3.15 A connection into the existing 400kV OHL would require a new substation to be built. This was assessed on the basis that it would be co-located within the converter site option areas and would also require either the existing OHL to be diverted into and out of the new substation or a cable route (where economic and efficient) from the substation to the OHL with a cable sealing end compound located adjacent to the OHL.

9.3.16 Converter site option areas A and B are both within the Suffolk Coasts and Heaths AONB (**Figure 9-8**) but offers opportunities to keep existing and proposed energy infrastructure together. Both areas are also within land which is being used as part of ecological mitigation areas for the proposed Sizewell C Nuclear Power Station. As set out above a connection from either of these sites into either the existing or proposed Sizewell substation was considered to be significantly constrained and a connection into either the proposed Friston substation or a new connection into the existing 400kV OHL would likely be required. Site option area A was not identified as suitable for either a connection into the proposed Friston substation or the existing 400kV OHL due to the distance from this option area to these connection points.

9.3.17 Converter site option area C was considered to be constrained by the existing access, however the development of the proposed Theberton bypass as part of the proposed Sizewell C development, would alleviate some of these constraints if developed in time.

9.3.18 Converter site option area D was considered constrained by planned future development plans to the north including the proposed Sizewell C rail head and poor site access along the existing road network that would require routing of traffic through Leiston.

9.3.19 Converter site option areas E and F both have good access from the A1094 but were considered constrained by the proximity to the Suffolk Coasts and Heaths AONB (**Figure 9-8**) in terms of the potential for setting impacts.

9.3.20 Converter site option areas G and H were considered highly constrained by future development plans on the eastern side of the A12 constraining the ability to connect into either the proposed Friston substation and, in the case of option area H, a new connection point on the existing 400kV OHL.

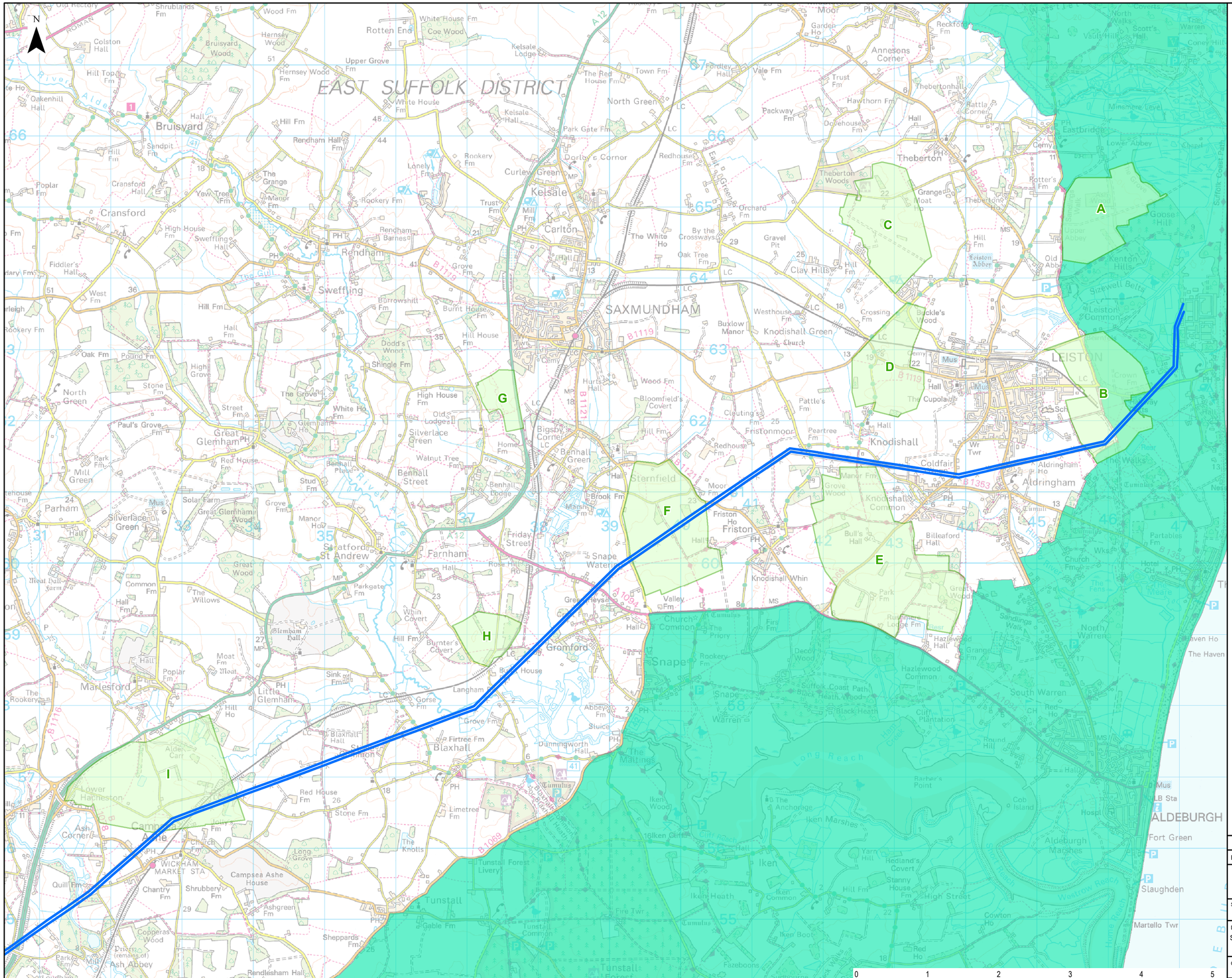
9.3.21 Converter site option area I was not identified for a Friston connection due to the distance from this proposed connection point so the site would require a new connection point to be established. This option area is also constrained by the length of onshore cable that would be required to connect to any of the landfall areas of search increasing the spread of potential temporary disturbance during construction.

9.3.22 Of the converter site option areas that could facilitate a connection into either the existing or proposed Sizewell substation, Option Area B is the closest and could provide the shortest HVAC connection. However, for the reasons explained above such a connection would be constrained and would require the relocation of a number of existing circuits and routeing through the Sizewell Marshes SSSI. Of the converter site option areas that could provide a connection into the proposed Friston

substation, Option Areas E and F would provide the shortest HVAC connection. Of the converter site option areas that could provide for a new connection point into the existing OHL, Option Areas, B, F and I could potentially provide the closest new connection point to the existing lines therefore minimising the length of potential line diversions.

9.3.23 Constraints will largely be dependent on the location of a converter station within the wider option areas with HVAC connections into either the existing or proposed Sizewell substation considered to be the most constrained. Due to the existing and proposed energy development within the study area coupled with the proximity of the Suffolk Coats and Heaths AONB in this locality the environmental and socio-economic appraisal concluded that an underground HVAC connection would be preferred to an OHL HVAC connection.

Figure 9-8 Suffolk Converter Site Option Areas in relation to Suffolk Coasts and Heaths AONB



Legend

- 400kV Overhead Line
- Proposed Converter Site Option Areas
- Area of Outstanding Natural Beauty (AONB)

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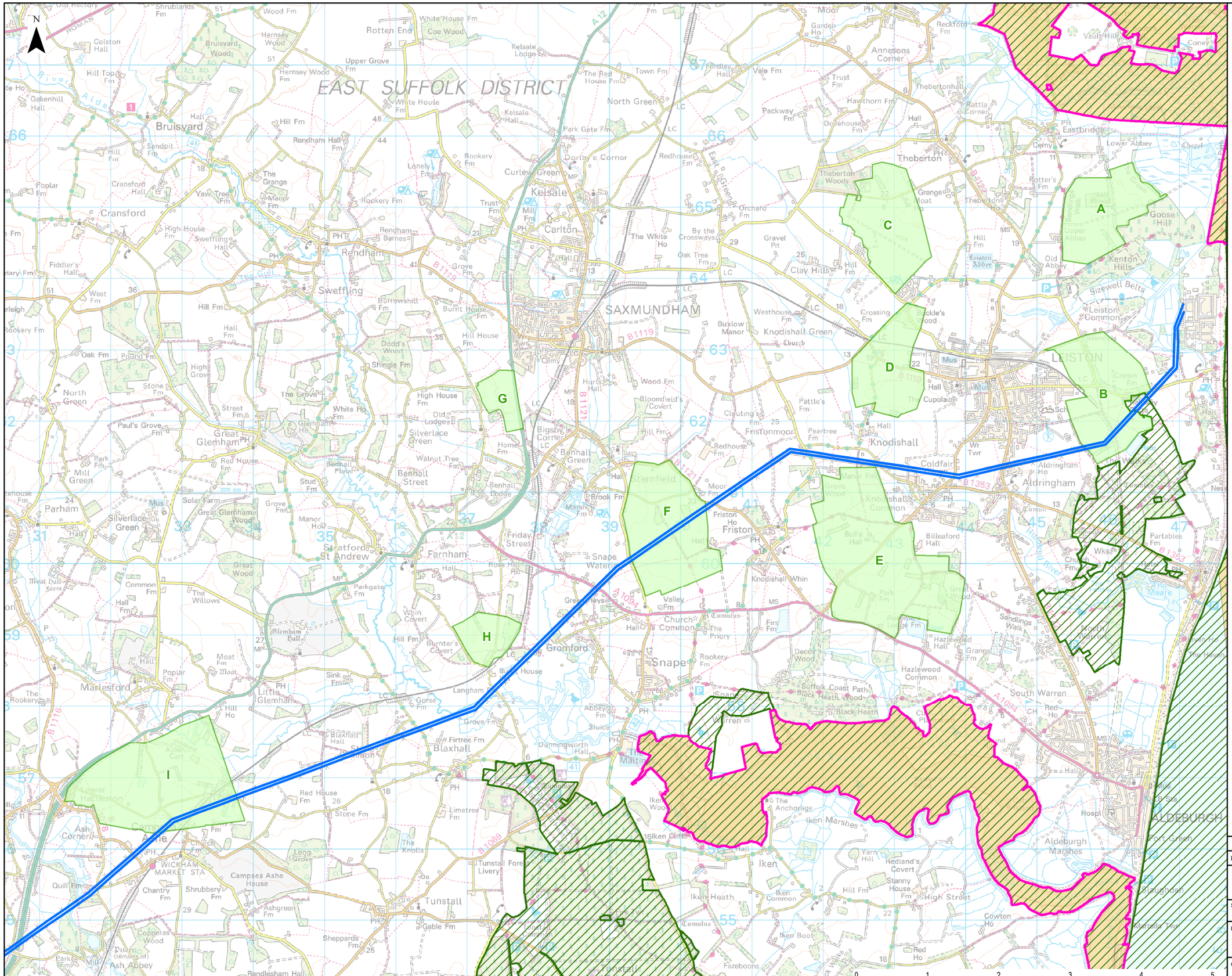
Figure 9-9 Suffolk Converter Site Option Areas in relation to Ramsar sites/SPA/SAC



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- 400kV Overhead Line
- Proposed Converter Site Option Areas
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Ramsar

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FIGURE 9-9	1:50,000	A3	1	0

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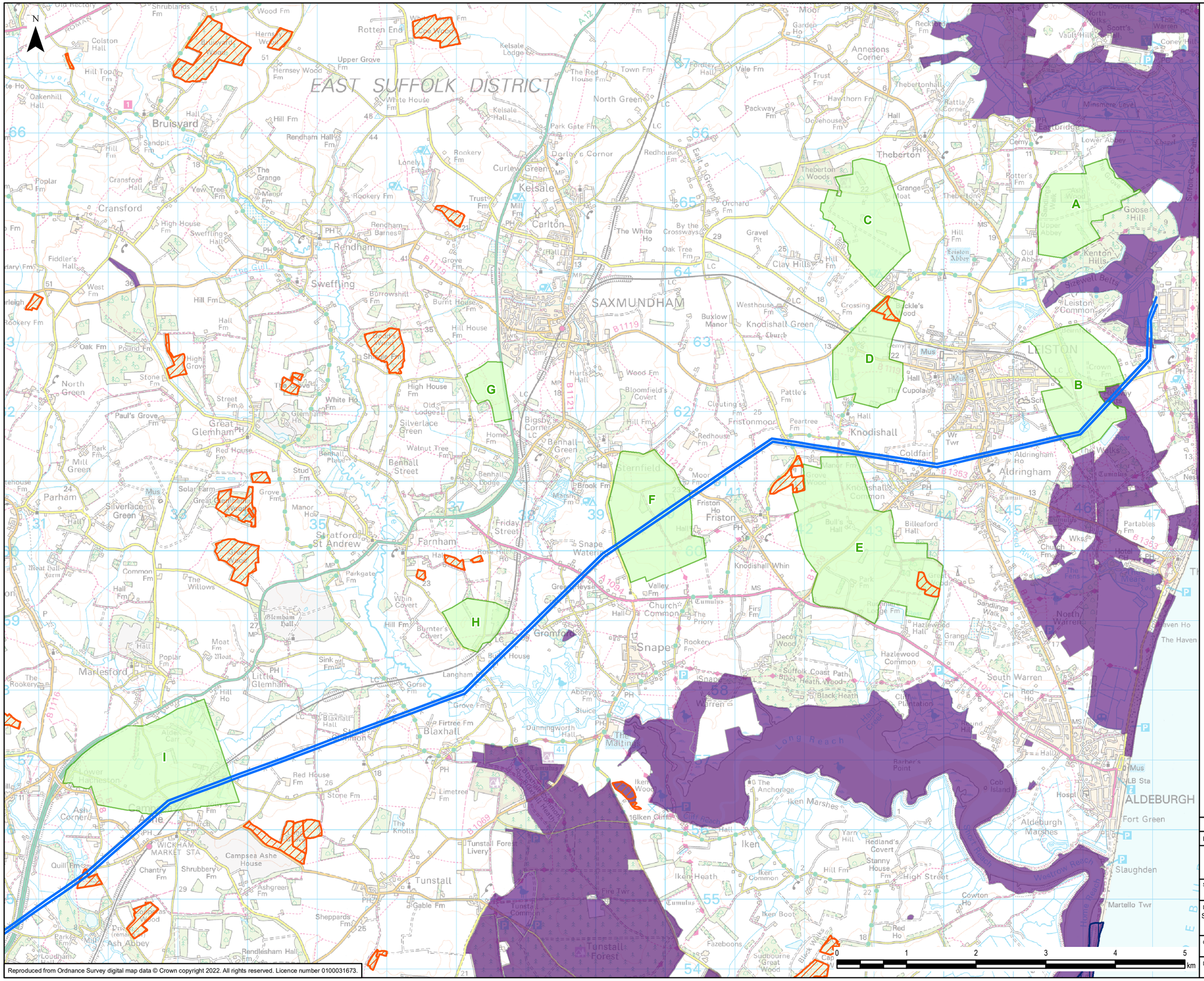
Figure 9-10 Suffolk Converter Site Option Areas in relation to SSSI/NNR/Ancient Woodland



Legend

- 400kV Overhead Line
- Ancient Woodland
- Proposed Converter Site Option Areas
- National Nature Reserve (NNR)
- Site of Special Scientific Interest (SSSI)

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Document Title: SUFFOLK CONVERTER SITE OPTION AREAS IN RELATION TO SSSI /NNR / ANCIENT WOODLAND

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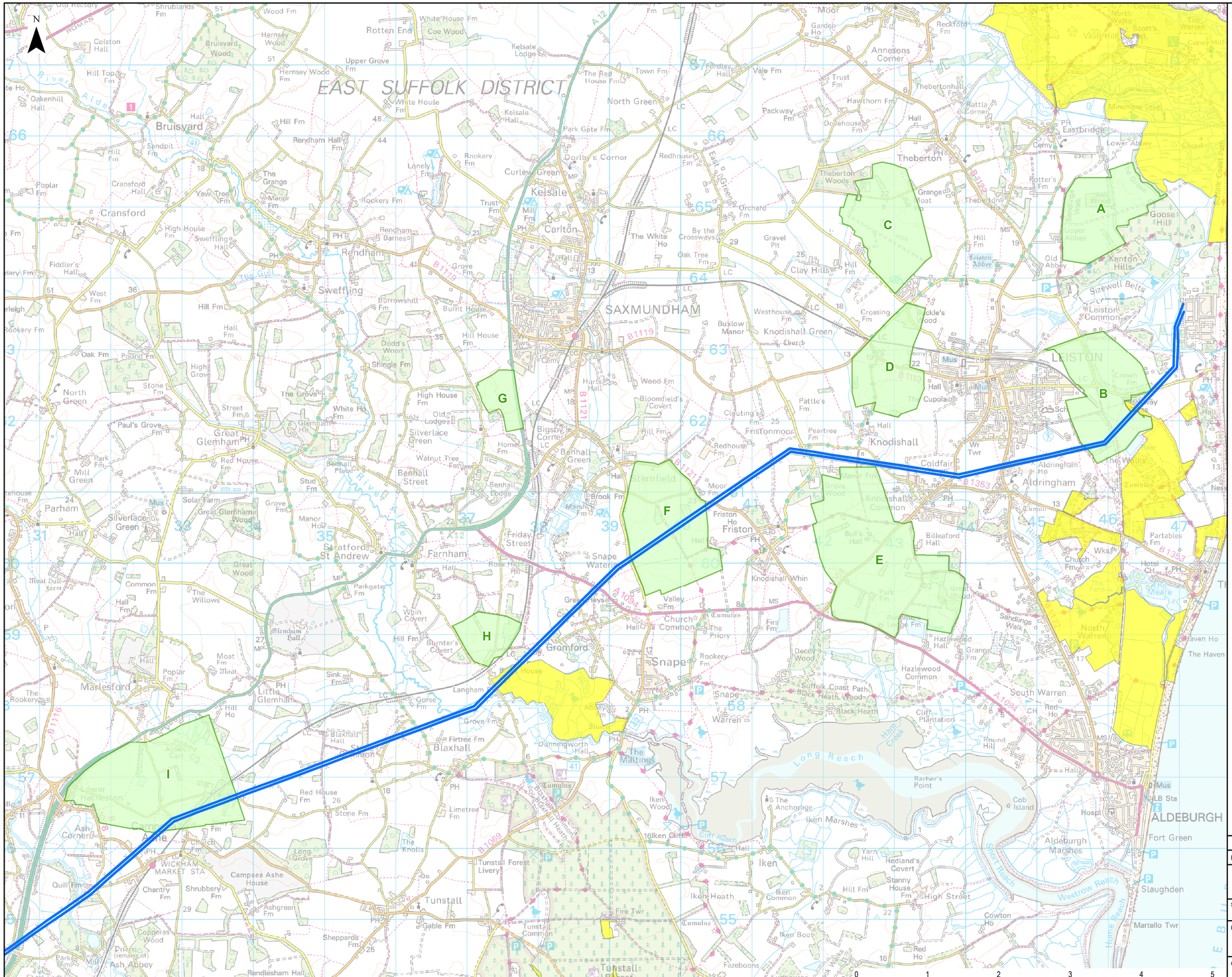
Figure 9-11 Suffolk Converter Station Sites in relation to RSPB Reserves



Legend

- 400kV Overhead Line
- Proposed Converter Site Option Areas
- RSPB Reserve

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FIGURE 9-11	1:50,000	A3	1	0

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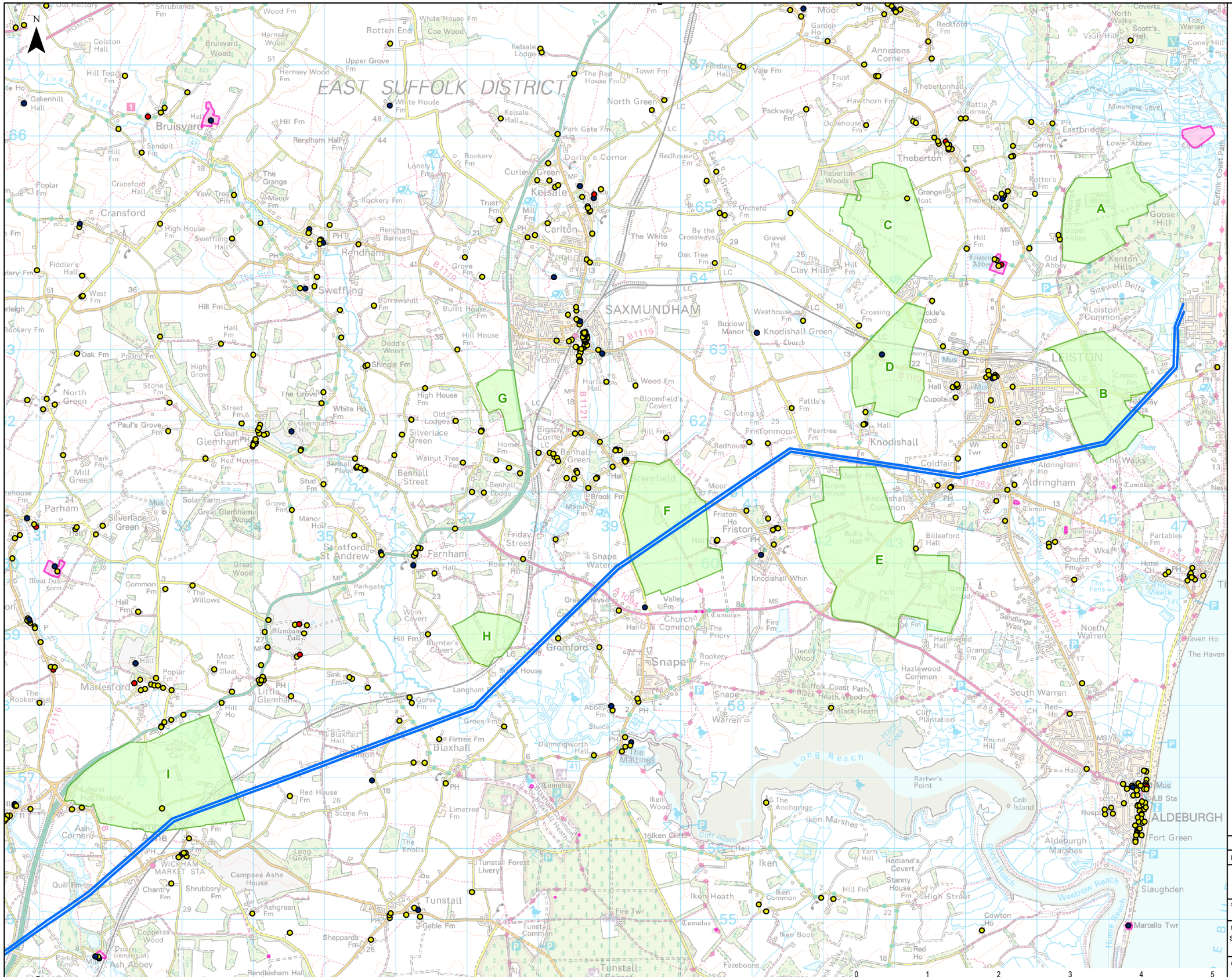
Figure 9-12 Suffolk Converter Site Option Areas in relation to Scheduled Monuments and Listed Buildings



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Document Title: SUFFOLK CONVERTER SITE OPTION AREAS IN RELATION TO SCHEDULED MONUMENTS AND LISTED BUILDINGS

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FIGURE 9-12	1:50,000	A3	1	0

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Figure 9-13 Suffolk Converter Site Option Areas in relation to Flood Zones 2 and 3

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Legend

- 400kV Overhead Line
- Proposed Converter Site Option Areas
- Flood Zone 2
- Flood Zone 3

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Document Title: SUFFOLK CONVERTER SITE OPTION AREAS IN RELATION TO FLOOD ZONES 2 AND 3

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Document Ref:	Scale:	Format:	Sheets:	Rev:
FIGURE 9-13	1:50,000	A3	1	0

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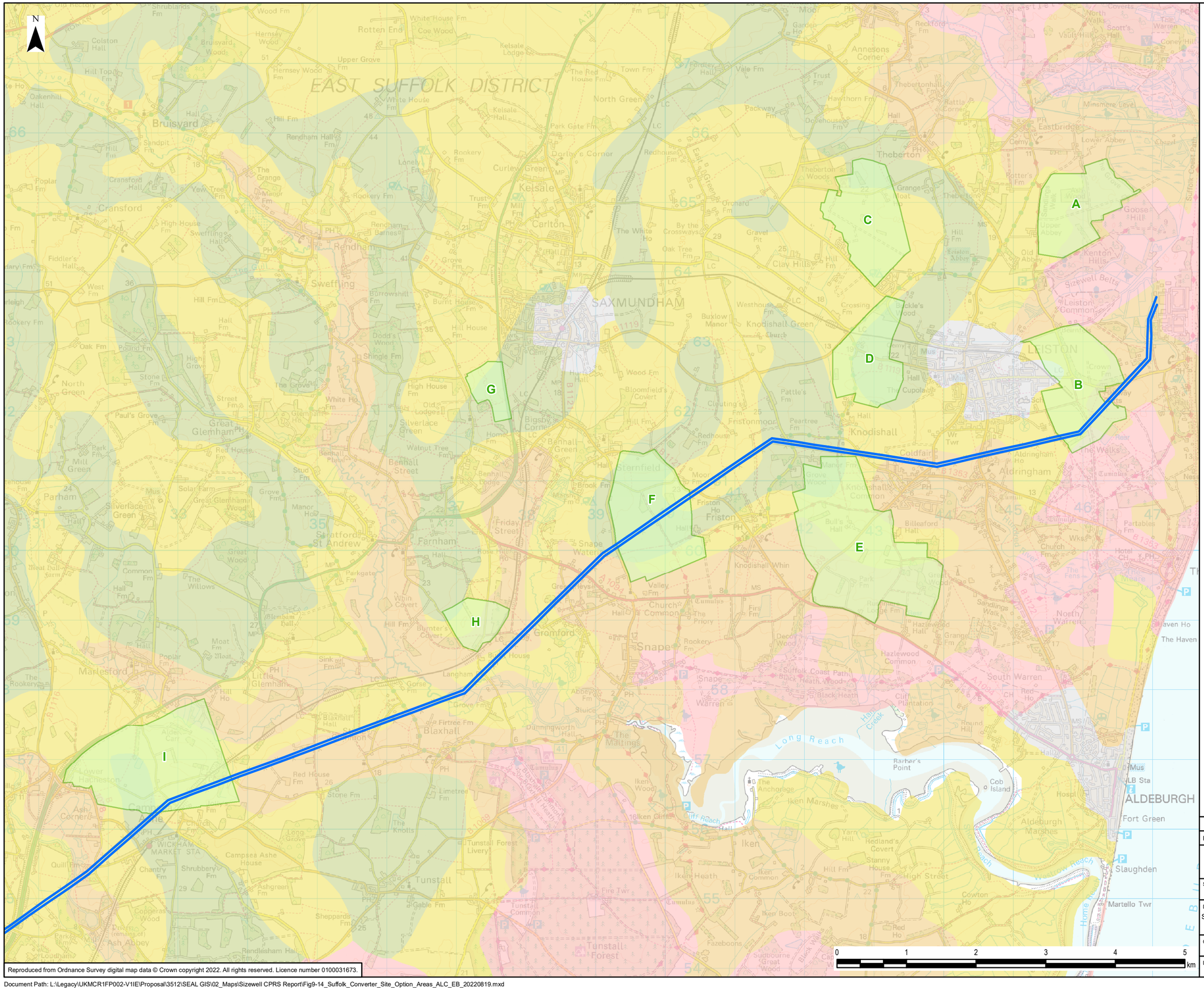
Figure 9-14 Suffolk Converter Site Option Areas in relation to ALC



Legend

- 400kV Overhead Line
- Proposed Converter Site Option Areas

Agricultural Land Classification

- Grade 2
- Grade 3
- Grade 4
- Non Agricultural
- Urban

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Document Title: SUFFOLK CONVERTER SITE OPTION AREAS IN RELATION TO AGRICULTURE LAND CLASSIFICATION

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Document Ref:	Scale:	Format:	Sheets:	Rev:
FIGURE 9-14	1:50,000	A3	1	0

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9.4 Technical Appraisal

9.4.1 When undertaking the environmental and socio-economic appraisal, discussions were ongoing with the terrestrial engineering team to ensure that all corridors being considered, could support a viable engineered solution.

Converter Station and AC Connection

9.4.2 The technical appraisal of the converter station and AC connection gave consideration to the following criteria:

- Ground Conditions
- Site Access
- Topography
- Connectivity between Project infrastructure
- Grid Connection Technical Performance

9.4.3 Key technical and cost constraints identified were:

9.4.4 Connection into existing Sizewell 400kV GIS substation (next to Sizewell B Power Station) would require taking over two of the SGT circuits feeding the existing Leiston 132kV substation by connecting into the 400kV circuits feeding the SGTs. This will require installation of two new 400/132kV SGTs in the converter station site with new 400kV cables connecting into the existing Sizewell B substation and new 132kV cables connecting the SGTs in the converter station with Leiston. The 400kV cable route to the substation would require using the corridor allocated to the existing 132kV connection or require routing through the SSSI. This option is considered high risk and is technically very challenging. The existing GIS substation equipment is considered near end of life and would not be suitable to connect into likely triggering the requirement to provide an alternative substation as proposed for the Sizewell C development.

9.4.5 When considering connection into the new future Sizewell 400kV GIS substation for connection of new Sizewell C nuclear power station (next to Sizewell B Power Station) there are space constraints in the latest proposed design of the new Sizewell C 400kV substation to allow for additional bays. Future bays shown in the latest information are potentially not available due to increased technology footprint requirements. There are currently risks on the proposed switchgear footprint (i.e. due to additional rating and non-SF6 chamber alterations). Additionally, extensions for future bays will be located on one of the extremes of the GIS building, which will come with the challenges of exiting the new 400kV cables and having to cross all the proposed and existing cables in that area. The 400kV cable route to the substation would require using the corridor allocated to the existing 132kV connection or require routing through the SSSI. This option is considered high risk and is technically very challenging.

9.4.6 The AC connection from Suffolk converter Area G is considered highly constrained by future development plans on the eastern side of the A12 adjacent to the option area.

9.4.7 Suffolk converter Area D is considered constrained by planned future development plans to the north included the proposed Sizewell C rail head and poor site access along the existing road network that would require routing of traffic through Leiston.

9.4.8 Suffolk converter Area A and the associated AC connection is considered highly constrained by future development plans associated with the Sizewell C development and poor existing access routes.

HVDC Corridors

9.4.9 The technical appraisal of the HVDC corridors gave consideration to the following criteria:

- Ground Conditions
- Site Access
- Topography
- Crossing Points

9.4.10 Key technical and cost constraints identified were:

9.4.11 The green corridors from landfall S1 were considered high risk from a ground conditions perspective due to multiple long river crossings and routeing through marshland. Site access was also considered a significant constraint.

9.4.12 The orange corridors from landfall S5 was considered highly constrained by poor construction access and the proximity of proposed development areas, principally Sizewell C.

9.4.13 The southern blue corridors from landfall S4 is considered highly constrained due to the pinch point between the SSSI and an existing sewage treatment plant and an additional pinch point near Leiston Road and local residences.

9.4.14 Further constraints at the Hundred River and surrounding woodlands and through Aldringham impact on routeing along multiple corridors. However, it is considered feasible to route through these sections with mitigation.

9.4.15 The red corridors from S2 requires crossing the SSSI and RSPB nature reserve, further stakeholder liaison and ground investigation is required to confirm the installation technique through this area.

9.5 Preliminary Findings

9.5.1 Considering the key environmental, socio-economic and technical constraints presented above, for all the individual elements appraised, on balance the following combination of elements in Suffolk were identified as preferred:

- Connection Point: Proposed Friston Substation
- Landfall Area of Search: S2
- HVDC Corridor: S2 Friston Red Corridor

- Converter Site Option Area: Area E (AC connection underground cables)

9.5.2 As further ground investigation studies/surveys are required to inform the feasibility of utilising trenchless techniques at the S2 landfall and the ecological sensitivity of this landfall an alternative landfall area of search and HVDC corridor has been identified as the following:

- Connection Point: Proposed Friston Substation
- Landfall Area of Search: S3 (Marine Approach S3N)
- HVDC Corridor: S3 Friston Purple Corridor
- Converter Site Option Area cables): Area E (AC connection underground

9.6 Stakeholder Engagement

9.6.1 During engagement with stakeholders Suffolk County Council and East Suffolk District Council emphasised the importance of looking at opportunities to coordinate with the interconnector projects being proposed by NGV in the area. These are the proposed Nautilus Interconnector which undertook non-statutory consultation in September 2021 and the proposed EuroLink Interconnector. Both projects are at the pre EIA Scoping stage. Both interconnector projects would require its own converter station, underground HVDC cables between a landfall and the converter station and an HVAC connection between the converter station and the network connection point.

9.6.2 The Project has explored the concept of colocation of converter stations, shared cable corridors and consolidation of landfalls and to look at potential challenges and options for consenting a coordinated approach. The coordinating exercise has been undertaken in consultation with NGV and the Project will continue to engage with NGV to consider opportunities for coordination as the proposal for Sea Link, Nautilus and EuroLink progress. The findings are presented below.

9.7 Coordination Opportunities

9.7.1 The scope of works for the coordination focused on:

- Physical coordination – is there sufficient space to be able to coordinate infrastructure including the colocation of up to three converter stations.
- Consenting risks or challenges of coordination.
- Technical risks or challenges of coordination.

Co-ordination Process

9.7.2 The following describes the process undertaken for the coordination exercise:

9.7.3 **Step 1:** Identification of potential co-located converter station sites, landfalls and cable corridors to be considered. Desk top review of constraints information

supported by landscape and visual site visit. This was based on the following routeing and siting parameters:

- Connection point assumed to be the proposed Friston substation.
- Study area for site identification - 5km from the proposed Friston substation as per previous assessment criteria.

9.7.4 **Step 2:** Environmental/socio-economic/policy appraisal of the sites, landfalls and corridors to identify:

- Constraints and opportunities associated with each site.
- Which sites, landfalls and corridors should progress through to step 3.

9.7.5 **Step 3:** Engineering feasibility appraisal of sites, landfalls and corridors.

Converter Stations

9.7.6 A backcheck and review of all potential converter station sites/option areas identified independently through both the NGV Nautilus[10] and the Sea Link routeing and siting studies was undertaken to check the feasibility of whether those sites could accommodate up to three co-located converter stations and to identify any additional sites that should be investigated/appraised further for co-location opportunities, again up to three converter stations.

9.7.7 The sites identified as potentially suitable for co-location of up to three converter stations are shown on **Figure 9-15.**

Landfall Locations

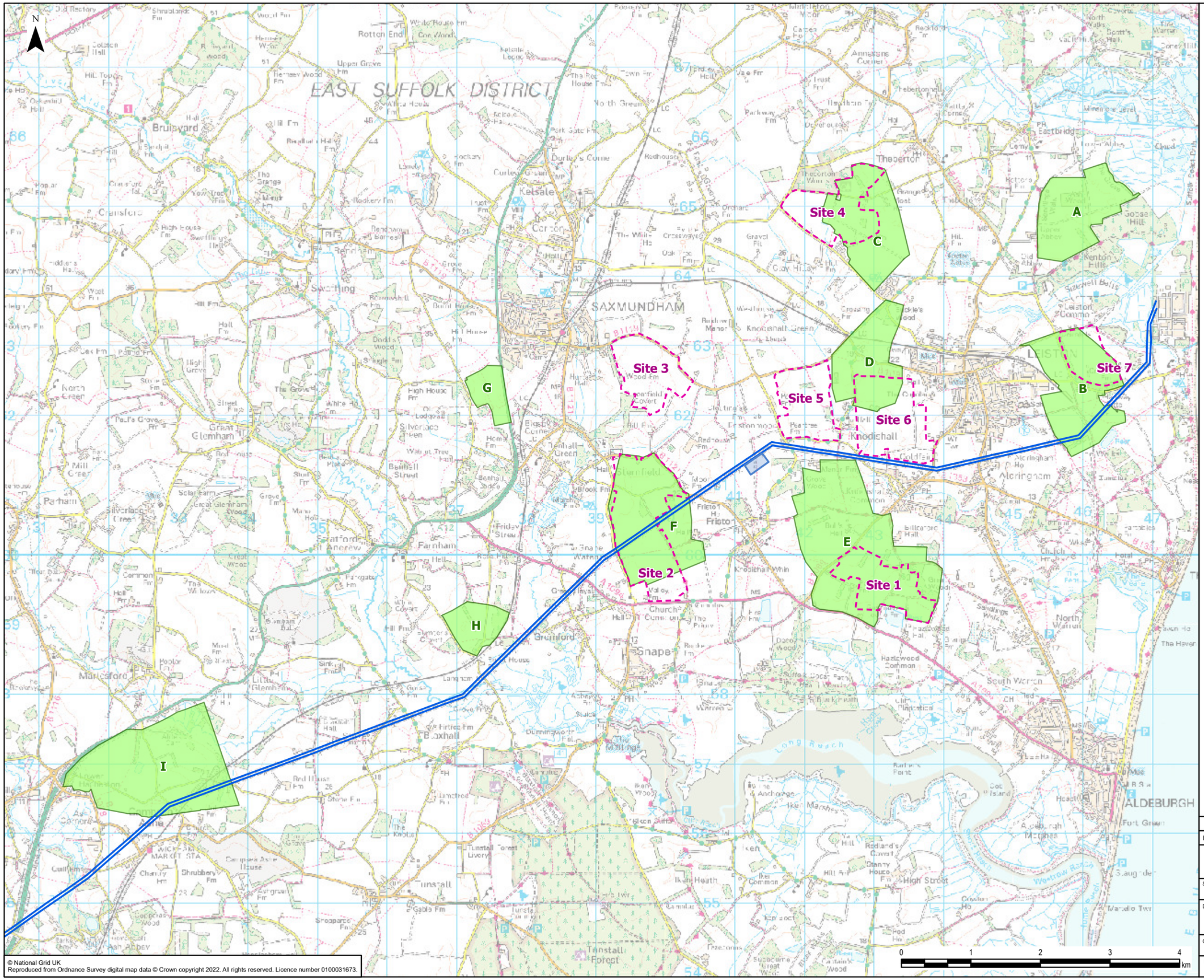
9.7.8 The landfall areas of search S2 and S3 were revisited to understand the feasibility of co-ordinated landfalls following a backcheck and review of all the potential landfalls areas of search

HVDC Corridor

9.7.9 The HVDC and HVAC terrestrial corridors are somewhat dictated by the identification of a suitable landfall and converter site location. As such a number of coordination corridors were identified and are shown on **Figure 9-16** and **Figure 9-17** respectively.

[10] As presented during the Nautilus Interconnection Non Statutory Consultation in September 2021

Figure 9-15 Coordinated Converter Site Options



Legend

- National Grid Overhead Line - 400kV
- Proposed Friston Substation
- Converter Site Option Areas
- Potential Coordinated Converter Station Sites

Rev	Date	Description	GIS	Chk	App
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Document Title: POTENTIAL COORDINATED CONVERTER STATION SITES

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FIGURE 9-15	1:50,000	A3	1	0

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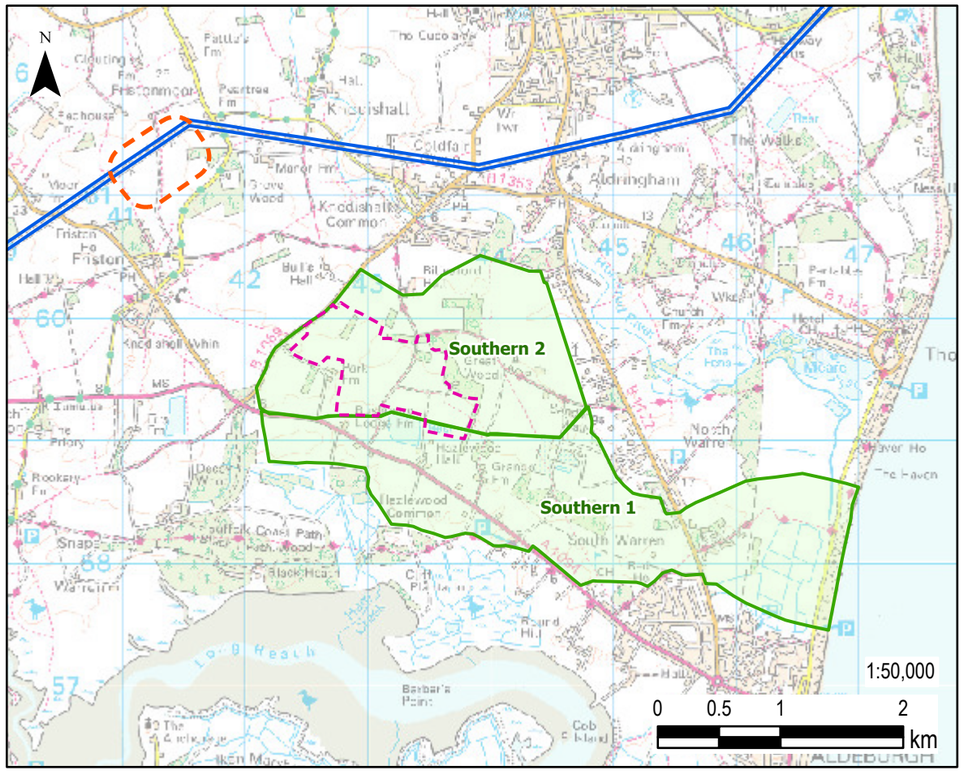
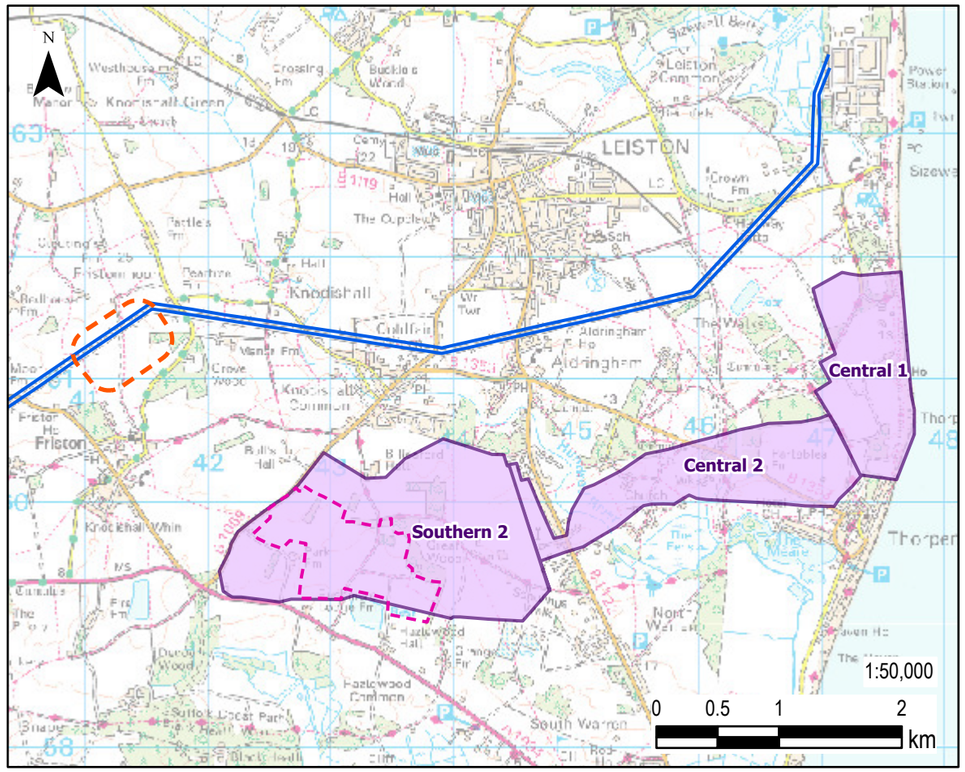
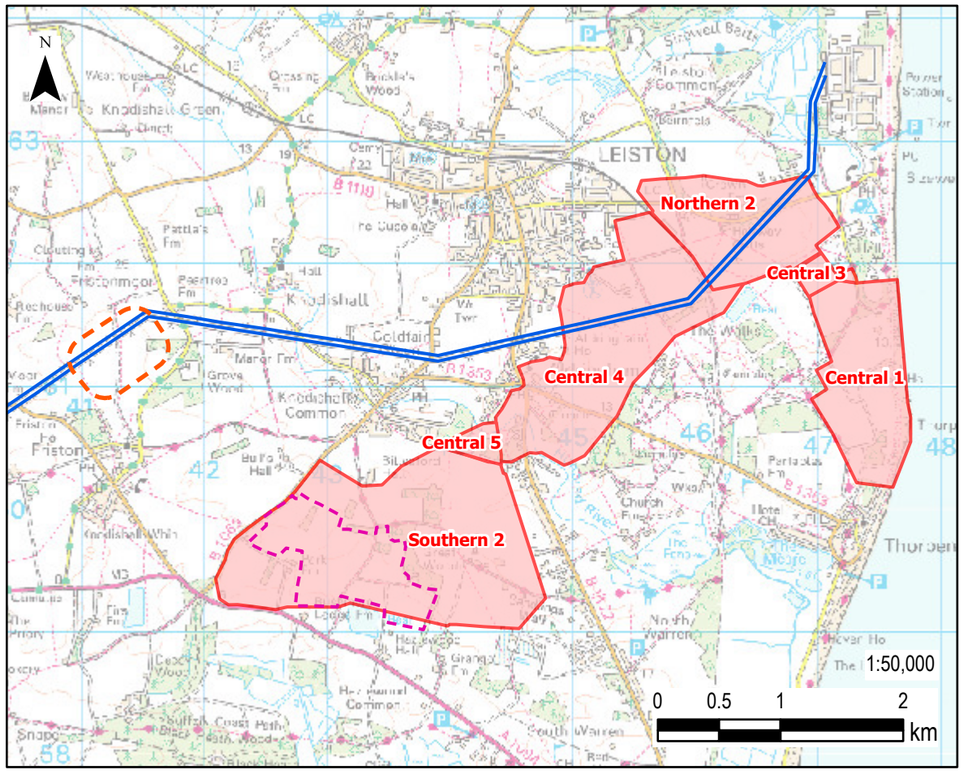
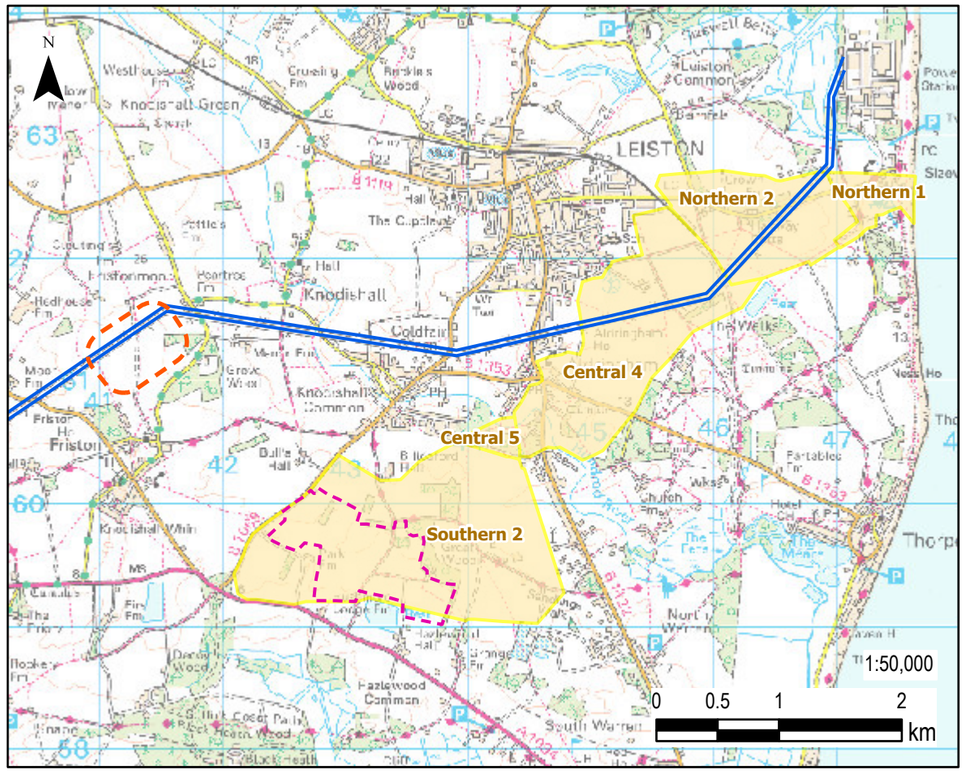
Figure 9-16 Coordinated HVDC Corridors









Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 1
- Corridor 1
- Corridor 2
- Corridor 3
- Corridor 4

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Document Title: COORDINATED HVDC CORRIDOR OPTIONS - SHEET 1 OF 7

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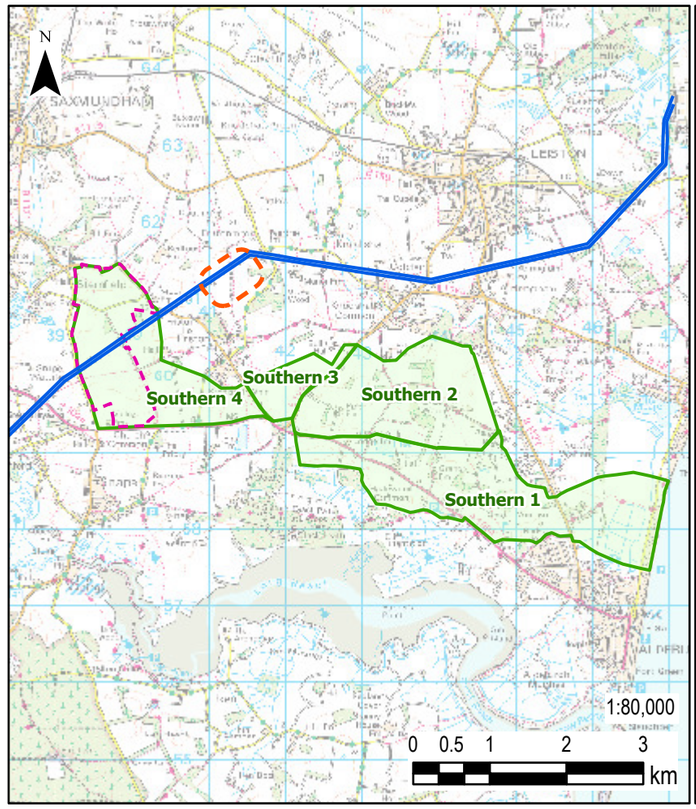

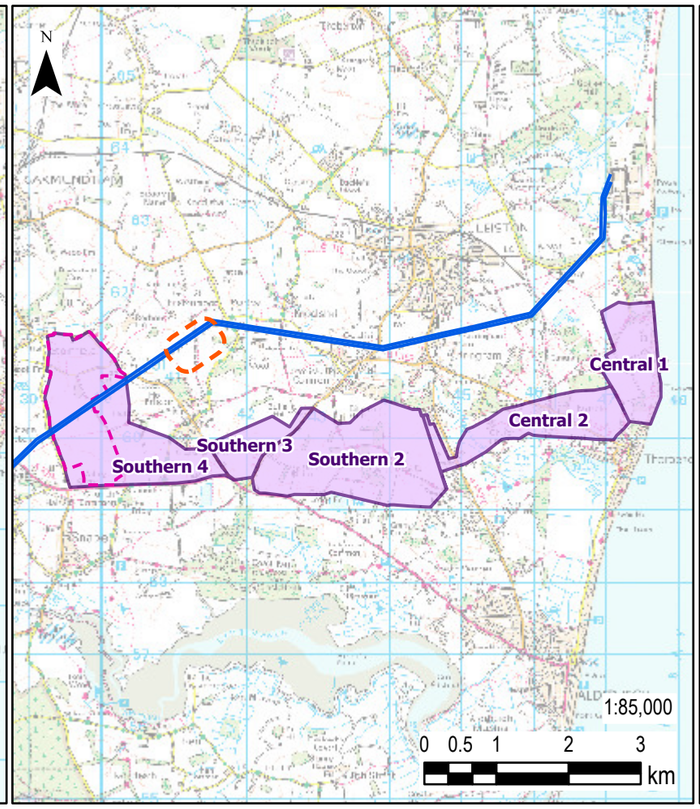

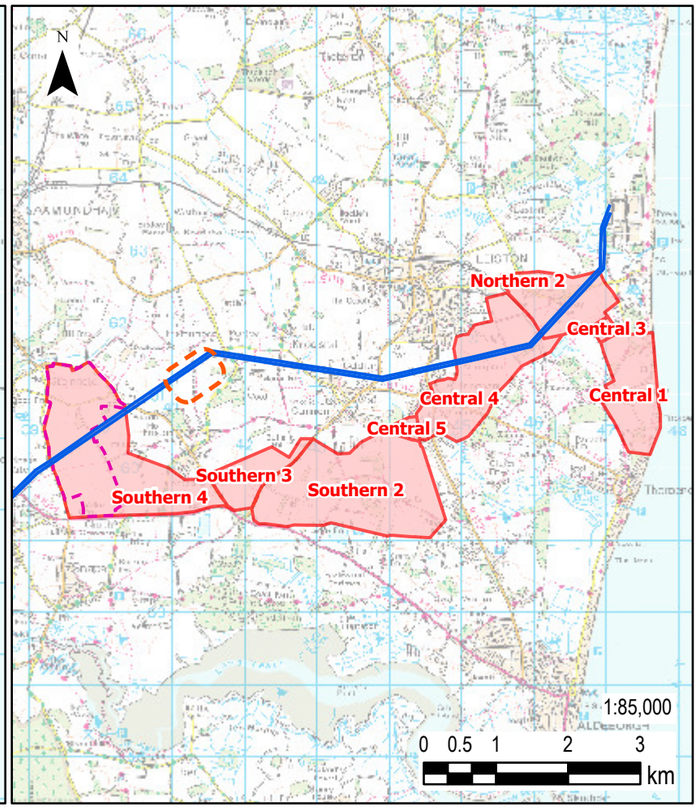

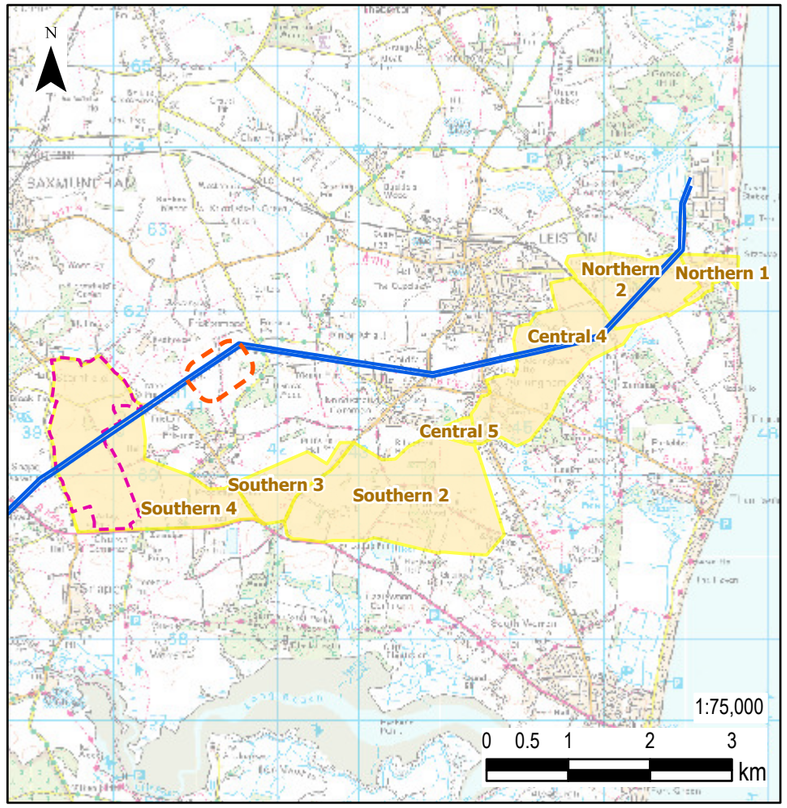

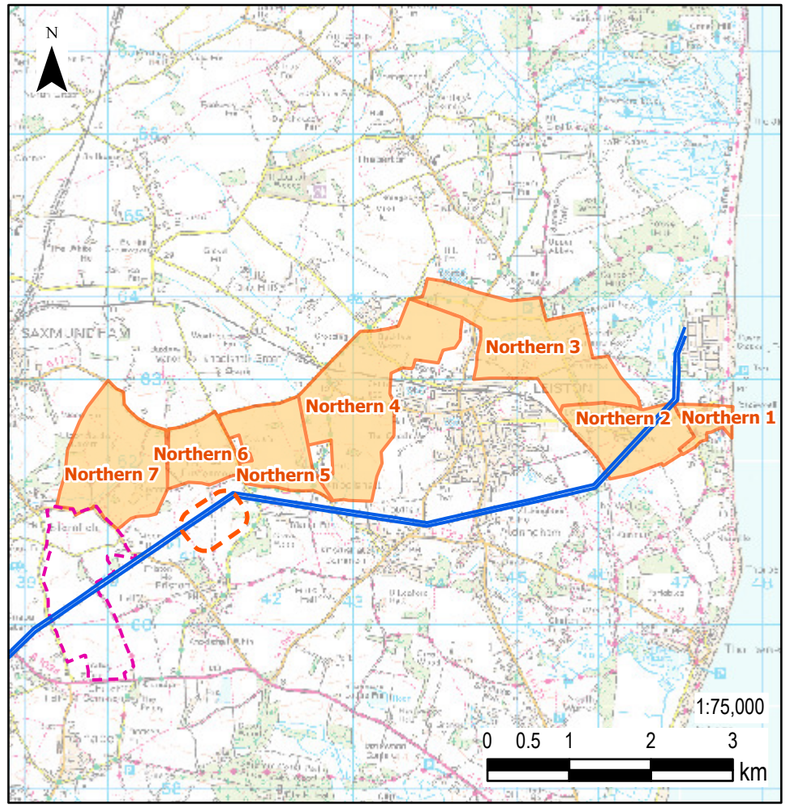

Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 2
- Corridor 1
- Corridor 2
- Corridor 3
- Corridor 4
- Corridor 5

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Document Title: COORDINATED HVDC CORRIDOR OPTIONS - SHEET 2 OF 7

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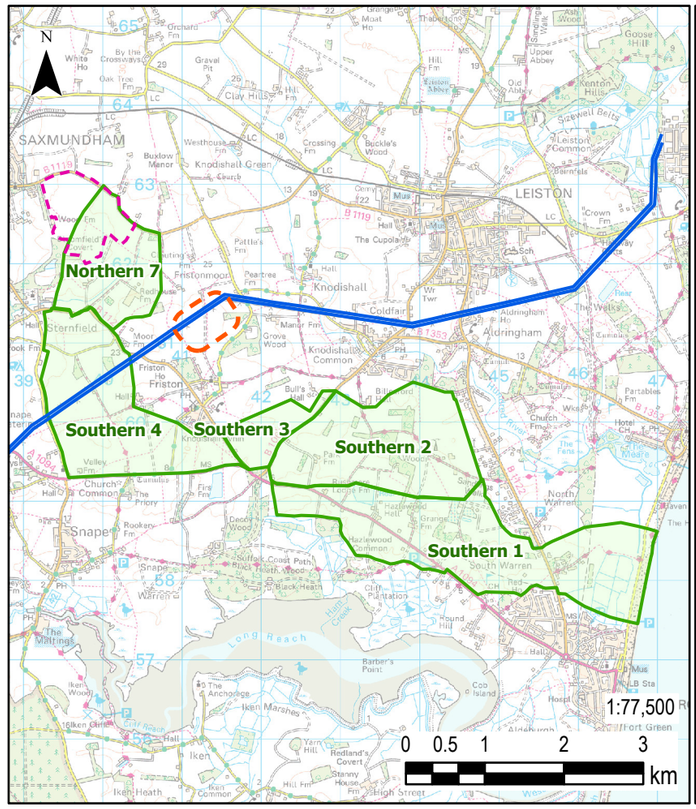

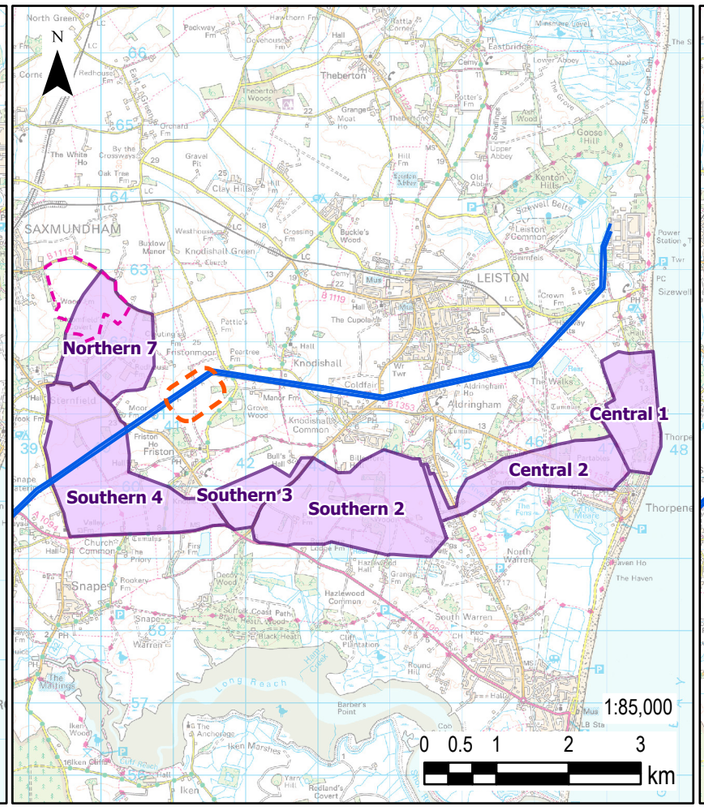

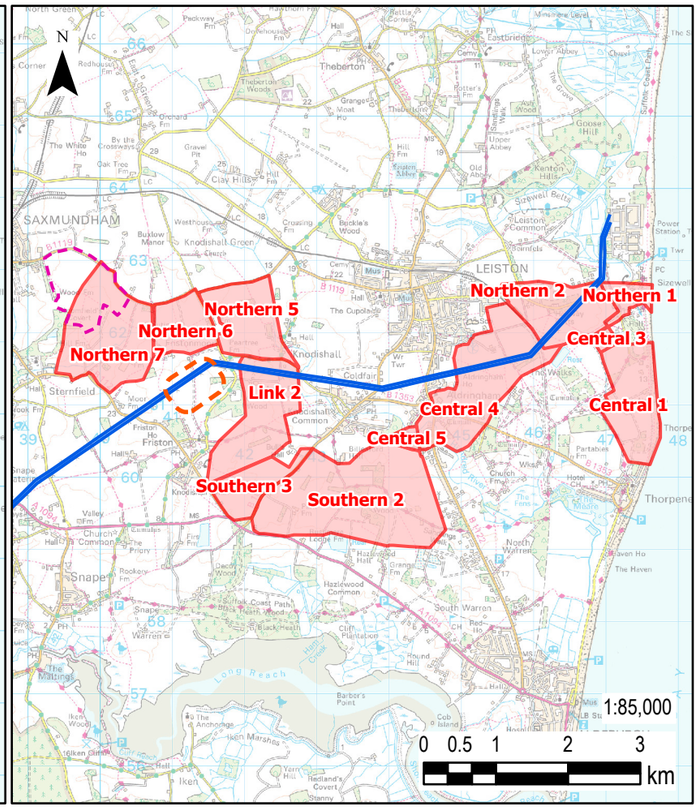

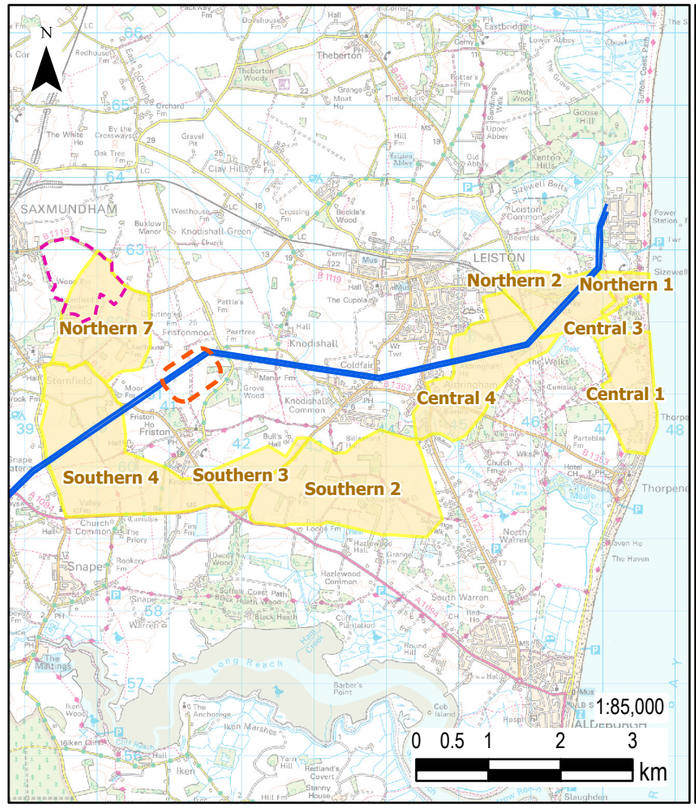

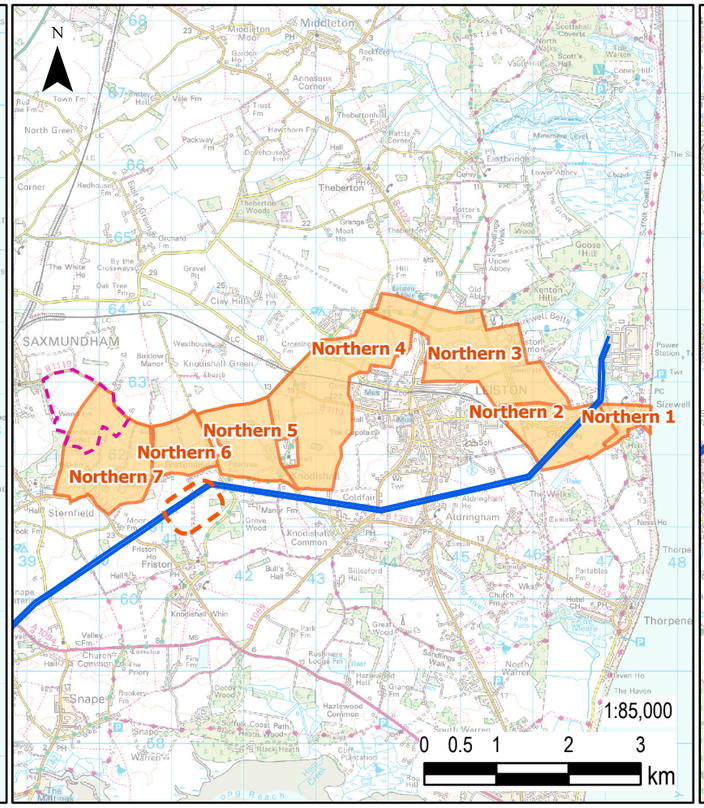

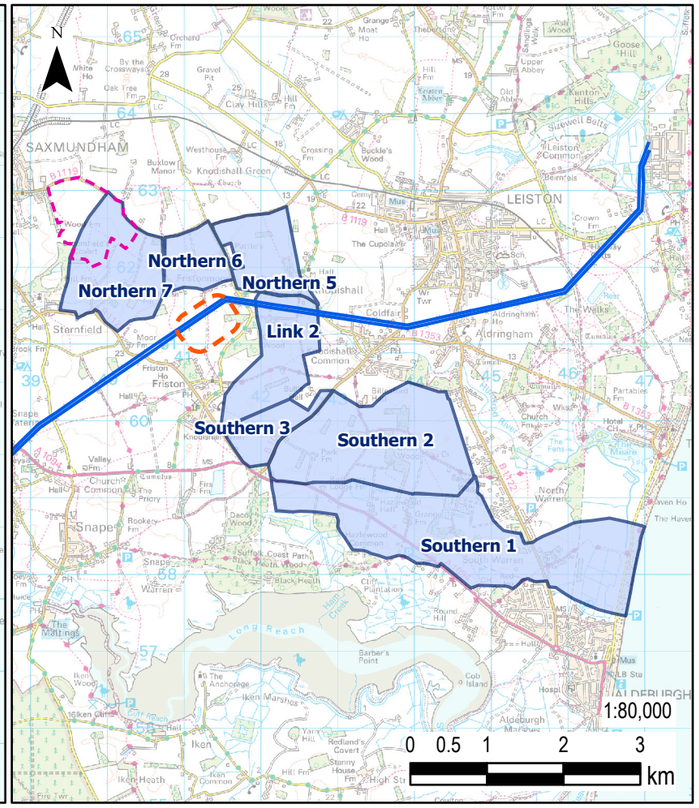

Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 3
- Corridor 1
- Corridor 2
- Corridor 3
- Corridor 4
- Corridor 5
- Corridor 6

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Document Title: COORDINATED HVDC CORRIDOR OPTIONS - SHEET 3 OF 7

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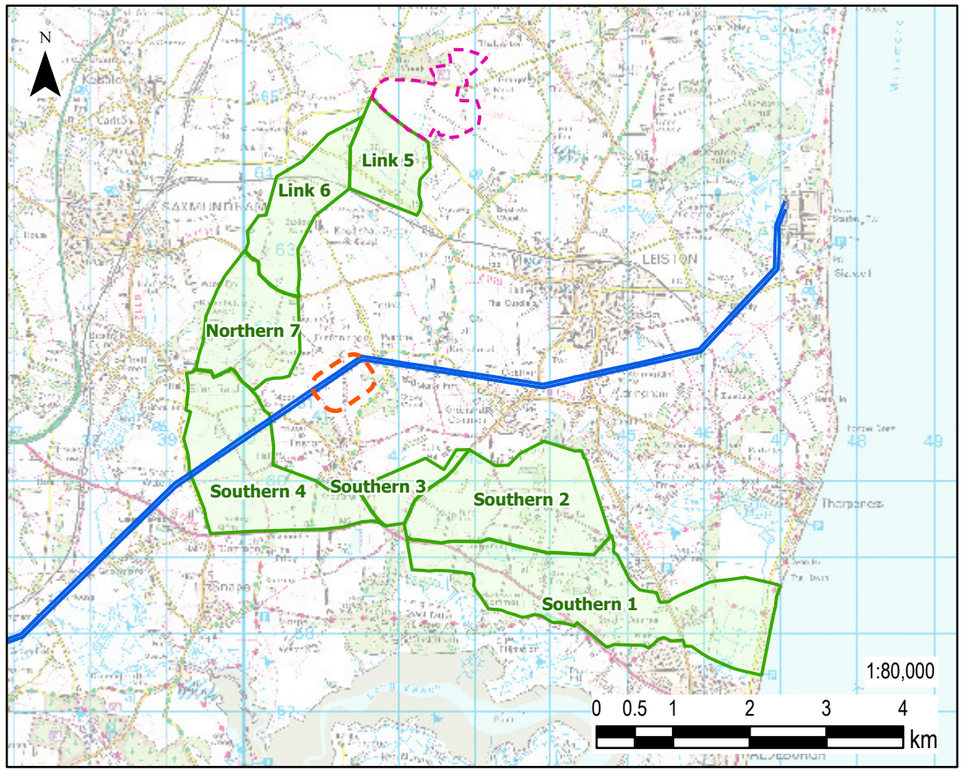

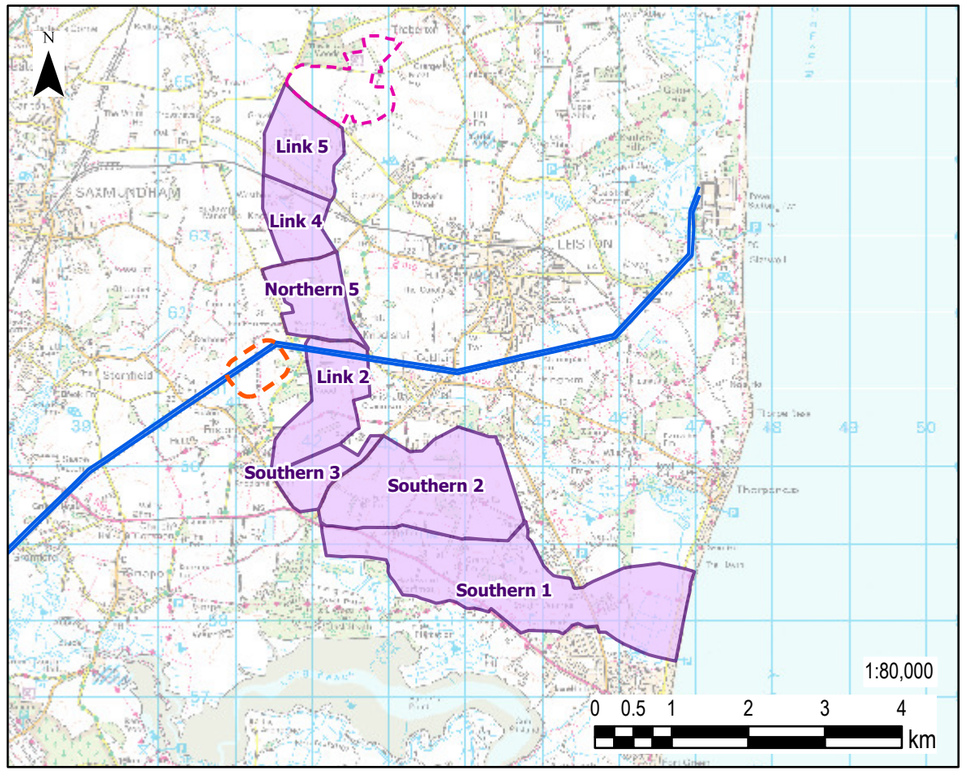

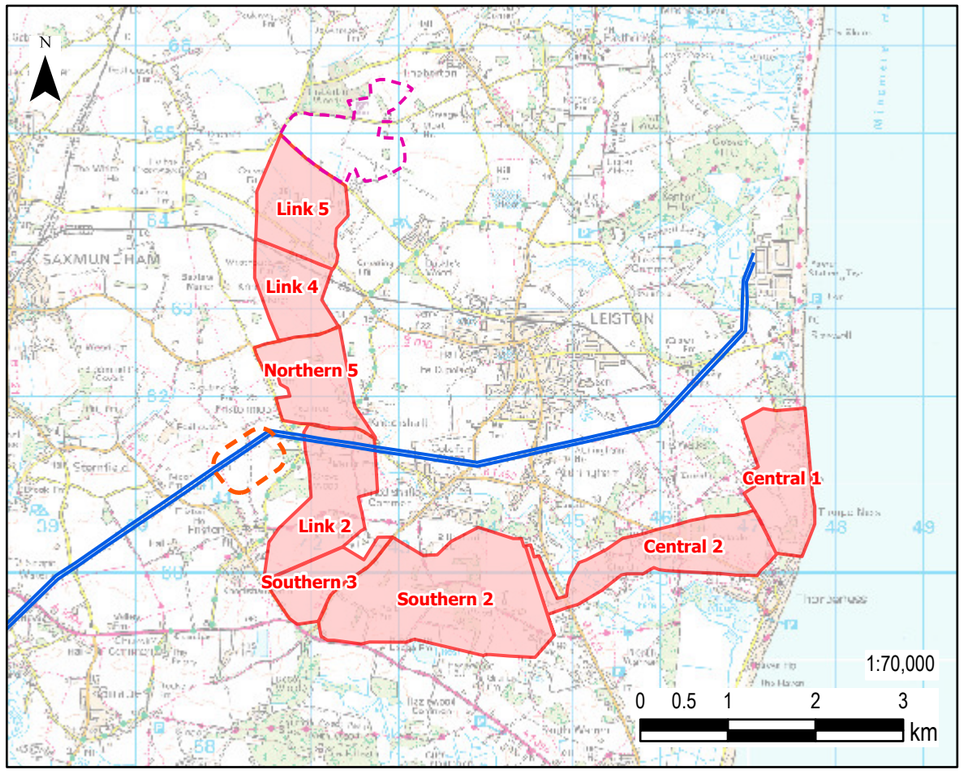

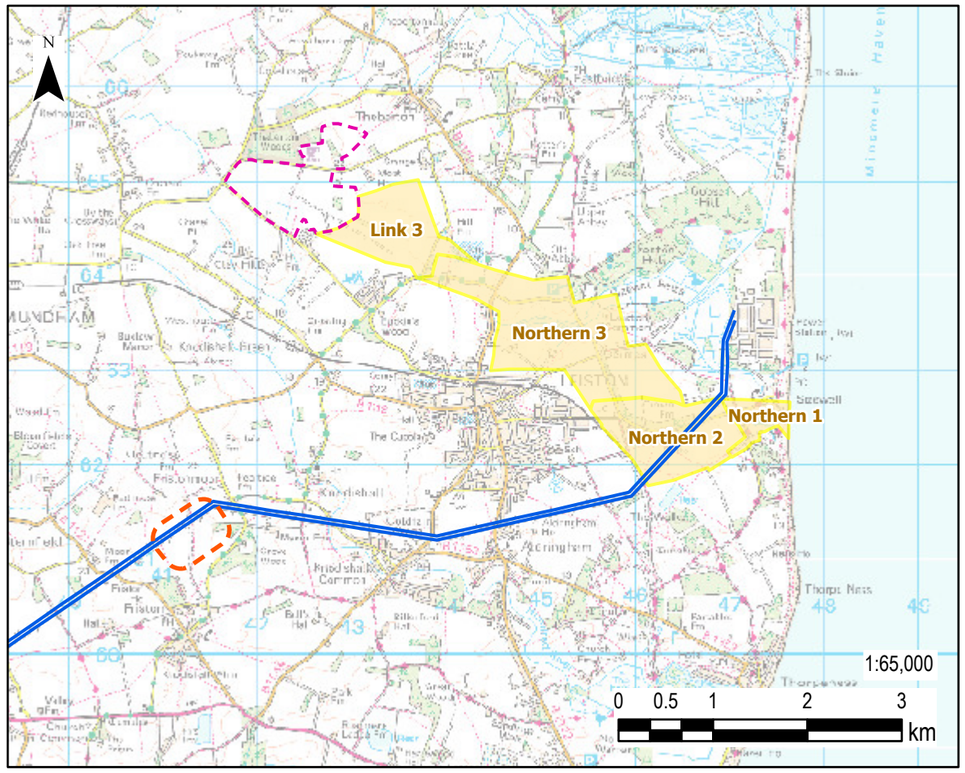

Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 4
- Corridor 1
- Corridor 2
- Corridor 3
- Corridor 4

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Document Title: COORDINATED HVDC CORRIDOR OPTIONS - SHEET 4 OF 7

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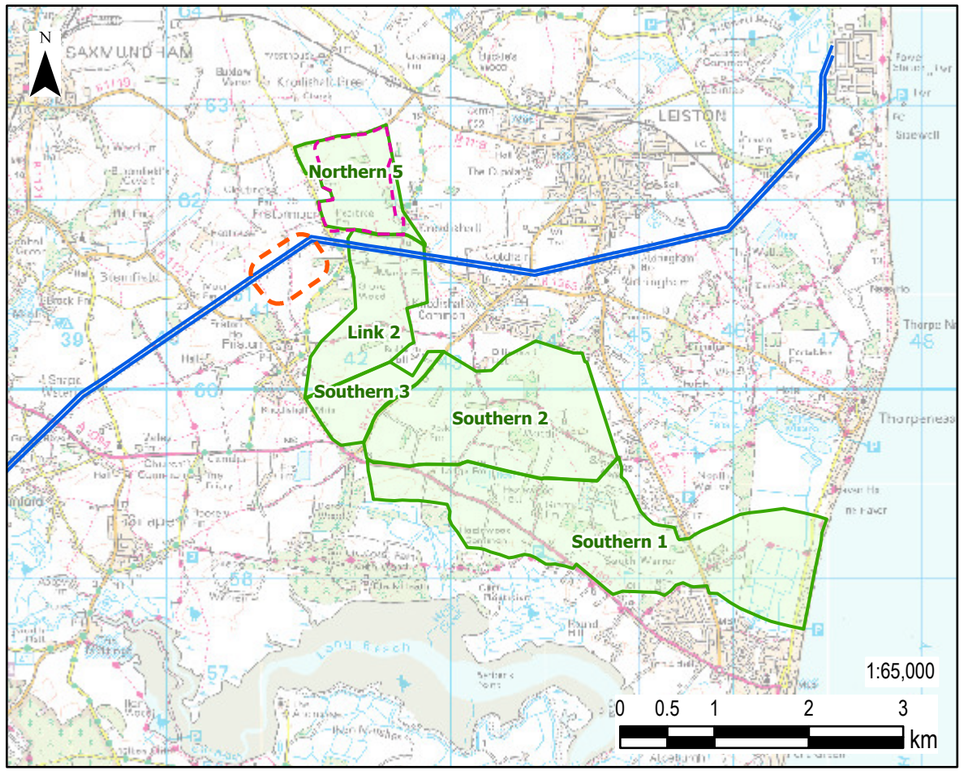

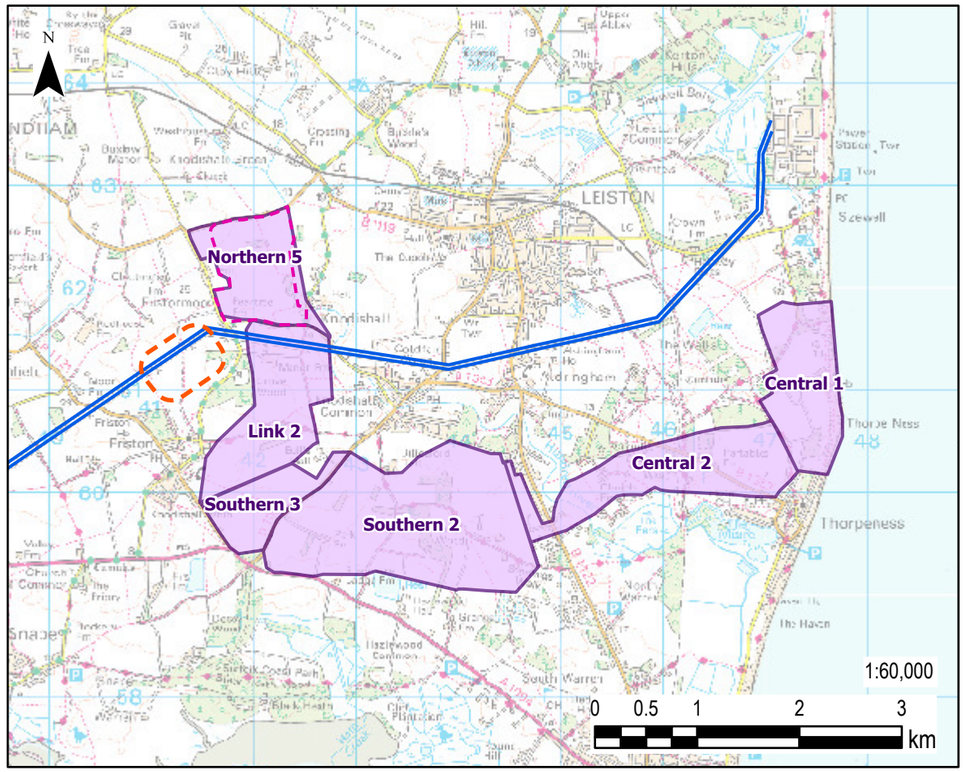

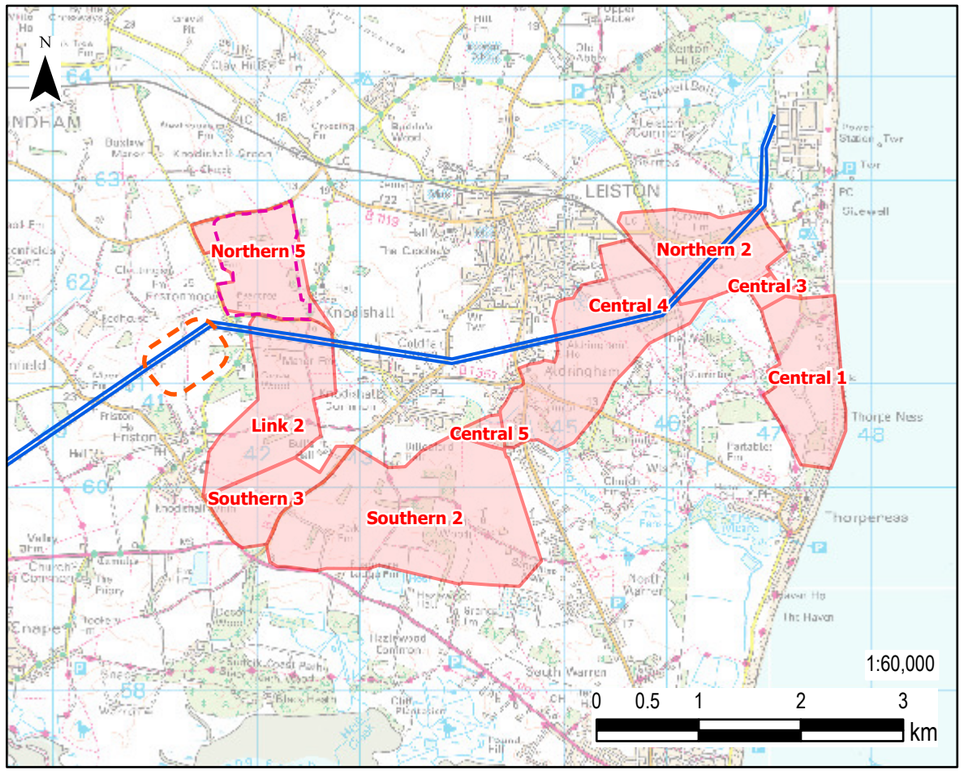

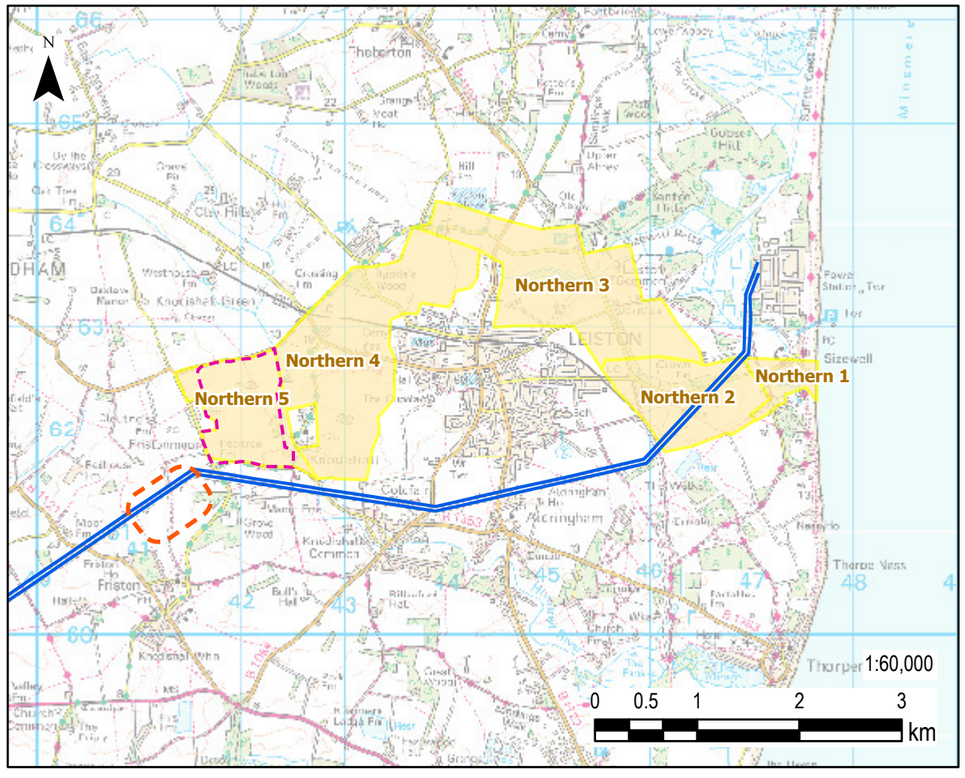

Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 5
- Corridor 1
- Corridor 2
- Corridor 3
- Corridor 4

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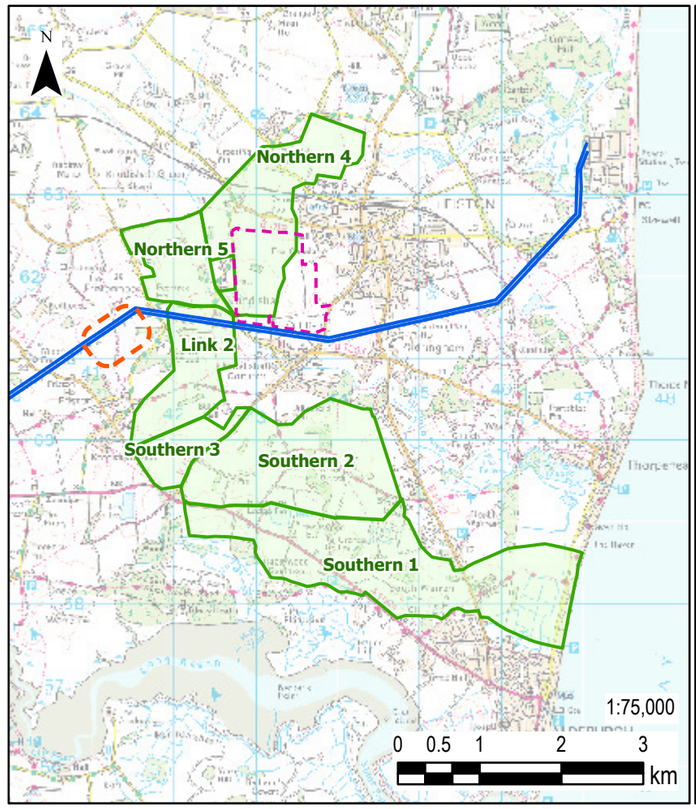

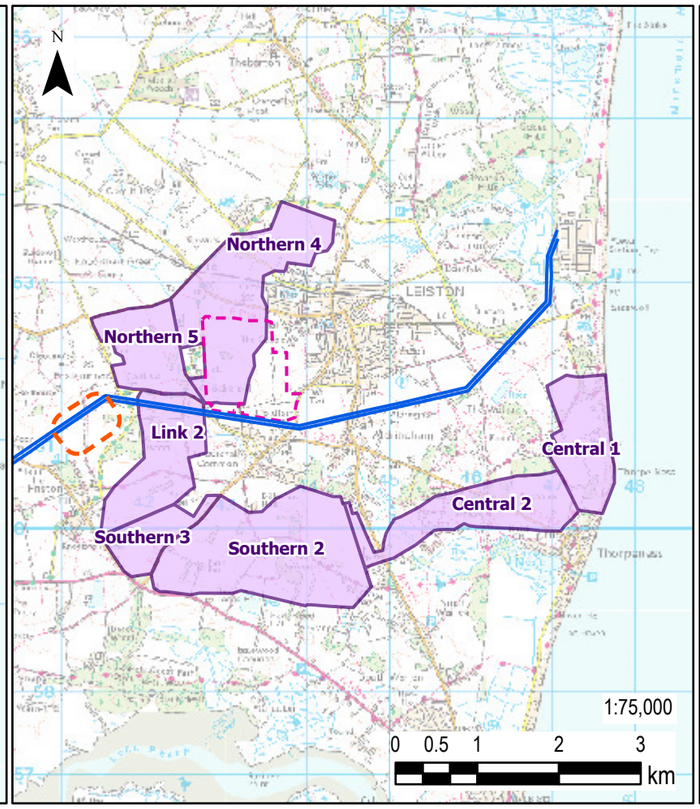

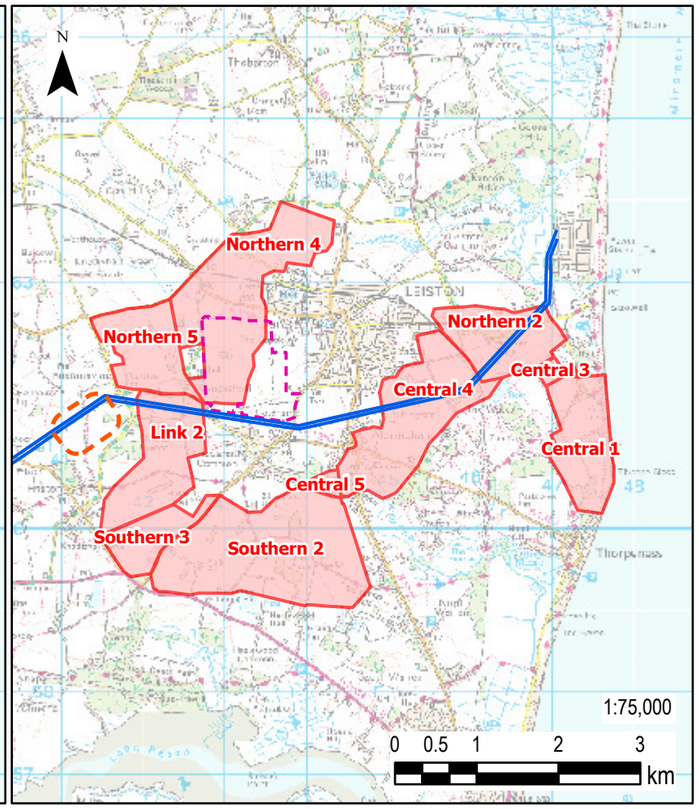

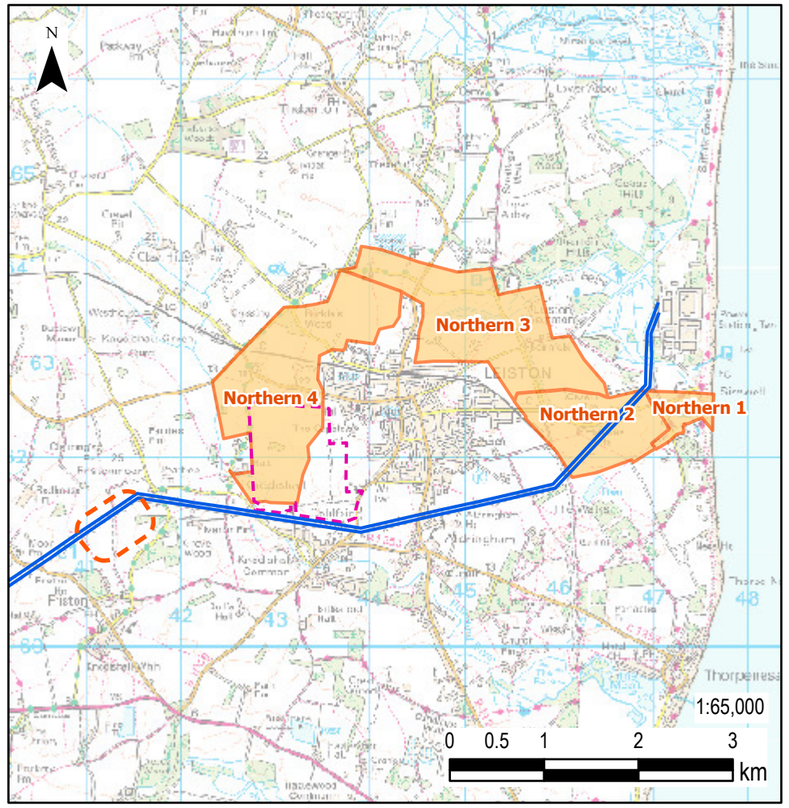

Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 6
- Corridor 1
- Corridor 2
- Corridor 3
- Corridor 4
- Corridor 5

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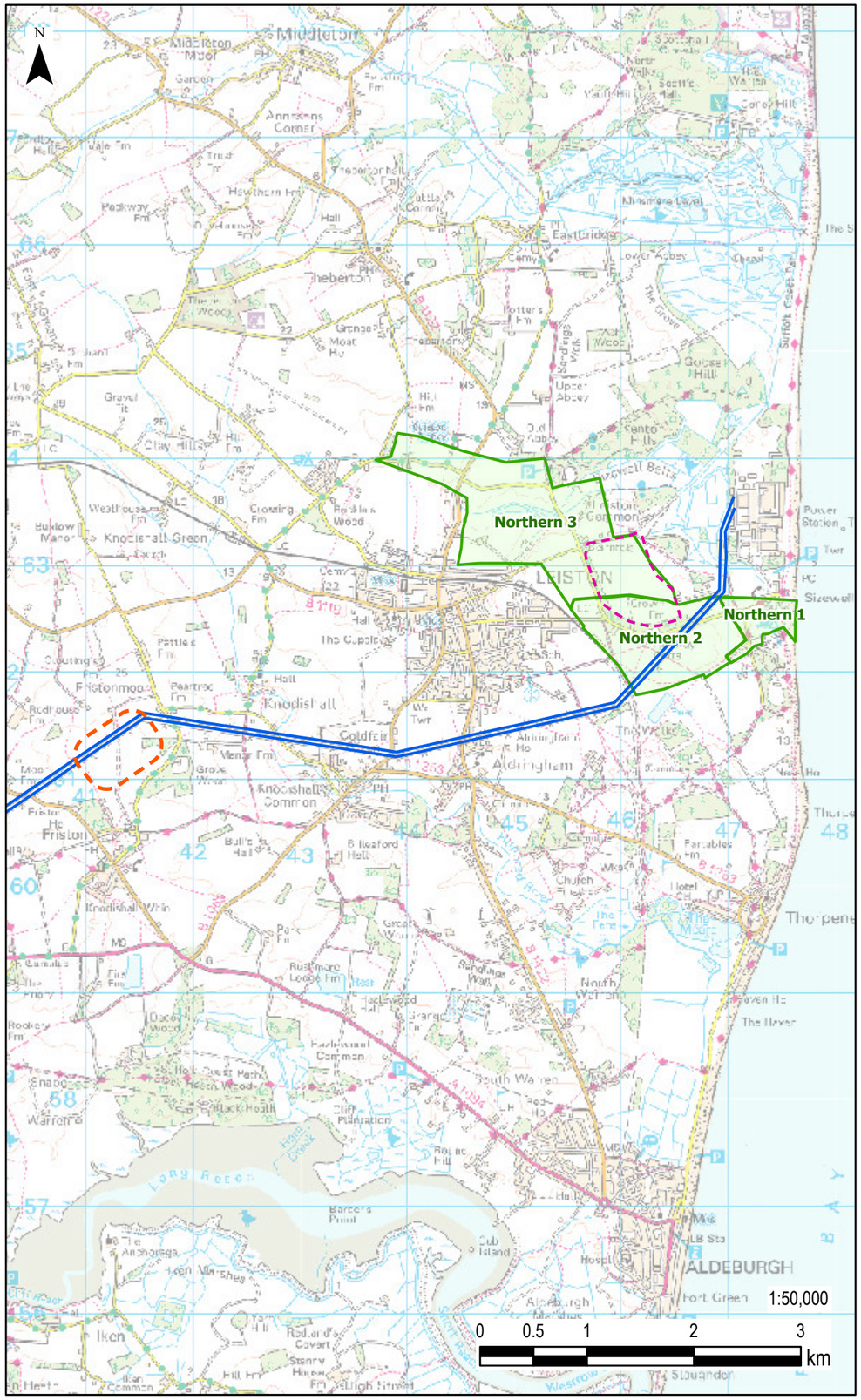

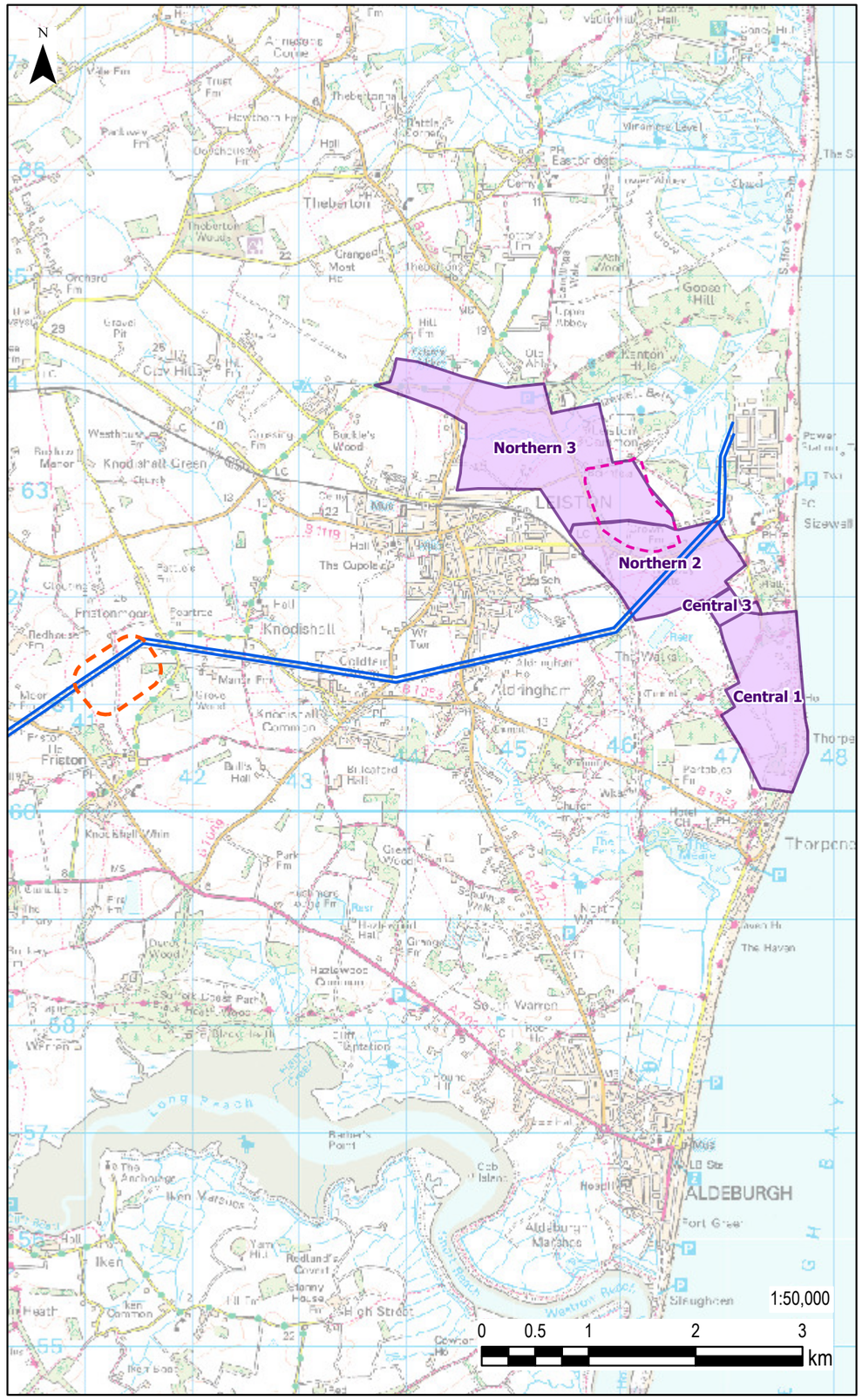

Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 7
- Corridor 1
- Corridor 2

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Document Title: COORDINATED HVDC CORRIDOR OPTIONS - SHEET 7 OF 7

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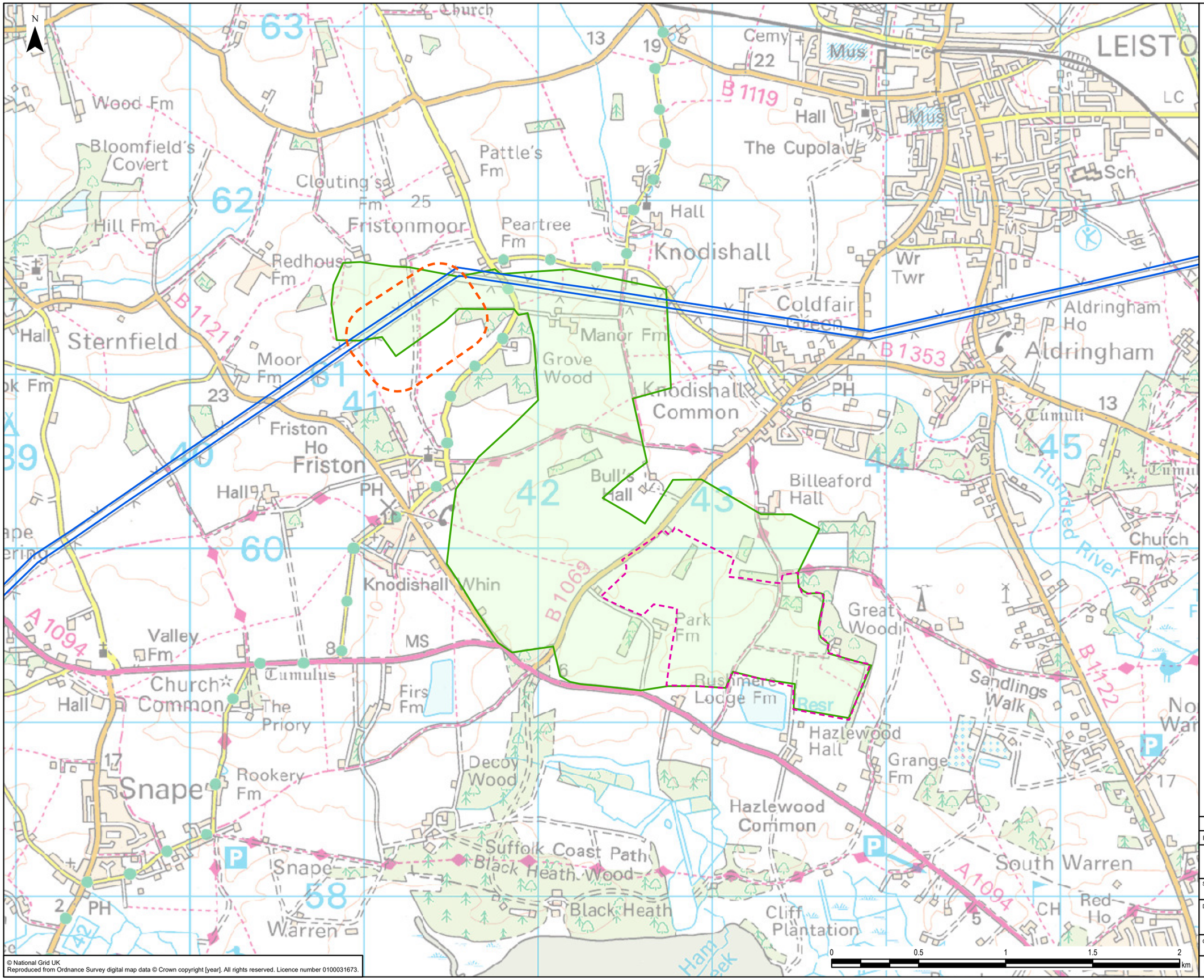
Figure 9-17 Coordinated HVDC Corridor Options



Legend

- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated Converter Station Site 1
- Corridor 1

Rev	Date	Description	GIS	Chk	App
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Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 2
- Corridor 1
- Corridor 2

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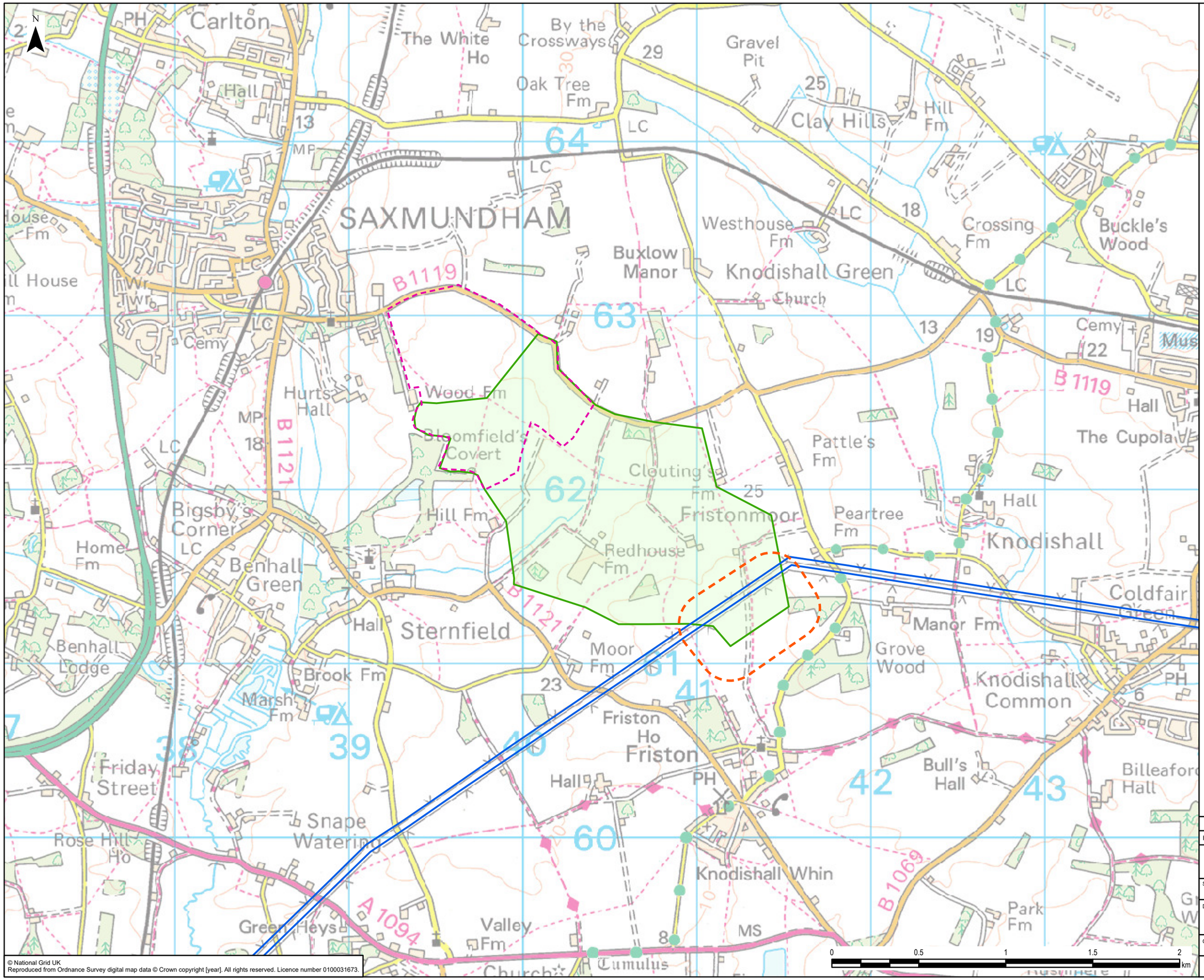

Legend

- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated Converter Station Site 3
- Corridor 1

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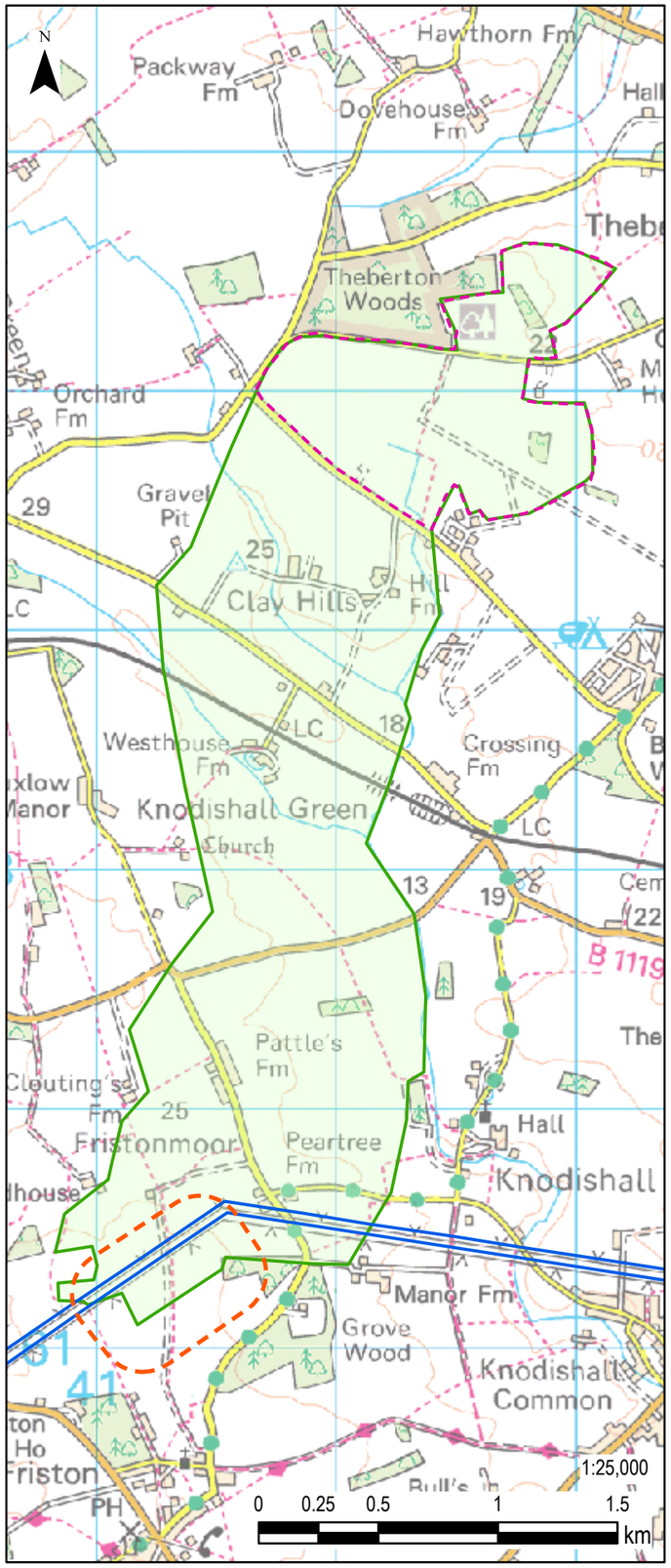

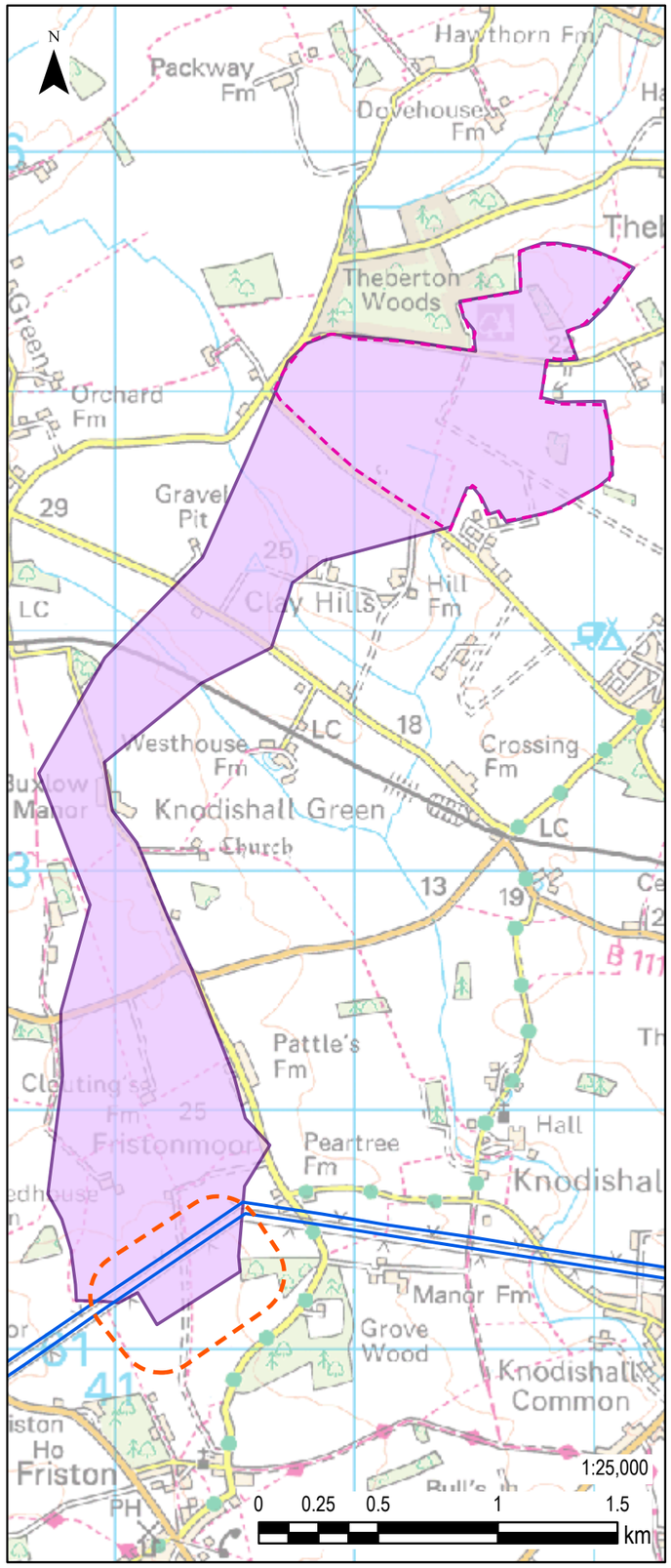

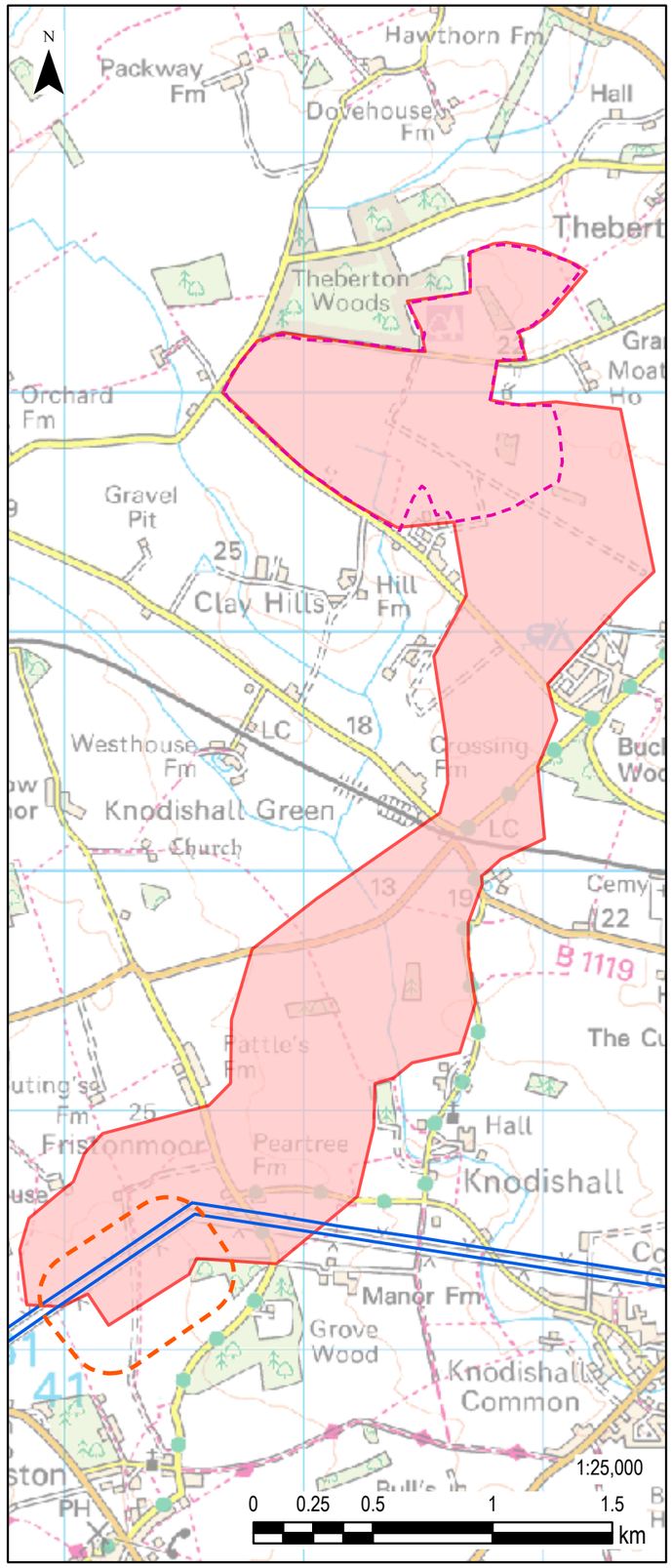

Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 4
- Corridor 1
- Corridor 2
- Corridor 3

Rev	Date	Description	GIS	Chk	App
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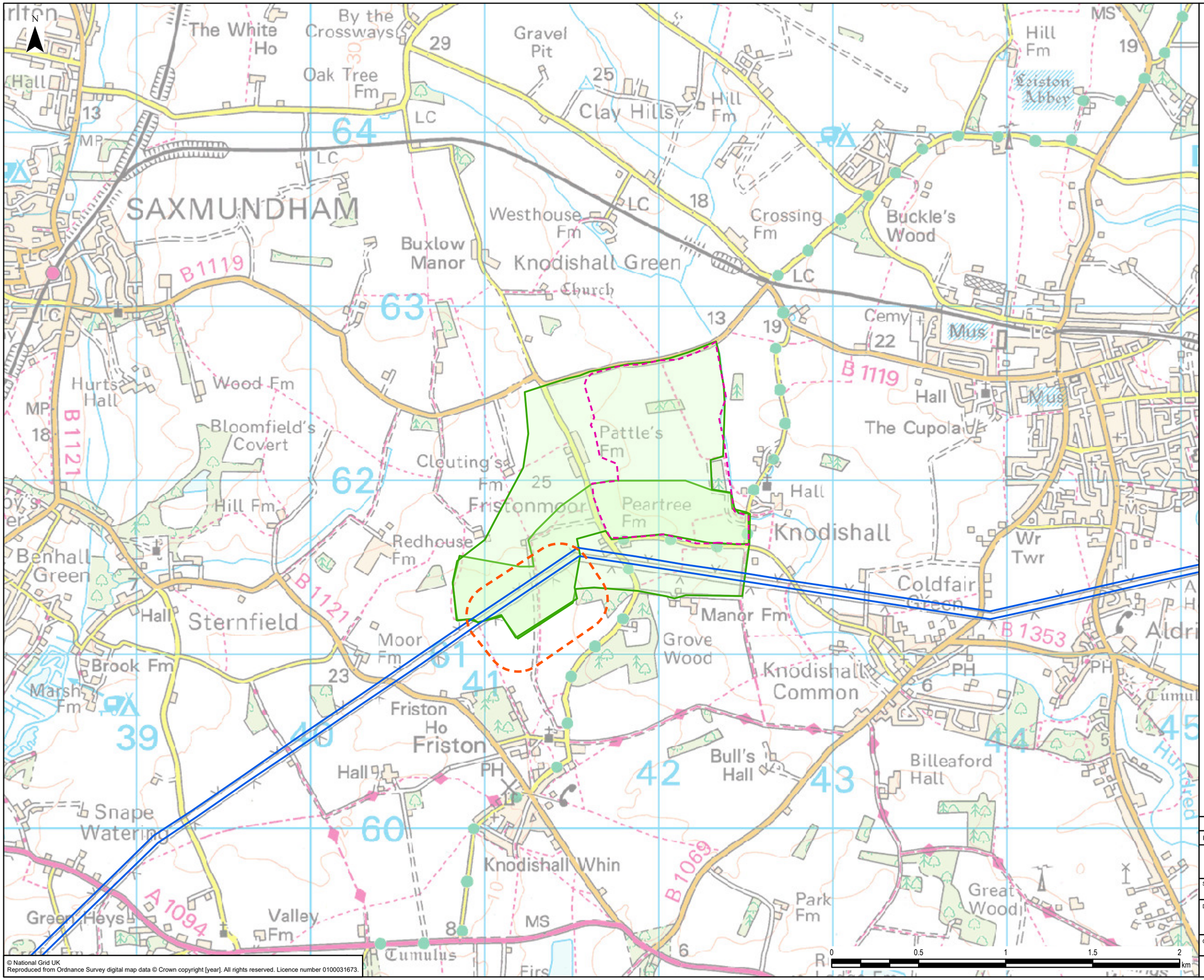

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Document Title: COORDINATED HVAC CORRIDOR OPTIONS SHEET 5 OF 7

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FIGURE 9-17	1:20,000	A3	1	0

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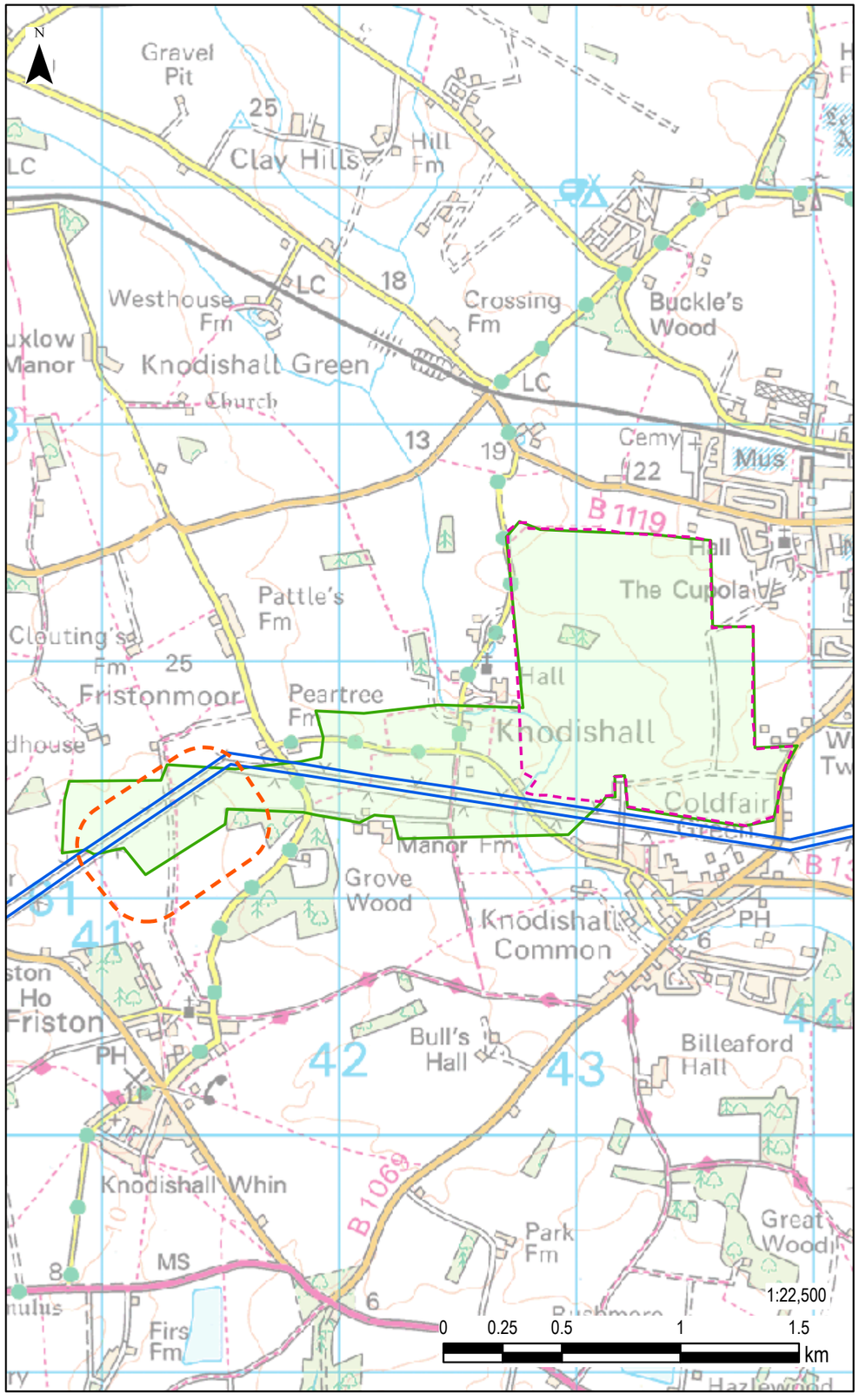

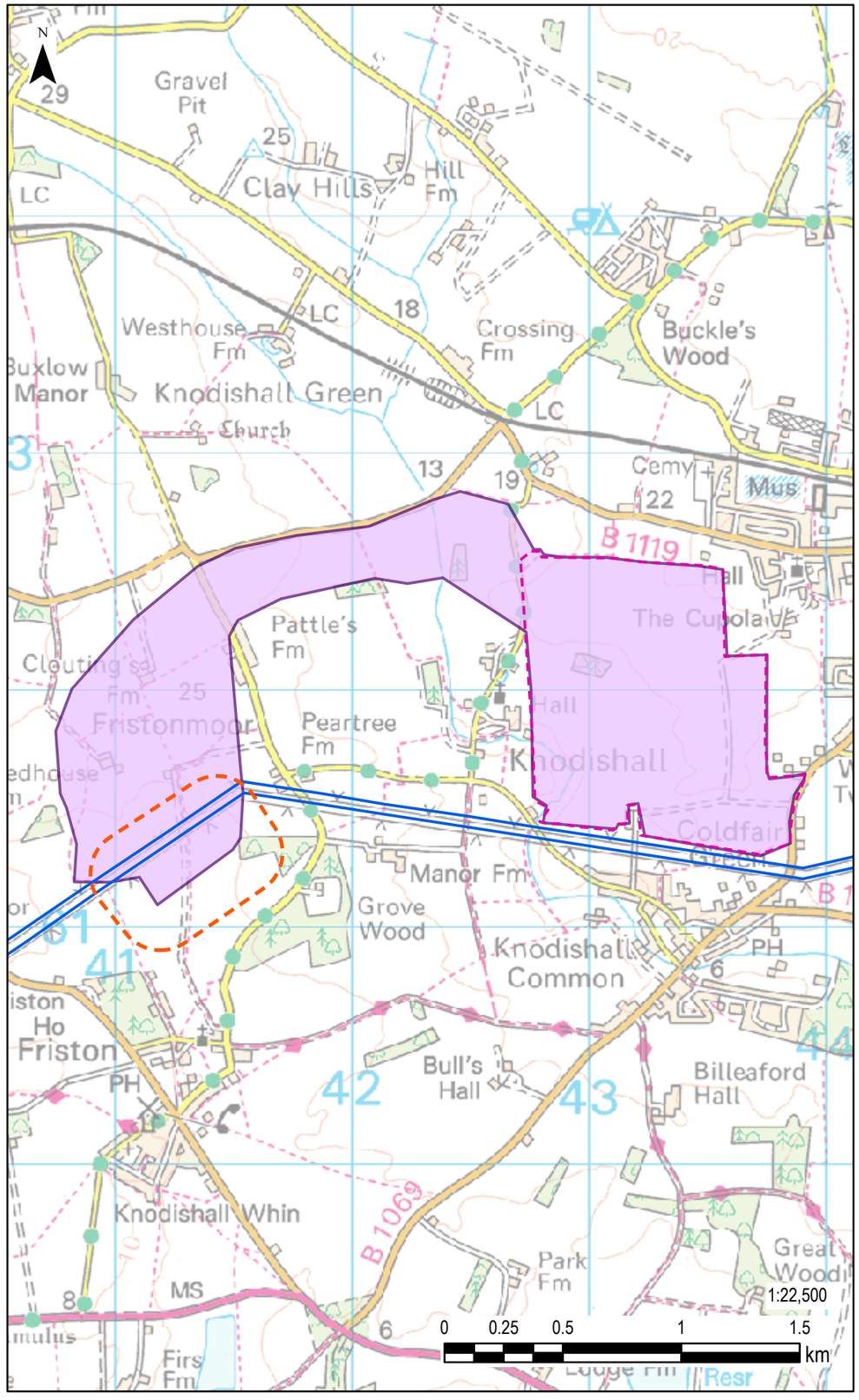

Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 6
- Corridor 1
- Corridor 2

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Document Title: COORDINATED HVAC CORRIDOR OPTIONS - SHEET 6 OF 7

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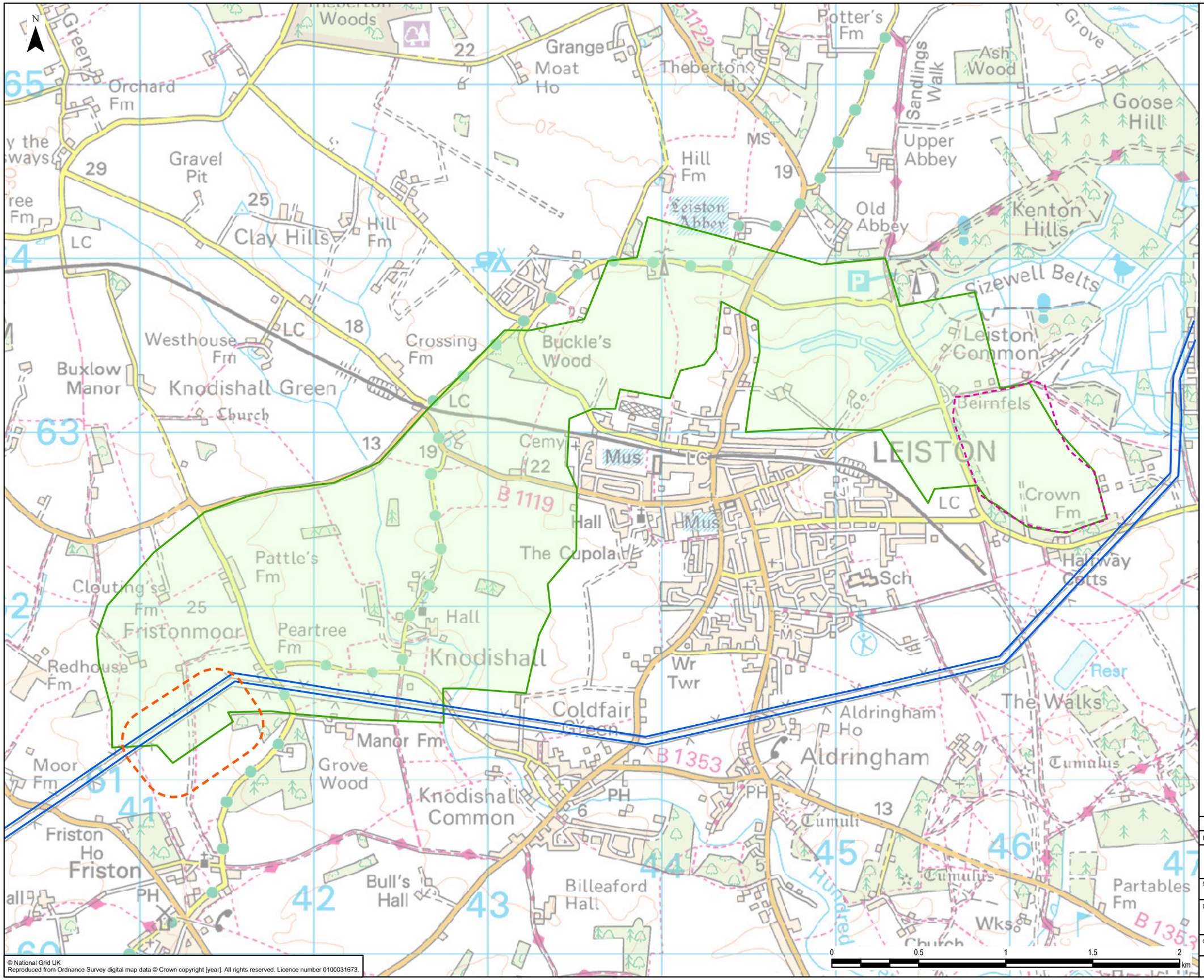

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FIGURE 9-17	1:20,000	A3	1	0

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9.8 Co-ordination Options Appraisal

9.8.1 A summary of key considerations is presented below.

Converter Station Site Options

9.8.2 Site 1 offers good existing screening to the north of the site and good construction access to the strategic road network. It is close to the AONB (Figure **9-18**) so setting is a consideration for this site. However, the site offers good opportunities for mitigation in keeping with the existing landscape character. This site offers the shortest overall onshore cable route.

9.8.3 Site 2 whilst being located close to strategic road network in terms of access, in terms of landscape character it is a very open landscape and development of a coordinated solution on this site would likely involve substantial mitigation. Suffolk Coasts and Heaths AONB (**Figure 9-18**) is adjacent to the southern boundary of this site. The settlement of Sternfield is located to the northwest of the site, Church Common to the southwest of the site and Friston to the east of the site.

9.8.4 Site 3 is located further from the AONB (**Figure 9-18**) but in close proximity to the settlement of Saxmundham. There is good existing screening along the western and southern edges of the site, this along with the topography of the local area limits the intervisibility between the settlement and the site. Access to this site is constrained and would need to be routed through the settlement of Saxmundham if taken off the B1119. Opportunity does exist to take temporary construction access from the B1121. This would require construction of a temporary access route and a crossing of the River Fromus (**Figure 9-21**).

9.8.5 Site 4 is located further away from the AONB (**Figure 9-18**Figure 9-24) and offers good existing screening and additional screen plating could be developed in keeping with the existing landscape character. Access to this site is challenging however Site 4 has the benefit of the proposed new link road being developed by the proposed Sizewell C Nuclear Power Station albeit the cumulative impact with this development would be a consideration. The site contains the former RAF Leiston Airfield, therefore this non-designated asset would need to be considered further if taken forward for development.

9.8.6 Site 5 is located approximately 2.5km from the AONB (**Figure 9-18**) at its closest point. There are smaller settlements which surround the site on the west, south and east although intervening vegetation particularly in the southern part of the site would provide a degree of existing screening. The existing OHL are routed to the south of the site, and this is the closest of the proposed sites to the proposed Friston substation development. There are a number of non-designated assets within the site which include potential extensive remains of a roman settlement and villa within the north of the site. Physical impacts to these assets could potentially be avoided if development was to take place in the southern part of the site. A small section of flood zones 2 and 3 (**Figure 9-21**) are located along the eastern boundary of the site associated with the Hundred River although it is likely that these areas could be avoided. This site is located further from the strategic road network and routeing construction traffic through settlements is unlikely to be avoidable.

9.8.7 Site 6 is located approximately 1.5km from the AONB (**Figure 9-18**) at its closet point. The site is located to the west of the settlement of Leiston and north of the settlement of Knodishall. There are a number of woodland blocks and shelterbelts which do offer some

opportunity for existing screening and integration of mitigation planting. There are a number of historical designated assets (**Figure 9-26**) within the settlements of Leiston and Knodishall but these are well screened by existing vegetation surrounding the assets. Similar to site 5 this site is located further from the strategic road network and routeing construction traffic through settlements is unlikely to be avoidable.

9.8.8 Site 7 is located within the Suffolk Coasts and Heaths AONB (**Figure 9-18**) adjacent to the existing nuclear power stations and the Galloper and Gabbard Offshore Windfarm substations as well as the proposed Sizewell C Nuclear Power Station. Whilst within the designated site, this site does offer the opportunity to keep energy development close together. The settlement of Leiston is located to the west of this site although it is the industrial edge of this settlement closest to this site. Existing planting along the southern boundary of the site also provides good existing screening. Sandlings SPA (**Figure 9-19**) is adjacent to the southern boundary of this site and Sizewell Marshes SSSI (**Figure 9-19**) to the northern and western boundaries. The site is currently being used as a reptile mitigation area for the proposed Sizewell C Nuclear Power Station, therefore should this site be developed this would need to be considered. This is the furthest of the sites from the strategic road network and like Site 4 access is constrained based on the existing road network. The proposed bypass as part of the proposed Sizewell C Nuclear Power Station would reduce potential impacts if in place for the start of construction but the cumulative impacts with the Sizewell C development would need to be considered.

9.8.9 Site 7 whilst obviously very close to the coast cable routes into the site are challenging due to the availability of space associated with the presence of other infrastructure both offshore and onshore.

9.8.10 Sea Link routeing and siting identified that whilst landfall 3 is already constrained for one set of cables, there is the potential that it may be able to achieve landfall with two sets of cables but with technical complexity, unlikely/impossible that three projects could land at the Sizewell gap. Therefore, whilst site 7 is the closest of the sites to the coast it is likely that more than one landfall would need to be utilised to coordinate on this site.

9.8.11 A connection back into Friston from site 7 is also technically challenging and if this site was to be taken forward it is likely an alternative solution would be required in terms of connecting into the existing network on the site.

Landfalls

9.8.12 The majority of landfall S3 is significantly constrained in the immediate offshore environment due to the presence of the Coralline Crag which is an important feature when considering coastal processes. There does exist opportunities to minimise interaction with this feature to the northern and southern ends of the landfall area of search however the southern extent of the landfall is spatially constrained by the proposed SPR East Anglia 1N and East Anglia 2 Offshore Windfarm developments.

9.8.13 Landfall S2 interacts with the North Warren RSBP reserve and the Leiston to Aldeburgh SSSI but has minimal constraints in the marine environment and is not constrained by the presence or any other existing or proposed infrastructure.

HVDC Corridors

9.8.14 Co-located HVDC routes would need to pass through at least one of the pinch points described earlier to route to any of the coordinated converter site options with the exception of site 7. The third pinch point at Aldringham and the Hundred River and

associated Woodlands mean that co-located HVDC corridors through this pinch points are unviable. The second pinch point just north of Thorpeness is also constrained that would prevent its use as a co-located corridor.

9.8.15 The southern landfall between Aldeburgh and Thorpeness (S2) and the associated southern HVDC corridor is the only combination that can provide a co-located HVDC solution for three projects. The crossing of Leiston Road may require the separation of the circuits over a short length including routeing some of the cables through the Aldeburgh golf course.

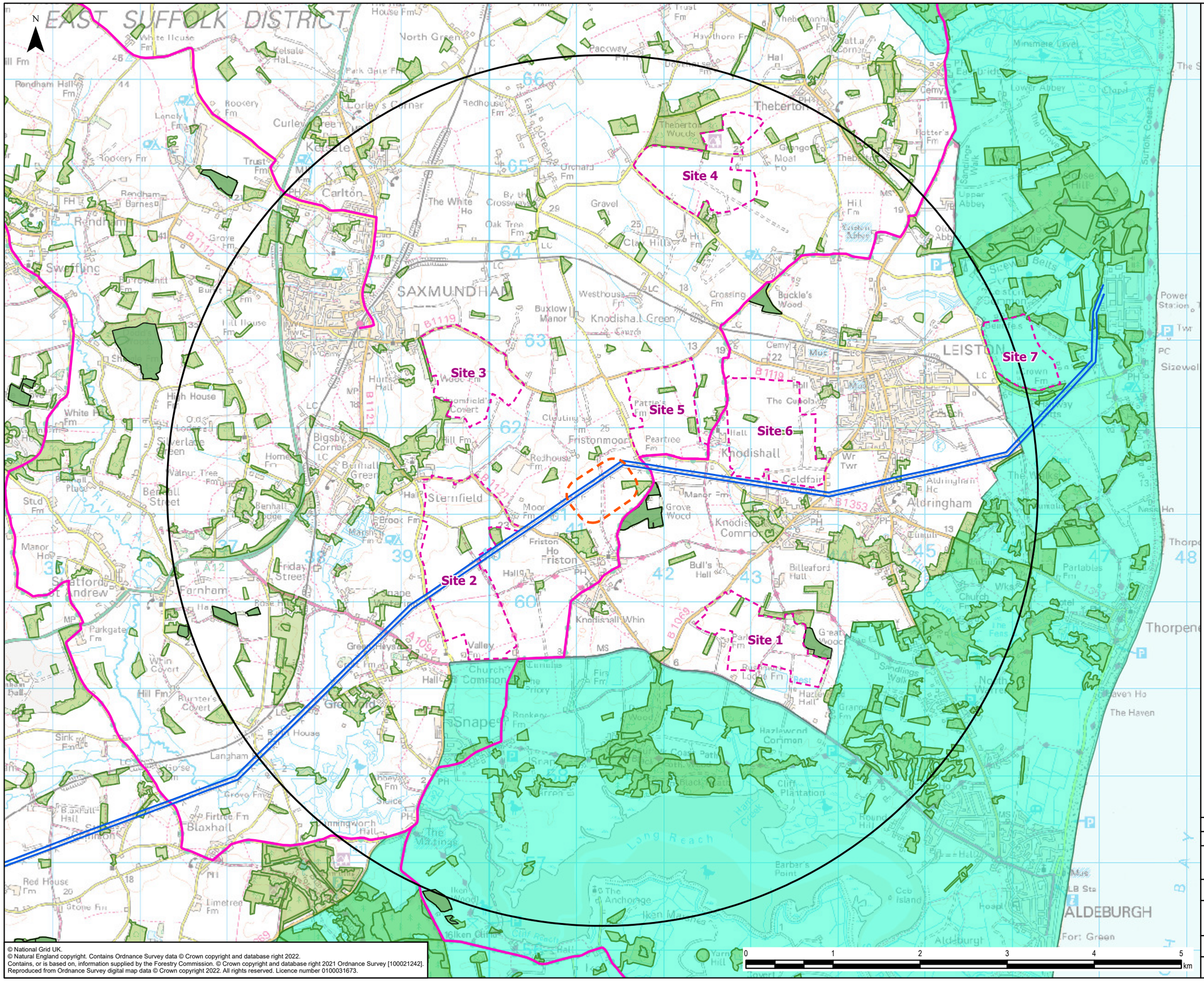
Co-ordination Appraisal Findings

9.8.16 Following the desk based environmental, socio-economic and technical appraisal undertaken by NGET. Coordinated converter sites 1 and 3 and landfall S2 have been identified as emerging preferences. Site 1 Corridor 1 as shown on **Figure 9-16** Sheet 1 of 7 has been identified as the emerging HVDC corridor for site 1 and Site 3 Corridor 6 as shown on **Figure 9-16** Sheet 3 of 7 has been identified as the emerging preference HVDC corridor for site 3. The HVAC corridors for sites 1 and 3 are shown on **Figure 9-17** Sheets 1 of 7 and 3 of 7 respectively.

9.8.17 For the reasons explained above, that further ground investigation studies/surveys are required to inform the feasibility of utilising trenchless techniques at the landfall S2 and the ecological sensitivity of this landfall, an alternative landfall S3 has been included. Should landfall S3 be brought forward the preferred HVDC corridor from this landfall to site 1 is Site 1 Corridor 4 as shown on **Figure 9-16** Sheet 1 of 7. Two alternative HVDC corridors are included for site 3. The first alternative (option 1) was not initially assessed as a site 3 corridor but the sections which made up the corridor were individually assessed as part of the site 4 HVDC corridors and provided a better alternative to any of the site 3 HVDC corridors. The HVDC corridor that has been identified for this alternative is shown on **Figure 9-29**. The second alternative (option 2) Site 3 Corridor 3 as shown on **Figure 9-16** Sheet 3 of 7. Should this alternative landfall and associated HVDC corridors be brought forward over the emerging preference it is unlikely that a co-located landfall and HVDC cable route could be achieved.

9.8.18 Sea Link will continue to engage with NGV to explore opportunities for co-location of infrastructure but also opportunities for coordination during the construction phases of the projects to minimise disruption to local communities.

Figure 9-18 Coordinated Converter Station Site Options in relation to Landscape Designations



Legend

- Coordinated Converter Station Sites Study Area
- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated Converter Station Site Options
- National Cycle Network
- National Woodland Inventory
- Ancient Woodland
- Area of Outstanding Natural Beauty

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Document Title: COORDINATED CONVERTER SITE OPTIONS IN RELATION TO LANDSCAPE DESIGNATED SITES

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Figure 9-19 Coordinated Converter Site Options in relation to Ecological Designated Sites

EAST SUFFOLK DISTRICT

N

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

MINSMERE RSPB RESERVE

Sizewell Marshes SSSI

Sandlings SPA

Leiston - Aldeburgh SSSI

Outer Thames Estuary SPA

NORTH WARREN RSPB RESERVE

Gromford Meadow SSSI

SNAPE RSPB RESERVE

Snape Warren SSSI

Alde-Ore & Butley Estuaries SAC

Alde-Ore Estuary Ramsar

Alde-Ore Estuary SSSI

Alde-Ore Estuary SPA

Round Hill Pit, Aldeburgh SSSI

Iken Wood SSSI

Legend

- Coordinated Converter Station Sites Study Area
- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated Converter Station Site Options
- Ramsar
- Special Area of Conservation
- Special Protection Area
- Site of Special Scientific Interest
- RSPB Reserve
- Ancient Woodland

0 1 2 3 4 5 km

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Figure 9-20 Coordinated Converter Station Sites in relation to Historic Environment Designated Sites

EAST SUFFOLK DISTRICT

N

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

SAXMUNDHAM

LEISTON

ALDEBURGH

Knodishall

Theberton

Friston

Snape

Aldringham

Thorpeness

Blaxhall

Stratford St Andrew

Farnham

Sternfield

Benhall

Sweffling

Rendham

Gromford

Carlton

Leiston

Aldeburgh

Legend

- Coordinated Converter Station Sites Study Area
- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated Converter Station Site Options
- Listed Buildings - Grade I
- Listed Buildings - Grade II
- Listed Buildings - Grade II*
- Parks and Gardens - Grade II
- Scheduled Monuments

0 1 2 3 4 5 km

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Figure 9-21 Coordinated Converter Station Sites in relation to Flood Zones 2 and 3 and Main Rivers

EAST SUFFOLK DISTRICT

N

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

SAXMUNDHAM

LEISTON

ALDEBURGH

Legend

- Coordinated Converter Station Sites Study Area
- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated Converter Station Site Options
- Main Rivers
- Flood Zone 2
- Flood Zone 3

0 1 2 3 4 5 km

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Document Title: COORDINATED CONVERTER SITE OPTIONS IN RELATION TO FLOOD ZONES 2 AND 3 AND MAIN RIVERS

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Figure 9-22 Coordinated Converter Site Options in relation to Socio-Economic Constraints

EAST SUFFOLK DISTRICT

N

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

SAXMUNDHAM

LEISTON

ALDEBURGH

Knodishall

Aldringham

Theberton

Sternfield

Friston

Snape

Blaxhall

Leiston Abbey

Minsmere Level

Sizewell Belts

Sizewell

Thorpeness

Aldeburgh

Long Reach

Iken Marshes

Knodishall Common

Hazlewood Common

Knodishall Whin

Site Boundary

Legend

- Coordinated Converter Station Sites Study Area
- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated Converter Station Site Options

Accommodation

- Bed and Breakfast
- Campsite
- Caravan Park
- Guest House
- Holiday Park
- Hotel
- Cultural Facility
- Education
- Heritage
- Leisure Facility
- Medical
- Sports And Leisure Centre & Sports Club

- National Cycle Network
- Golf Course

0 1 2 3 4 5 km

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Document Title: COORDINATED CONVERTER SITE OPTIONS IN RELATION TO SOCIO-ECONOMIC CONSTRAINTS

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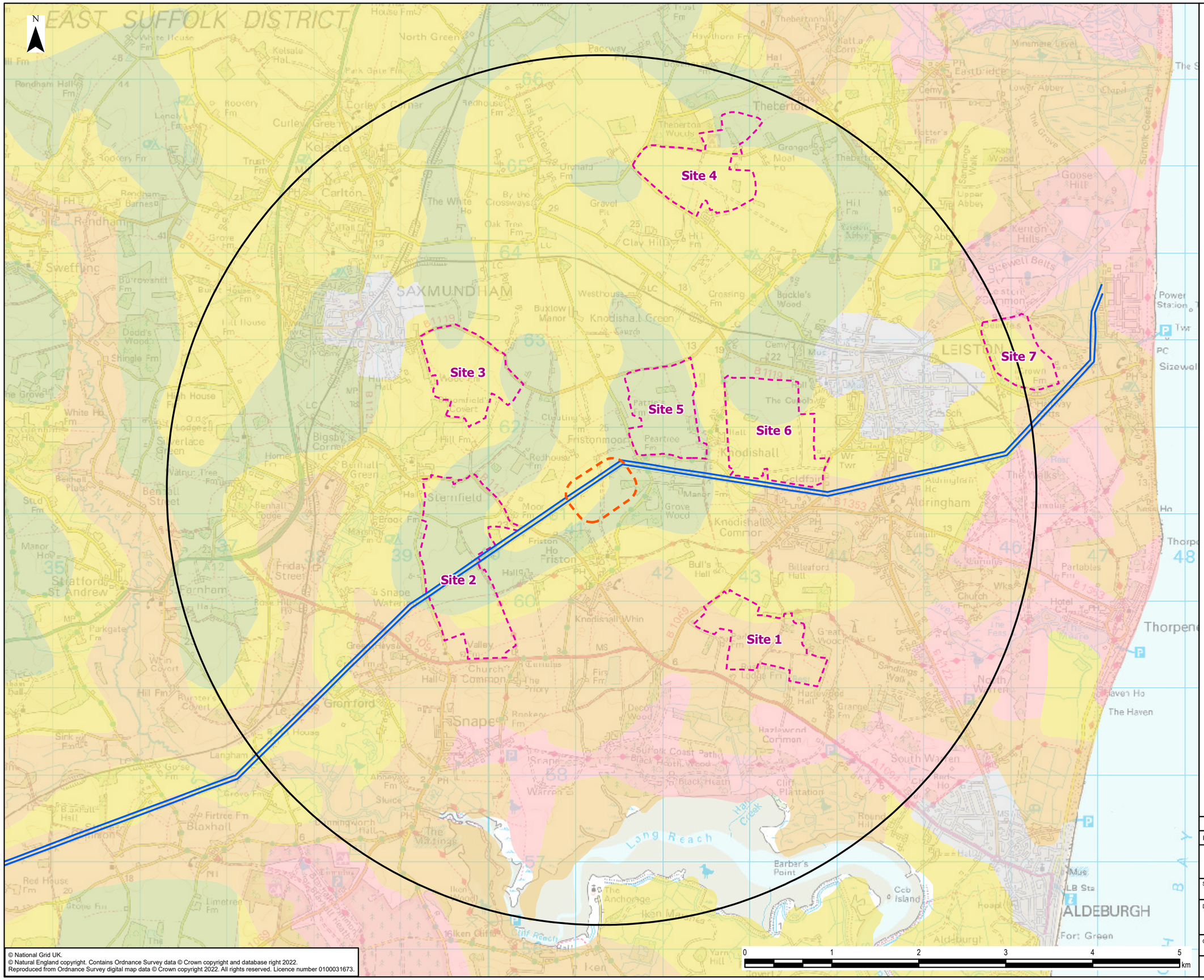
Figure 9-23 Coordinated Converter Site Options in relation to Agricultural Land Classification



Legend

- Coordinated Converter Station Sites Study Area
- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated Converter Station Site Options

Agricultural Land Classification

- Grade 2
- Grade 3
- Grade 4
- Non Agricultural
- Urban

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Document Title: COORDINATED CONVERTER SITE OPTIONS IN RELATION TO AGRICULTURAL LAND CLASSIFICATION

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Figure 9-24 Coordinated HVDC Corridors in relation to Landscape Designations

EAST SUFFOLK DISTRICT

N

Link 1
Link 2
Link 3
Link 4
Link 5
Link 6
Northern 1
Northern 2
Northern 3
Northern 4
Northern 5
Northern 6
Northern 7
Central 1
Central 2
Central 3
Central 4
Central 5
Southern 1
Southern 2
Southern 3
Southern 4

Legend

- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated HVDC Corridors
- National Cycle Network
- National Woodland Inventory
- Ancient Woodland
- Area of Outstanding Natural Beauty

0 1 2 3 4 5 km

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Figure 9-25 Coordinated HVDC Corridors in relation to Ecological Designations

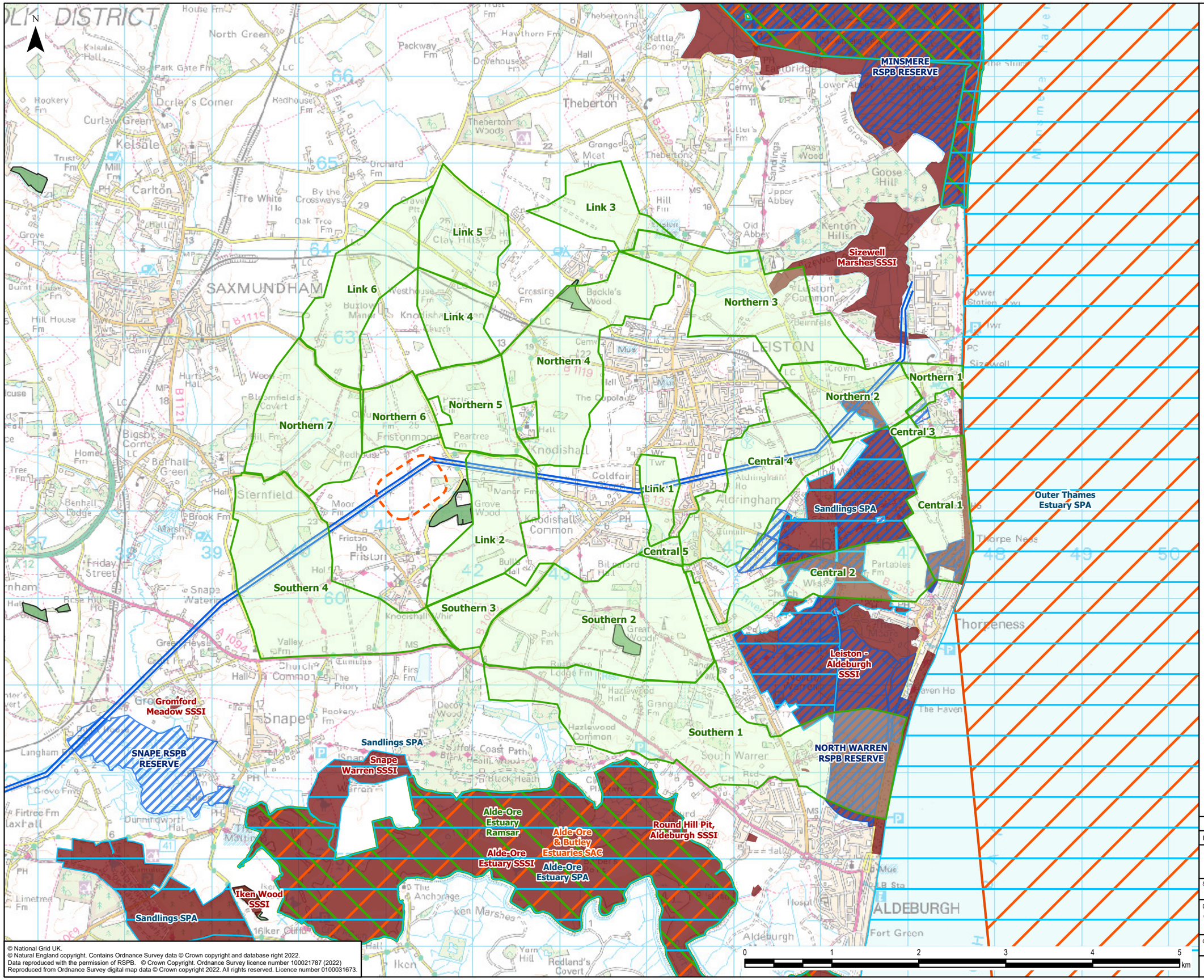

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Figure 9-26 Coordinated HVDC Corridors in relation to Historic Environment Designations

Legend

- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated HVDC Corridors
- Listed Buildings - Grade I
- Listed Buildings - Grade II
- Listed Buildings - Grade II*
- Scheduled Monuments

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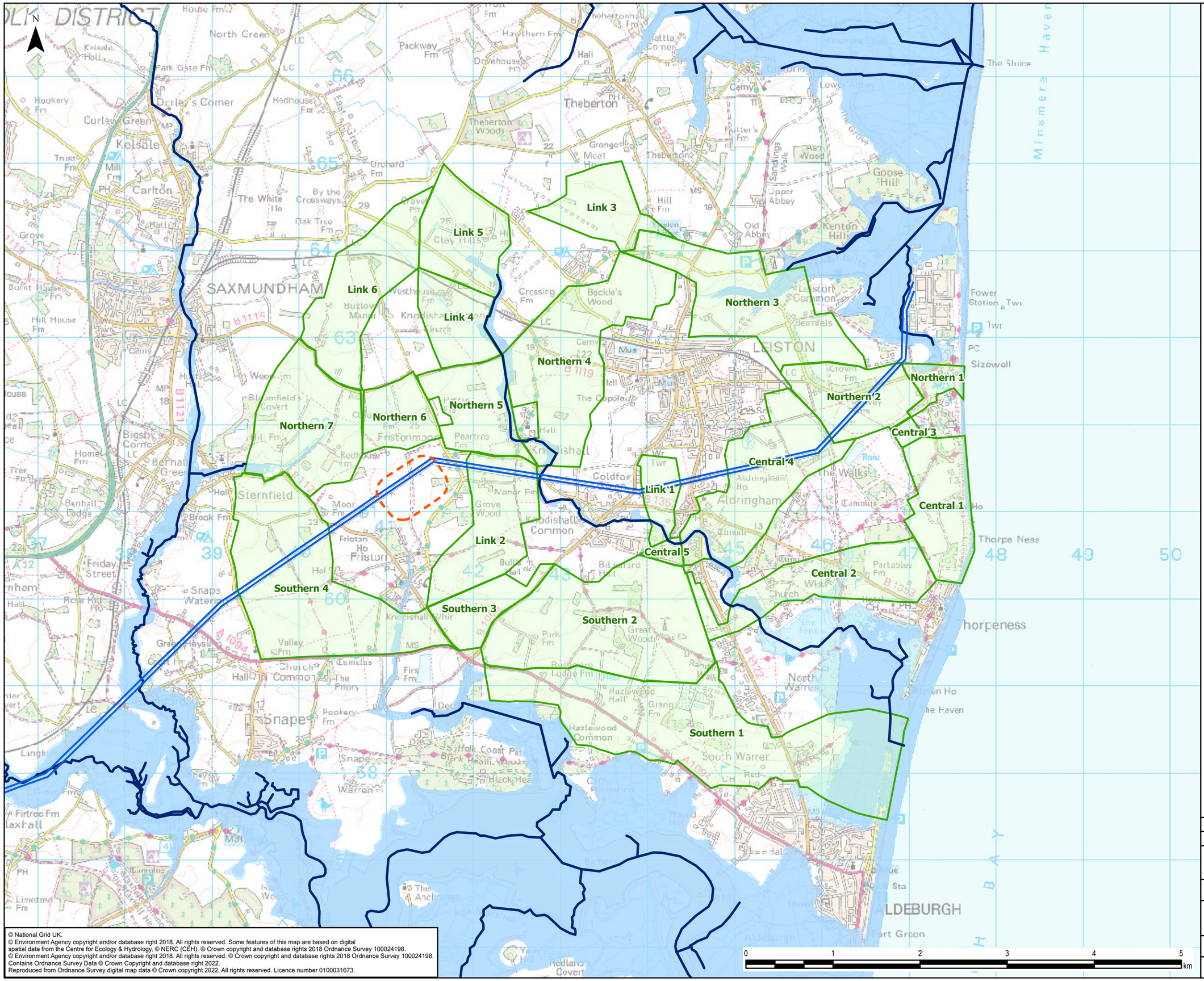
Figure 9-27 Coordinated HVDC Corridors in relation to Flood Zones 2 and 3 and Main Rivers



Legend

- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated HVDC Corridors
- Main Rivers
- Flood Zone 2
- Flood Zone 3

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Document Title: COORDINATED HVDC CORRIDOR OPTIONS IN RELATION TO FLOOD ZONES 2 AND 3 AND MAIN RIVERS

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Figure 9-28 Coordinated HVDC Corridors in relation to Socio-economic Constraints

N

Link 1
Link 2
Link 3
Link 4
Link 5
Link 6
Northern 1
Northern 2
Northern 3
Northern 4
Northern 5
Northern 6
Northern 7
Central 1
Central 2
Central 3
Central 4
Central 5
Southern 1
Southern 2
Southern 3
Southern 4

Legend

- Existing 400kV Overhead Lines
- Proposed Friston Substation
- Coordinated HVDC Corridors

Accommodation

- Bed and Breakfast
- Campsite
- Caravan Park
- Guest House
- Holiday Park
- Hotel
- Cultural Facility
- Education
- Heritage
- Leisure Facility
- Medical
- Sports And Leisure Centre & Sports Club
- National Cycle Network
- Golf Course

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0	22/08/2022	CPRSS REPORT	EB	DF	CC

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Scheme: SEA LINK

Document Title: COORDINATED HVDC CORRIDOR OPTIONS IN RELATION TO SOCIO-ECONOMIC CONSTRAINTS

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EB	22/08/2022	DF	22/08/2022	CC	22/08/2022

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FIGURE 9-28	1:40,000	A3	1	0

0 1 2 3 4 5 km

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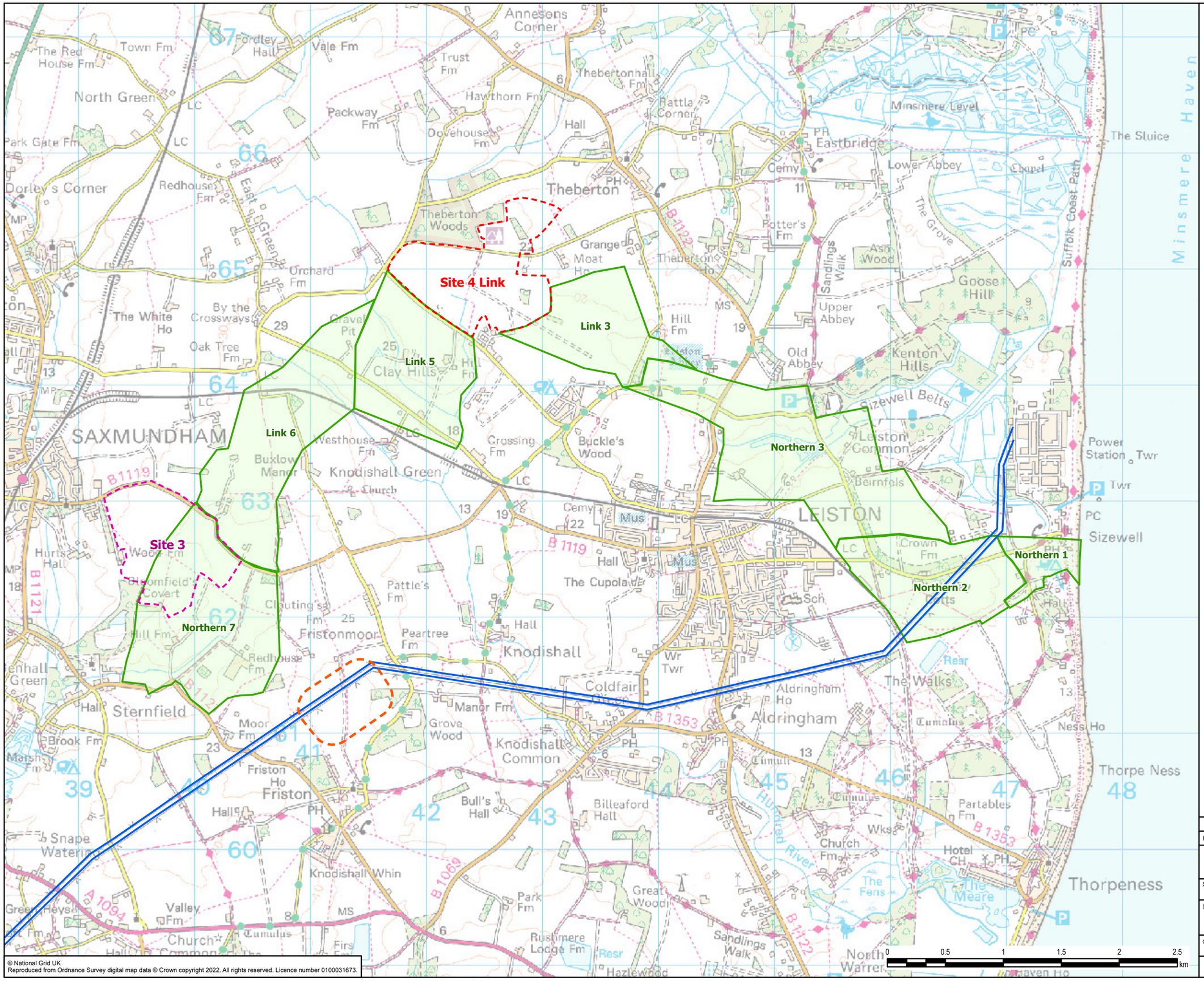
Figure 9-29 Site 3 Coordinated HVDC Corridors Alternative



Legend

- Proposed Friston Substation
- Existing 400kV Overhead Lines
- Coordinated Converter Station Site 3
- Site 4 Link
- Alternative Corridor

Rev	Date	Description			
0	22/08/2022	CPRSS REPORT	EB	DF	CC

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Scheme: SEA LINK

Document Title: COORDINATED HVDC CORRIDORS - ALTERNATIVE

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Document Ref:	Scale:	Format:	Sheets:	Rev:
FIGURE 9-29	1:30,000	A3	1	0

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10. Emerging Preference

10.1.1 This chapter considers and sets out NGETs emerging preferences in relation to each element of the Project following environmental, socio-economic and technical appraisals, and stakeholder engagement as described in **Chapters 7, 8 and 9**.

10.2 Marine Summary

10.2.1 When considering the appraisal of the marine options (landfalls up to MHWS and marine alignments) in isolation from the terrestrial elements the overall preference was for Kent landfall area K1a at Broadstairs connecting to marine alignment section K1a, connecting to marine alignment section C8B and then either marine alignment sections S1 to landfall S1, S2 to landfall S2 or S3N to landfall S3.

10.3 Terrestrial – Kent Summary

10.3.1 When considering the appraisal of the terrestrial options in isolation, the overall preference is for the Pegwell Bay to Richborough green HVDC corridor, which connects to landfall area K1 at Pegwell Bay.

10.3.2 The preferred converter station search area in Kent is the refined Area A.

10.3.3 Following stakeholder engagement an extended connection point and associated HVAC area of search has been identified to be brought forward for further consideration.

10.4 Terrestrial – Suffolk Summary

10.4.1 Coordinated converter sites 1 and 3 and landfall S2 have been identified as emerging preferences. Site 1 Corridor 1 as shown on **Figure 9-16** Sheet 1 of 7 has been identified as the emerging preference HVDC corridor for site 1 and Site 3 Corridor 6 as shown on **Figure 9-16** Sheet 3 of 7 has been identified as the emerging preference HVDC corridor for site 3. The HVAC corridors for sites 1 and 3 are shown on **Figure 9-17** Sheets 1 of 7 and 3 of 7 respectively.

10.4.2 For the reasons explained above, that further ground investigation studies/surveys are required to inform the feasibility of utilising trenchless techniques at the landfall S2 and the ecological sensitivity of this landfall, an alternative landfall S3 has been included. Should landfall S3 be brought forward the preferred HVDC corridor from this landfall to site 1 is Site 1 Corridor 4 as shown on **Figure 9-16** Sheet 1 of 7. Two alternative HVDC corridors are included for site 3. The first alternative (option 1) was not initially assessed as a site 3 corridor but the sections which made up the corridor were individually assessed as part of the site 4 HVDC corridors and provided a better alternative to any of the site 3 HVDC corridors. An HVDC corridor has been identified for this alternative, this is shown on **Figure 9-29**. The second alternative (option 2) Site 3 Corridor 3 is shown on **Figure 9-16** Sheet 3 of 7. Should this alternative landfall and associated HVDC corridors be brought forward over the emerging preference it is unlikely that a co-located landfall and HVDC cable route could be achieved.

10.5 Emerging Preference

10.5.1 Due to the significant constraints associated with the onward terrestrial corridor from landfall K1a at Broadstairs, this landfall has not been identified as the emerging preference. From a marine perspective the next preferred Kent landfall option is K1 at Pegwell Bay. This is also the landfall that is connected to the preferred terrestrial corridor for Kent which is the Pegwell Bay to Richborough green corridor (**Figure 8-1** Sheet 3 of 3) and preferred converter site option area (Area A) (**Figure 8-14**). Therefore, these three elements would be taken forward as part of the emerging preference for the end-to-end solution.

10.5.2 The marine appraisal was revisited to identify a suitable preferred marine alignment to connect with the Pegwell Bay green terrestrial corridor and this was identified as marine alignment section K1c (**Figure 7-4**). Although this marine alignment section intersects with the northwest corner of the Goodwin Sands MCZ for approximately 4.5km (**Figure 7-5**) the alternative option connecting to this corridor, K1b, is significantly constrained by shipping and navigation considerations associated with the port at Ramsgate. Due to the interaction an enhanced offshore environmental survey has been undertaken in the section of route intersecting with the Goodwin Sands MCZ (approx. 4.5km length), in addition further mitigation opportunities will be investigated such as the type of material to be used at crossings and the potential for micro routeing.

10.5.3 Marine alignment section K1c would then connect to the preferred marine alignment central section's C4A and C8B.

10.5.4 At Landfall K1 the Pegwell Bay green corridor intersects with areas designated under statute for their ecological value. Landward of this area, it also intersects with St Augustine's Golf Course and the Pegwell Bay Country Park, which is located on an historic landfill site (**Figure 8-9**). A trenchless technique is proposed at the landfall to mitigate impacts to saltmarsh habitat within the designations. Routeing a trenchless technique through the historical landfill would introduce substantial engineering risks, as well as the risk of mobilisation of historical contamination. Onshore routeing will therefore need to be carefully considered to avoid routeing through the historic landfill whilst also ensuring a trenchless technique is achievable, as it is considered to be essential mitigation to avoid impacting on the designated habitats.

10.5.5 Taking account of the further work undertaken in relation to coordination the emerging preferred solution in Suffolk is Landfall S2 and associated marine alignment S2, and coordinated converter sites 1 and 3. Site 1 Corridor 1 as shown on **Figure 9-16** Sheet 1 of 7 has been identified as the emerging HVDC corridor for site 1 and Site 3 Corridor 6 as shown on **Figure 9-16** Sheet 3 of 7 has been identified as the emerging preference HVDC corridor for site 3. The HVAC corridors for sites 1 and 3 are shown on **Figure 9-17** Sheets 1 of 7 and 3 of 7 respectively.

10.5.6 For the reasons explained above, that further ground investigation studies/surveys are required to inform the feasibility of utilising trenchless techniques at the landfall S2 and the ecological sensitivity of this landfall, an alternative landfall S3 has been included. Should landfall S3 be brought forward the preferred HVDC corridor from this landfall to site 1 is Site 1 Corridor 4 as shown on **Figure 9-16** Sheet 1 of 7. Two alternative HVDC corridors are included for site 3. The first alternative (option 1) was not initially assessed as a site 3 corridor but the sections which made up the corridor were individually assessed as part of the site 4 HVDC corridors and provided a better alternative to any of the site 3 HVDC corridors. The HVDC corridor that has been identified for this alternative is shown on **Figure 9-29**. The second alternative (option 2) Site 3 Corridor 3 as shown on **Figure 9-16**

Sheet 3 of 7. Should this alternative landfall and associated HVDC corridors be brought forward over the emerging preference it is unlikely that a co-located landfall and HVDC cable route could be achieved.

10.5.7 Due to the number of terrestrial and marine elements, to cost every theoretical end-to-end solution would be disproportionate as there are tens of thousands of end-to-end combinations. As cost is generally a factor of length and technical complexity the decision was taken to cost one of the longest and one of the shortest end-to-end solutions to understand the cost differential between the two. The options costed were selected following the initial environmental, socio-economic and technical appraisal findings so as not to cost options which, for environmental, socio-economic, or technical reasons, may never be selected as emerging preferences. As such four options were initially costed. The elements which make up each of the costed options and the capital cost of each is provided in Table A1 in Appendix A. The relative cost of options compared to these four baseline options was taken into account alongside the results of the environmental, socio-economic and technical appraisal and stakeholder feedback.

10.5.8 As two coordinated converter station sites have been identified as emerging preferences in Suffolk and due to the need to undertake further survey work at landfall S2 to confirm the installation techniques relative to the designated sites for nature conservation, five options in Suffolk have been identified, two emerging preferences and three alternatives. The elements which make each option are summarised below. The elements in Kent and the Kent and central marine alignments which make up the end end-to-end emerging preferences and alternatives remain the same for each of the five Suffolk options.

Site 1 Emerging Preference

10.5.9 Site 1 emerging preference is made up of the following elements:

- Kent Connection Point: Richborough to Canterbury OHL
- HVAC Connection: Overhead or underground cables
- Converter Site Option Area: Option Area A
- HVDC Corridor: Richborough – Pegwell Bay Green Corridor
- Landfall Area of Search: K1
- Marine Alignments: K1c, C4A, C8B, S2
- Landfall Area of Search: S2
- HVDC Corridor: Site 1 Corridor 1
- Converter Site Option Area: Coordinated Site 1
- HVAC Connection: Underground cables
- Suffolk Connection Point: proposed Friston substation.

Site 3 Emerging Preference

10.5.10 Site 3 emerging preference is made up of the following elements:

- Kent Connection Point: Richborough to Canterbury OHL
- HVAC Connection: Overhead or underground cables

- Converter Site Option Area: Option Area A
- HVDC Corridor: Richborough – Pegwell Bay Green Corridor
- Landfall Area of Search: K1
- Marine Alignments: K1c, C4A, C8B, S2
- Landfall Area of Search: S2
- HVDC Corridor: Site 3 Corridor 6
- Converter Site Option Area: Coordinated Site 3
- HVAC Connection: Underground cables
- Suffolk Connection Point: proposed Friston substation.

Site 1 Alternative

10.5.11 Site 1 Alternative is made up of the following elements:

- Kent Connection Point: Richborough to Canterbury OHL
- HVAC Connection: Overhead or underground cables
- Converter Site Option Area: Option Area A
- HVDC Corridor: Richborough – Pegwell Bay Green Corridor
- Landfall Area of Search: K1
- Marine Alignments: K1c, C4A, C8B, S3N
- Landfall Area of Search: S3
- HVDC Corridor: Site 1 Corridor 4
- Converter Site Option Area: Coordinated Site 1
- HVAC Connection: Underground cables
- Suffolk Connection Point: proposed Friston substation.

Site 3 Alternative (option 1)

10.5.12 Site 3 Alternative (option 1) is made up of the following elements:

- Kent Connection Point: Richborough to Canterbury OHL
- HVAC Connection: Overhead or underground cables
- Converter Site Option Area: Option Area A
- HVDC Corridor: Richborough – Pegwell Bay Green Corridor
- Landfall Area of Search: K1
- Marine Alignments: K1c, C4A, C8B, S3N
- Landfall Area of Search: S3
- HVDC Corridor: Site 3 alternative

- Converter Site Option Area: Coordinated Site 3
- HVAC Connection: Underground cables
- Suffolk Connection Point proposed Friston substation.

Site 3 Alternative (option 2)

10.5.13 Site 3 Alternative (option 2) is made up of the following elements:

- Kent Connection Point: Richborough to Canterbury OHL
- HVAC Connection: Overhead or underground cables
- Converter Site Option Area: Option Area A
- HVDC Corridor: Richborough – Pegwell Bay Green Corridor
- Landfall Area of Search: K1
- Marine Alignments: K1c, C4A, C8B, S3N
- Landfall Area of Search: S3
- HVDC Corridor: Site 3 Corridor 3
- Converter Site Option Area: Coordinated Site 3
- HVAC Connection: Underground cables
- Suffolk Connection Point: proposed Friston substation.

10.5.14 Table A2 in Appendix A provides the capital costs for each of the emerging preference and alternative options. As the technology choice for the AC connection in Kent has not been made, two costs are provided for each option based on that connection being made either by underground AC cables or OHL. Site 3 emerging preference has the lowest capital cost approximately £6m less than Site 1 emerging preference which is the next lowest and approximately £39m less than Site 1 Alternative which has the highest capital cost of the five options.

11. Graduated Swathe

11.1.1 In line with National Grids approach to consenting guidance[11] further work has been undertaken to identify graduated swathes within the emerging preference and alternative corridors and site option areas identified. The darker areas of the swathe indicates, based on current information, a more likely location of the infrastructure within the emerging preference corridors and option areas. There may, for example, be sensitive habitats or cultural heritage sites within the corridor and in these cases, we would aim to avoid these constraints. Based on the outputs of the project marine survey undertaken summer 2021 the marine emerging preference corridor has been widened in some areas to allow flexibility regarding route optimisation and will be informed by additional surveys. The graduated swathes are shown on **Figure 11-1** to **Figure 11-7.**

[11] National Grid, Our Approach to Consenting (April 2022)

Figure 11-1 Kent Emerging Preference

N

Legend

National Grid Overhead Line - 400kV

Kent Converter Station Site

Preferred HVDC Graduated Swathe

Preferred HVDC Corridor

HVAC Graduated Swathe

HVAC Corridor

0 0.5 1 1.5 2 2.5 km

Rev	Date	Description	GIS	Chk	App
0	22/08/2022	CPRSS REPORT	EB	DF	KS

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Scheme: SEA LINK

Document Title: KENT EMERGING PREFERENCE

Creator:	Date:	Checker:	Date:	Approver:	Date:
EB	22/08/2022	DF	22/08/2022	KS	22/08/2022

Document Ref:	Scale:	Format:	Sheets:	Rev:
FIGURE 11-1	1:20,000	A3	1	0

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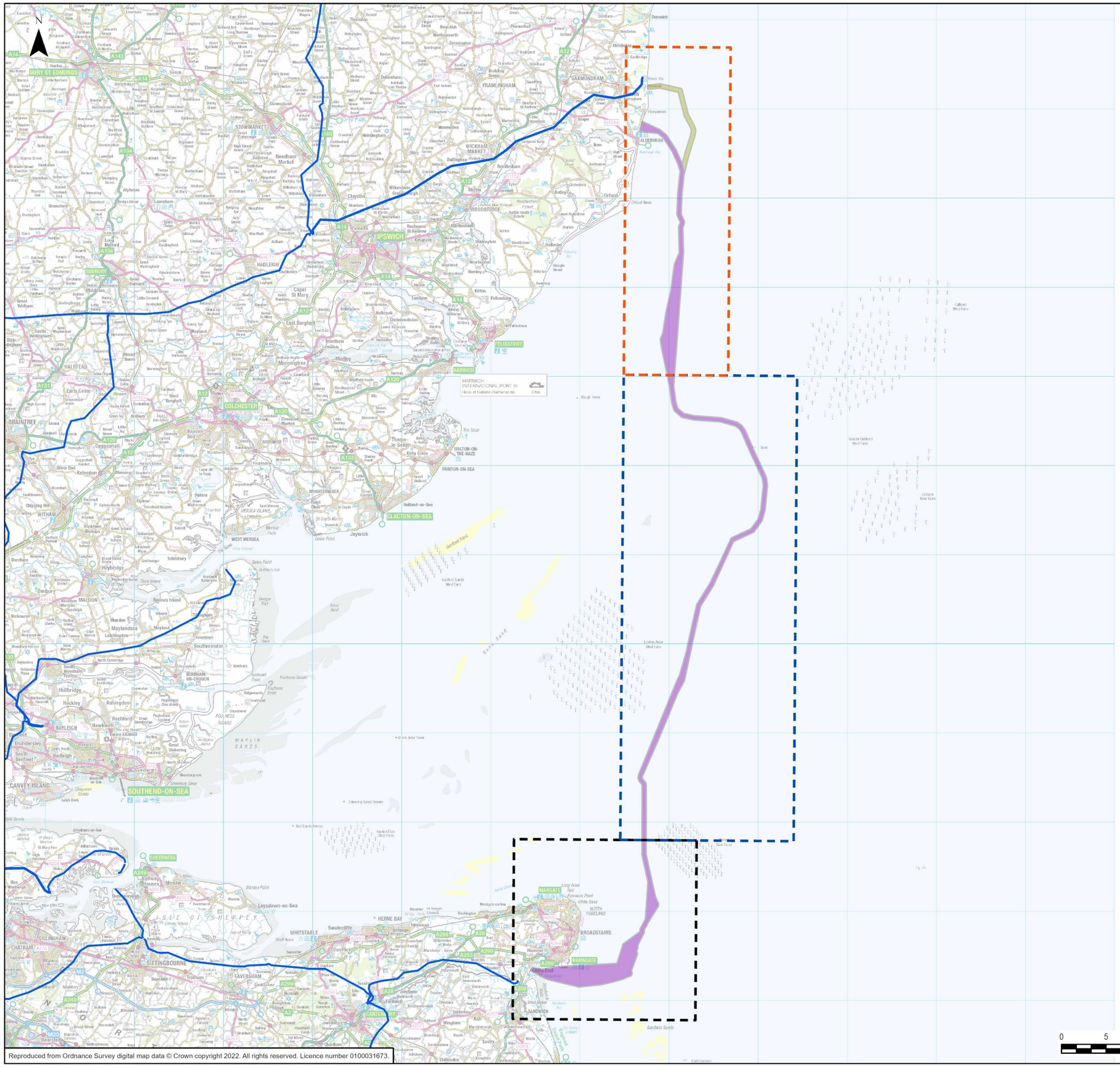
Figure 11-2 Marine Emerging Preference



Legend

- National Grid Overhead Line - 400kV
- Marine Corridor Emerging Preference
- Marine Corridor Alternative
- Suffolk Marine Corridor
- Central Marine Corridor
- Kent Marine Corridor

Rev	Date	Description	GIS	Chk	App
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Document Title: MARINE EMERGING PREFERENCE

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EB	13/06/2022	DF	13/06/2022	KS	13/06/2022

Document Ref:	Scale:	Format:	Sheets:	Rev:
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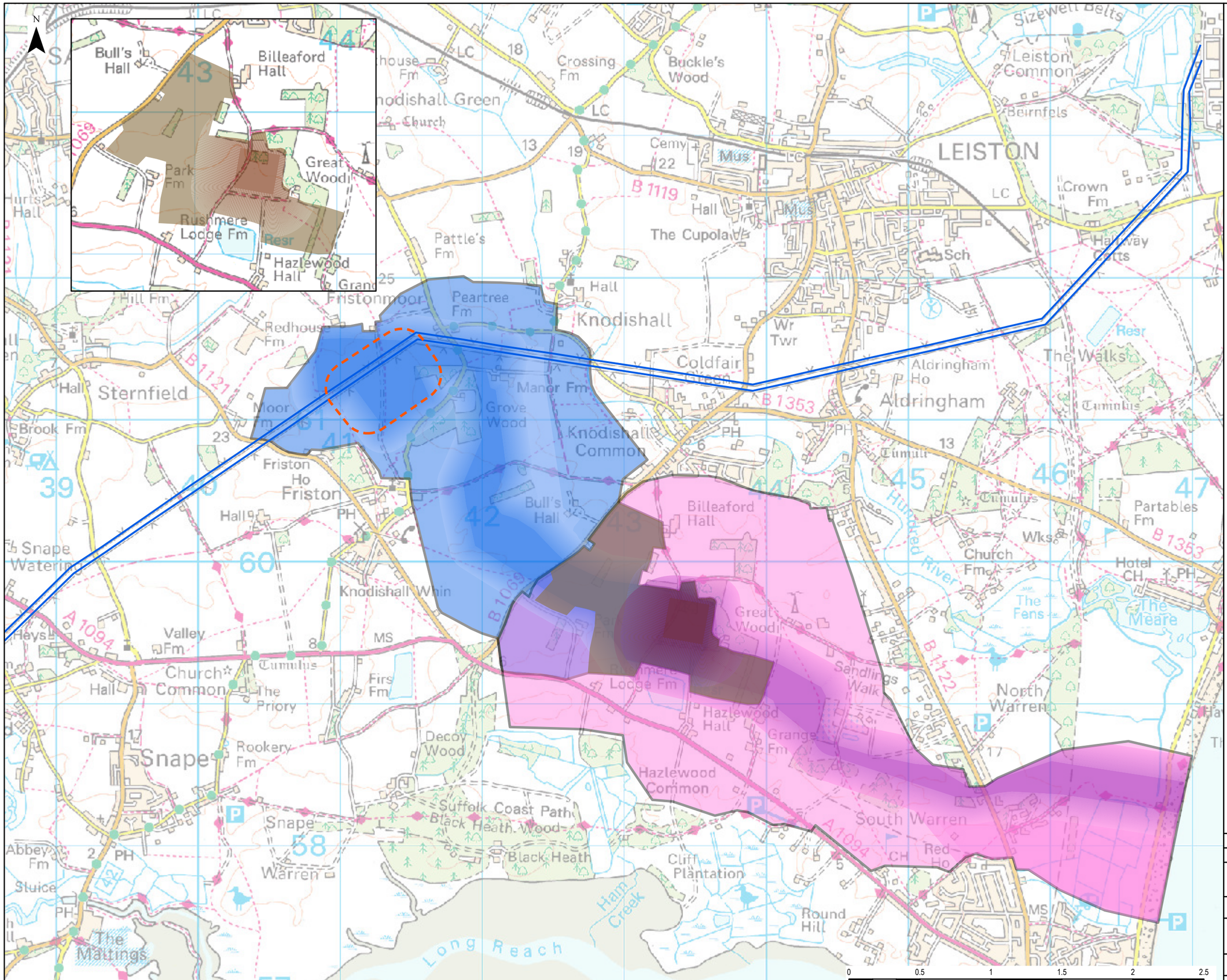
Figure 11-3 Suffolk Converter Station Site 1 Emerging Preference



Legend

- National Grid Overhead Line - 400kV
- Proposed Friston Substation
- Suffolk Converter Station Site 1
- Preferred HVDC Graduated Swathe
- Preferred HVDC Corridor
- HVAC Graduated Swathe
- HVAC Corridor

Rev	Date	Description	GIS	Chk	App
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Scheme: SEA LINK

Document Title: SUFFOLK - CONVERTER STATION SITE 1 - EMERGING PREFERENCE

Creator:	Date:	Checker:	Date:	Approver:	Date:
EB	22/08/2022	DF	22/08/2022	KS	22/08/2022

Document Ref:	Scale:	Format:	Sheets:	Rev:
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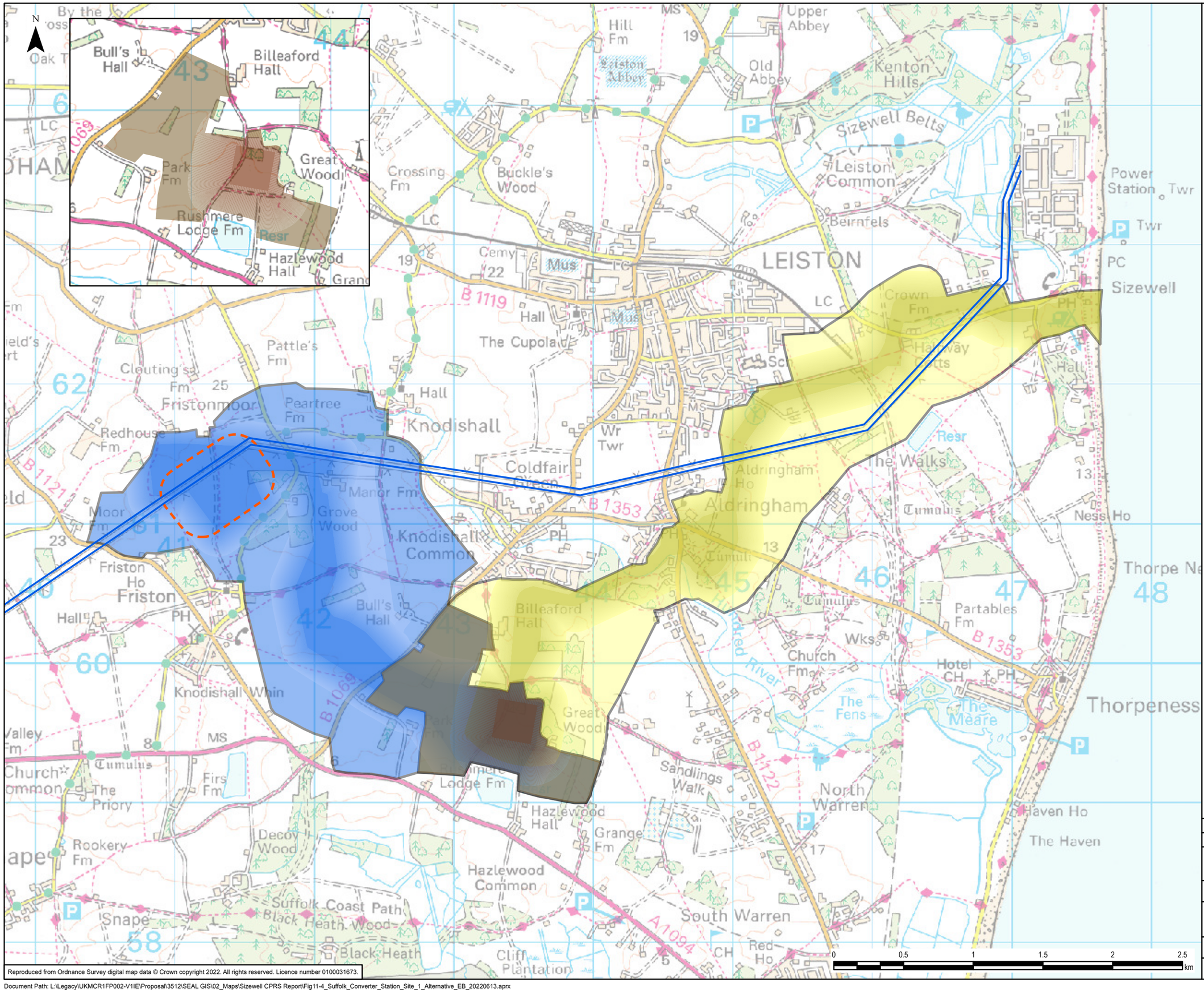
Figure 11-4 Suffolk Converter Station Site 1 Alternative



Rev	Date	Description	GIS	Chk	App
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Document Title: SUFFOLK - CONVERTER STATION SITE 1 - ALTERNATIVE

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Figure 11-5 Suffolk Converter Station Site 3 Emerging Preference

N

Legend

National Grid Overhead Line - 400kV

Proposed Friston Substation

Suffolk Converter Station Site 3

Preferred HVDC Graduated Swathe

Preferred HVDC Corridor

HVAC Graduated Swathe

HVAC Corridor

0 0.5 1 1.5 2 2.5 km

Rev	Date	Description	GIS	Chk	App
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Scheme: SEA LINK

Document Title: SUFFOLK - CONVERTER STATION SITE 3 - EMERGING PREFERENCE

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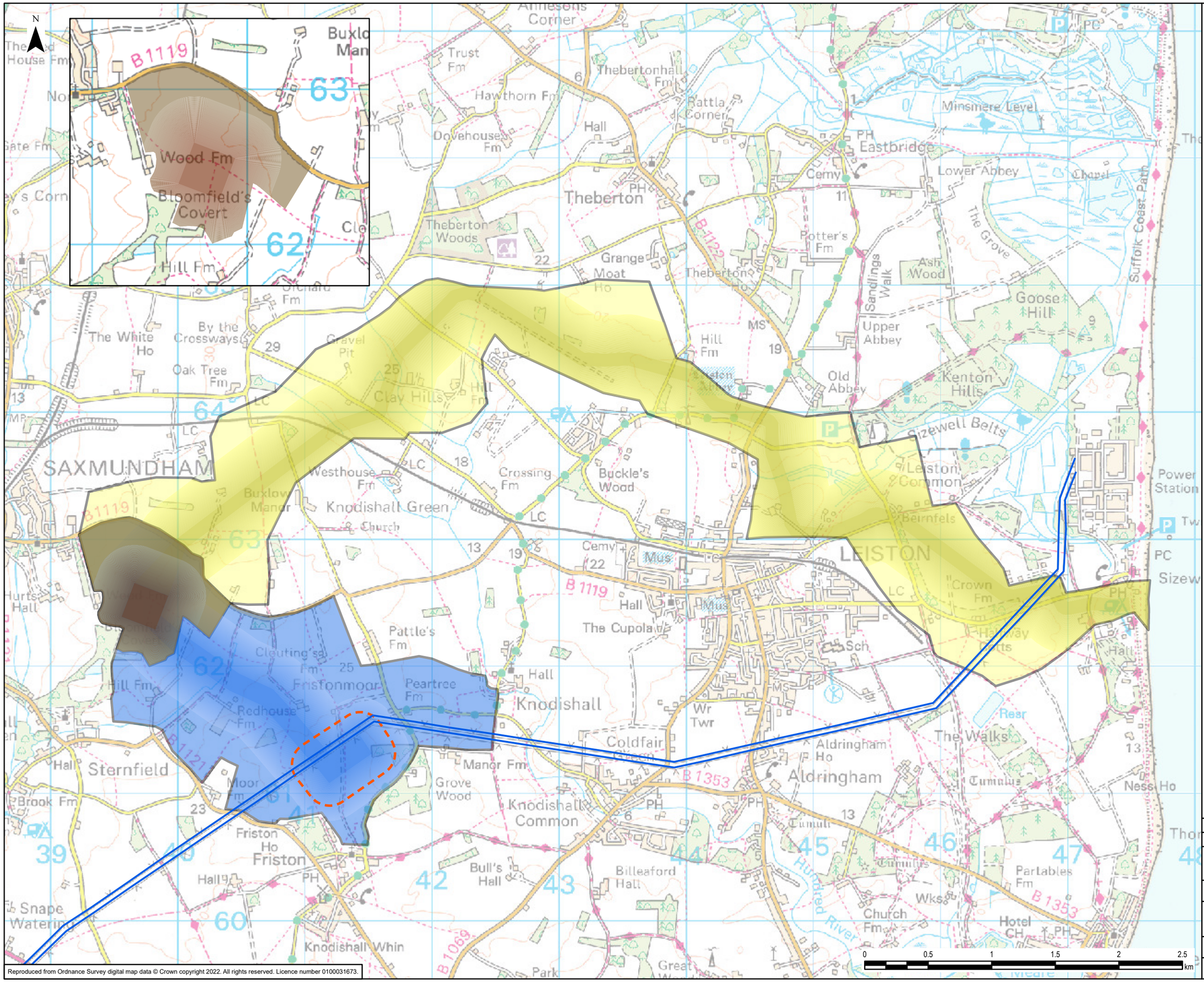
Figure 11-6 Suffolk Converter Station Site 3 Alternative (option 1)



Legend

- National Grid Overhead Line - 400kV
- Proposed Friston Substation
- Suffolk Converter Station Site 3
- Alternative HVDC Graduated Swathe
- Alternative HVDC Corridor
- HVAC Graduated Swathe
- HVAC Corridor

0 0.5 1 1.5 2 2.5 km

Rev	Date	Description	GIS	Chk	App
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Scheme: SEA LINK

Document Title: SUFFOLK - CONVERTER STATION SITE 3 - ALTERNATIVE (OPTION 1)

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EB	22/08/2022	DF	22/08/2022	KS	22/08/2022

Document Ref:	Scale:	Format:	Sheets:	Rev:
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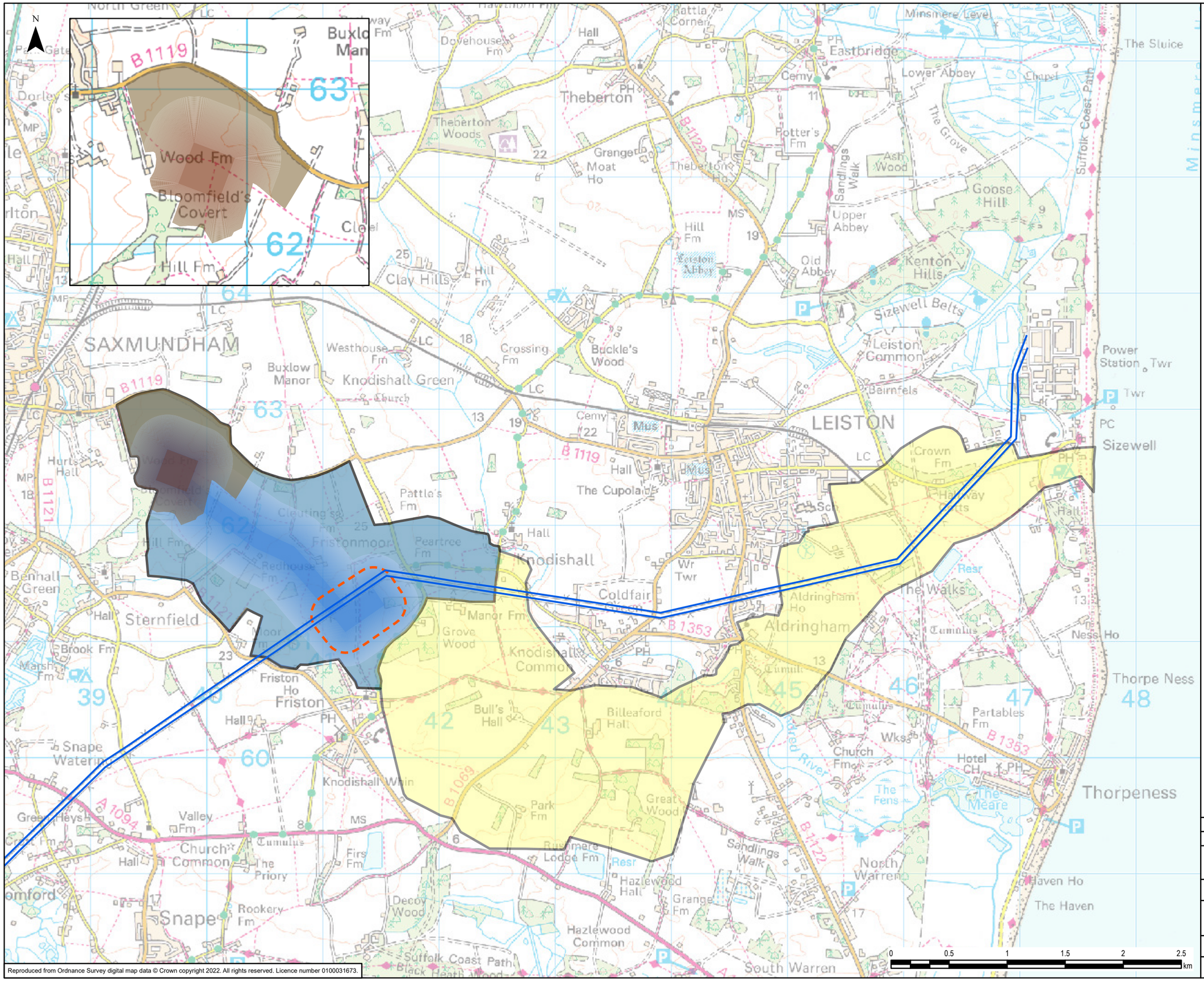
Figure 11-7 Suffolk Converter Station Site 3 Alternative (option 2)



Legend

- National Grid Overhead Line - 400kV
- Proposed Friston Substation
- Suffolk Converter Station Site 3
- Alternative HVDC Corridor
- HVAC Graduated Swathe
- HVAC Corridor

Rev	Date	Description	GIS	Chk	App
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Document Title: SUFFOLK - CONVERTER STATION SITE 3 - ALTERNATIVE (OPTION 2)

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12. Next Steps

12.1.1 The findings of this work provide the emerging preference corridors and sites and alternatives that will form the basis of non-statutory public consultation and engagement with stakeholders including landowners. The feedback from non-statutory consultation will be used to further inform the development of the design of the Project that will consulted on during Statutory Consultation and thereafter the DCO Submission.

12.1.2 The Project will be subject to an EIA. This assessment will require the gathering of site-specific data, including through desk study and field surveys; this data gathering will include environmental and social information to form a baseline for the assessment of potential impacts, as well as information relating to potential technical constraints or risks, such as poor ground conditions.

12.1.3 Feedback will continue to be sought through both informal non statutory and statutory consultation with a range of stakeholders, including local planning authorities, statutory consultees such as Natural England, the Environment Agency and Historic England, non-statutory organisations, affected landowners and communities who could potentially be affected by the proposals.

12.1.4 Together, the baseline data and feedback will be used to inform the ongoing development of the Project to ensure it is designed, where possible, to avoid or reduce potential environmental and social impacts, and to address technical challenges and landowner concerns.

12.1.5 This use of environmental information to inform the Project design forms a key part of the EIA process that will be undertaken, culminating in the publication of an Environmental Statement. The Environmental Statement will explain how the assessment process has informed the design, what mitigation measures are proposed to address potentially significant effects that could not be avoided and report any residual effects of the Project.

Appendix A
Costs

Due to the number of terrestrial and marine elements, to cost every theoretical end-to-end solution would be disproportionate as there are tens of thousands of end-to-end combinations. As cost is generally a factor of length and technical complexity the decision was taken to cost one of the longest and one of the shortest end-to-end solutions to understand the cost differential between the two. The options costed were selected following the initial environmental, socio-economic and technical appraisal findings so as not to cost options which, for environmental, socio-economic, or technical reasons, may never be selected as emerging preferences. As such four options were initially costed. The elements which make up each of the costed options and the capital cost of each is provided in **Table A1**. Option ID 2 has the lowest capital cost and Option ID 3 the highest with a difference of approximately 7%.

Table A1 Initial Costed Options

ID	Kent	Marine	Suffolk	Capital Cost
1	Connection into Richborough Substation	Landfall K1c	Connection to and extension of the proposed Friston substation	£1,460m
	Converter option Area A	Marine alignment K1	Converter option Area E	
	Pegwell Bay Green Corridor	Marine alignment C4A	Sizewell – Friston Red Corridor	
	Landfall K1	Marine alignment C8B	Landfall S2	
	Connection into Richborough Substation	Marine alignment S2		
		Landfall S2		
2	Connection into Richborough Substation	Landfall K1a	Connection to and extension of the proposed Friston substation	£1,444m
	Converter option Area A	Marine alignment K1a	Converter option Area E	
	Broadstairs Green Corridor	Marine alignment C4A	Sizewell – Friston Red Corridor	
	Landfall K1a	Marine alignment C8B	Landfall S2	
		Marine alignment S2		

ID	Kent	Marine	Suffolk	Capital Cost
		Landfall S2		
3	Connection into Richborough Substation	Landfall K1c	New substation and connection to the existing 4Z OHL	£1551m
	Converter option Area A	Marine alignment K1	Converter option Area I	
	Pegwell Bay Green Corridor	Marine alignment C4A	Sizewell – 4Z purple corridor	
	Landfall K1	Marine alignment C8B	Landfall S3	
		Marine alignment S3N		
		Landfall S3		
4	Connection into Richborough Substation	Landfall K1a	New substation and connection to the existing 4Z OHL	£1,526m
	Connection into Richborough Substation	Marine alignment K1a	Converter option Area I	
	Converter option Area A	Marine alignment C4A	Sizewell – 4Z purple corridor	
	Broadstairs Green Corridor	Marine alignment C8B	Landfall S3	
	Landfall K1a	Marine alignment S3N		
		Landfall S3		

Table A2 provides the capital costs for each of the emerging preference and alternative options as illustrated on **Figure 11-1** to **Figure 11-7.** As the technology choice for the AC connection in Kent has not been made, two costs are provided for each option based on that connection being made either by underground AC cables or OHL. Site 3 emerging preference has the lowest capital cost approximately £6m less than Site 1 emerging preference which is the next lowest and approximately £39m less than Site 1 Alternative which has the highest capital cost of the five options.

Table A2 Emerging preferences and alternatives

Option	Capital Cost
Site 1 Emerging Preference	Underground AC connection Kent - £1513m

Option	Capital Cost
	OHL Kent – £1461m
Site 1 Alternative	Underground AC connection Kent - £1546m
	OHL Kent – £1494m
Site 3 Emerging Preference	Underground AC connection Kent - £1507m
	OHL Line Kent – £1455m
Site 3 Alternative (option 1)	Underground AC connection Kent - £1537m
	OHL Kent – £1485m
Site 3 Alternative (option 2)	Underground AC connection Kent - £1539m
	OHL Line Kent – £1487m

Appendix B Glossary and Abbreviations

Term	Definition
Corridor	A broad area, within which a new overhead line or buried cable could be routed.
Current Source Convertor	Converts DC to AC current at a connection between an HVAC and HVDC cable where constant current is used.
Development Consent Order	The consent for nationally significant infrastructure projects under the Planning Act 2008 to the Planning Inspectorate (PINS).
Electricity System Operator	The body required to support and guide the future development of the electricity transmission system in Britain.
Electricity Transmission System	The electricity transmission system is made up largely of 400kV, 275kV and 132kV assets connecting separately owned generators, interconnectors, large demands fed directly from the transmission system, and distribution networks run by Distribution Network Operators (DNOs). In England and Wales, the 'transmission' classification applies to assets at 275kV and above. In Scotland or offshore it applies to assets at 132kV or above.
Joint Bay	Where separate lengths of terrestrial HVAC or HVDC cable sections join.
Marine Alignment	The specific location and route of the marine subsea cable.
National Grid	National Grid operates the national electricity transmission network across Great Britain and owns and maintains the network in England and Wales, providing electricity supplies from generating stations to local distribution companies. National Grid does not distribute electricity to individual premises, but its role in the wholesale market is vital

	to ensuring a reliable, secure and quality supply to all.
National Electricity Transmission System Security and Quality of Supply Standard	A collection of requirements and criteria collated by Ofgem underpinning the planning, design and operation of electricity transmission infrastructure.
Options appraisal	A robust and transparent process used to compare options and to assess the positive and negative effects they may have across a wide range of criteria including environmental, socio-economic, technical and cost factors. The outcome is to identify a Strategic Proposal for the Project.
Options Identification & Selection	Work undertaken to determine the preferred corridor and preliminary routeing and siting options. 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 provide information on the approach to the identification and appraisal of route corridors and siting locations.
Overhead line	Conductor (wire) carrying electric current, strung from pylon to pylon.
Project Need Case	Sets out the reasons why the Project is required.
Siting Area	An area of land within which a new converter station or substation could be sited.
Strategic Proposal	The outcome of the strategic options appraisal; the Strategic Proposal is then taken forward to the Options Identification & Selection stage.
Substation	Electrical equipment in an electric power system through which electrical energy is passed for transmission, transformation, distribution or switching.
Transition Joint Bay	The structure in which a length of onshore cable is joined to a length of offshore cable.

Underground Cable	An insulated conductor carrying electric current designed for underground installation.
Voltage Source Converter	Converts DC to AC current at a connection between an HVDC and HVAC cable where a constant voltage is used.

AC	**Alternating Current**
AIL	**Abnormal Indivisible Load**
AIS	**Automatic Information System**
ALARP	**As Low As Reasonably Practicable**
ALC	**Agricultural Land Classification**
AOI	**Area of Interest**
AONB	**Area of Outstanding Natural Beauty**
BMV	**Best and Most Versatile [Agricultural Land]**
C	**Upper Cretaceous**
CPRSS	**Corridor and Preliminary Routeing and Siting Study**
CSC	**Current Source Converter**
DCO	**Development Consent Order**
DNO	**Distribution Network Operators**
E	**Eocene**
ECDIS	**Electronic Chart Display and Information System**
EDF	**Electricite de France**
EIA	**Environmental Impact Assessment**
EMODnet	**European Marine Observation and Data Network**
ExA	**Extension Application**
FLO	**Fisheries Liaison Officer**
GIL	**Gas Insulated Lines**
GIS	**Geographic Information System**
GW	**Gigawatt**
HDD	**Horizontal Directional Drilling**
HGV	**Heavy Goods Vehicles**
HS1	**High Speed 1**
HVAC	**High Voltage Alternating Current**

HVDC	High Voltage Direct Current
IBA	Important Bird Area
IMO	International Maritime Organisation
km	Kilometres
kV	Kilovolt
LDP	Local Development Plan
LNR	Local Nature Reserve
LWS	Local Wildlife Sites
m	Metres
MCZ	Marine Conservation Zone
MHWS	Mean High Waters Springs
MLWS	Mean Low Waters Springs
MMO	Marine Management Organisation
MITS	Main Interconnected Transmission System
MW	Megawatt
NETS SQSS	National Electricity Transmission System Security and Quality of Supply Standard
NGET	National Grid Electricity Transmission
NGV	National Grid Ventures
NNR	National Nature Reserve
NOA	Network Options Assessment
NPPF	National Planning Policy Framework
NPV	Net Present Value
OHL	Overhead Lines
P	Palaeocene
PEC	Pan European Crossing
PEXA	Practice and Exercise Areas
PL	Pliocene
PLA	Port of London Authority
PRoW	Public Right of Way
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SGT	Super Grid Transformer
SINC	Sites of Importance for Nature Conservation
SOLAS	International Convention for the Safety of Life at Sea

SoS	**Secretary of State**
SPA	**Special Protection Area**
SPR	**Scottish Power Renewables**
SPZ	**Source Protection Zone**
SSSI	**Site of Special Scientific Interest**
TJB	**Transition Joint Bay**
TSS	**Traffic Separation Schemes**
VSC	**Voltage Source Converter**
VTS	**Vessel Traffic Schemes**
yr	**Year**

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