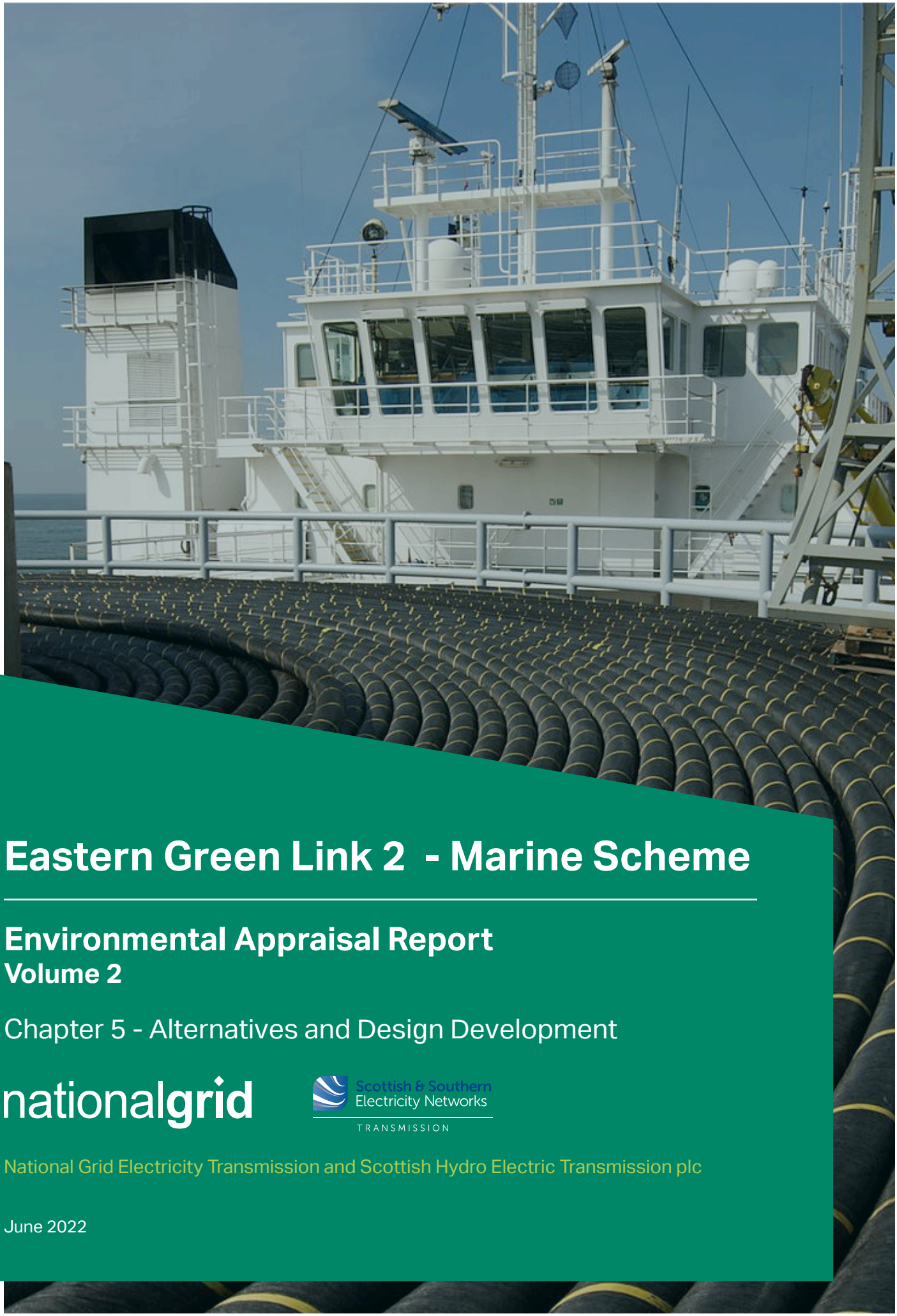

Eastern Green Link 2 - Marine Scheme

Environmental Appraisal Report
Volume 2

Chapter 5 - Alternatives and Design Development

nationalgrid

Scottish & Southern Electricity Networks
TRANSMISSION

National Grid Electricity Transmission and Scottish Hydro Electric Transmission plc

June 2022

Prepared for:

National Grid Electricity Transmission and
Scottish Hydro Electric Transmission Plc

Prepared by:

AECOM UK Limited
1 Tanfield
Edinburgh EH3 5DA
United Kingdom

T: +44 131 301 8600
aecom.com

In association with:

Xodus Group (Shipping and Navigation);

Wessex Archaeology (Marine Archaeology); and

Brown and May Marine Ltd (Commercial Fisheries).

Table of Contents

Figures

Tables

5. Alternatives and Design Development

5.1 Introduction

This chapter describes the evolution of the design of the Marine Scheme, including selection of the proposed technology – High Voltage Direct Current (HVDC) - for the cable system. The chapter also describes the consideration of alternatives carried out to reach a solution that balances the need for a technically feasible and economically viable route whilst limiting the disturbance to people, existing marine users and the environment. The chapter goes on to explain the rationale for selection of the Project Design Envelope (PDE) (Chapter 2: Project Description).

The “Need for the Project” is discussed in Chapter 1: Introduction, where the context of Government net-zero targets, North Sea developments, as well as north to south electricity transfer requirements are explained. The Network Options Appraisal (NOA) 2018/2019 (National Grid ESO, 2019) recommended the development of two HVDC reinforcements between the east coasts of Scotland and England, known as Scotland to England Green Link 1/2 (SEGL1/2). SEGL2, now known as EGL2, has continued to appear in each yearly NOA Report and is included in the most recent NOA 2021/22, published in January 2022.

Reflecting the need case, the primary objective of the Project is to reinforce the electricity network and increase transmission network capability between Scotland and northern England by 2029 in order to enable the efficient and economic transmission of electricity.

The development of the Marine Scheme has included the identification and assessment of a number of potential landfall locations along the east coast of Scotland and northern England. The approach to the identification of the Marine Installation Corridor connecting potential landfall locations has followed a structured process whereby a range of technical, environmental, social and commercial factors have been considered. The Transmission Owners (TOs) Scottish Hydro Electric Transmission (SHE Transmission) and National Grid Electricity Transmission (NGET) are the holders of electricity transmission licences and are subject to a number of statutory duties which they have had regard to in developing the Project.

5.2 Strategic Alternatives

5.2.1 The Do-Nothing Scenario

The ‘do nothing’ scenario considers a scenario in which the Project is not developed.

In such a scenario, transmission system reinforcement between Scotland and England, to increase the capability of the electricity transmission network and to accommodate the transfer of renewable and low carbon energy, is not realised. This would not achieve the primary objective of the Project.

Electricity flow between the north and south of the UK is forecast to increase at all levels across transmission and distribution because of increasing generation capacity, largely from Scottish offshore wind farms, connecting to the electricity network. In a ‘do-nothing’ scenario this forecasted growth will put pressure on the existing network, which may result in a requirement for constraining action by the TOs to restrict power flows and ensure equipment capacities are not exceeded. The cost of constraint actions would be passed on to consumers. The TOs predict that the ‘do-nothing’ scenario will result in sub-optimal operation of the network in the long-term.

In this scenario any contribution that the Project might have made towards UK targets of becoming net-zero in all greenhouse gases by 2050 for England and Wales, and 2045 for Scotland, would not be realised. Wider benefits of increased electricity transmission network capability contributing to energy, security, sustainability and affordability would also not be realised.

5.2.2 The Do-Something Scenario

Investment in network reinforcement, as proposed under the ‘do something’ scenario, will contribute additional transmission capacity between networks in Scotland and Northern England, increasing the ability to accommodate new and additional generation input to the network. This would help manage

the addition of increasing quantities of power generation (particularly onshore and offshore wind generation) over time.

Consideration has been given to alternative electricity transmission infrastructure design options for delivering this connection between Scotland and England, including:

- Selection of the most appropriate electricity transmission technology;
- Identification of connection points to Scottish and English electricity transmission systems;
- Selection of the proposed landfall areas;
- Selection of the proposed converter station sites;
- Selection of the proposed underground cable routes; and
- Selection of the proposed submarine cable corridor through Scottish and English waters.

A submarine HVDC link between Peterhead and Drax, known as the Eastern Link, was given a 'proceed' signal in the first NOA, published in 2015/2016. The NOA 2018/2019 recommended the development of two High Voltage Direct Current (HVDC) reinforcements between the east coasts of Scotland and England, known as Eastern Green Link 2 (EGL2), and the other as Scotland to England Green Link 1 (SEGL1) or Eastern Link 1 (EL1). It has continued to appear in each yearly NOA Report and is included in the most recent NOA 2021 / 22, published in January 2022, along with the SEGL1 / EL1 project. Therefore, the Do-Something scenario was taken forward by the Transmission Owners.

5.3 Approach to Corridor Selection and Design

5.3.1 Overview of Approach

The approach used to identify and assess both the potential landfall sites and also the marine installation corridor options followed an iterative and integrated process. It allowed the identification and consideration of technical, socio-economic, environmental and cost constraints. The aim was to identify sites or route options which best balance these factors and used a staged appraisal process in accordance with National Grid's 'Approach to Options Appraisal' (National Grid, 2012).

The approach to routeing the options for the Marine Scheme has been carried out in three main phases:

- **Phase 1:** Strategic Options Appraisal (SOA). This stage focused on the preliminary identification of key technical, socio-economic, environmental and cost constraints against seven Strategic Marine Route Options, with 33 sub-routes (East Coast Connection - Strategic Options Appraisal (RPS, 2019)), supported by other previous supporting documents;
- **Phase 2:** Marine Route Optioneering. The Marine Route Refinement and Selection Study was completed in March 2020, which included the high-level assessment of 33 sub-routes associated with the six offshore options as part of the refinement of the potential routes (Eastern Link - Phase 2 Marine Route Refinement & Selection (RPS, 2020)); and
- **Phase 3:** Marine Survey Corridor Development and Selection. The Marine Survey Corridor Development and Selection Study was completed in May 2020; it further considered multidisciplinary constraints of the preferred route from Peterhead to Drax Substation, identifying key constraints, crossing requirements and the development of a suitable survey route corridor. (Eastern Link – Phase 3 Marine Survey Corridor Development and Selection (RSK, 2020)).

A previous geophysical and geotechnical marine survey was undertaken in 2012 (MMT, 2012), which supported the development of a staged appraisal process in Scottish waters. Specific studies were also undertaken to further refine the landfall location selection, including the Eastern Link 2 – English Onshore Scheme Routeing and Siting Report (Aecom, 2021).

5.4 Phase 1 – Strategic Options Appraisal

A technical feasibility study of route options completed as part of the 2018/2019 NOA identified seven strategic route options to connect the two recommended HVDC reinforcement projects into the existing grid network (Figure 5-1). Six connection points were considered for the route options, two in the north and four in the south from which six strategic marine route options, and one strategic onshore route

option were derived. These were taken forward to the SOA (Phase 1) and are summarised in Table 5-1 and shown in Figure 5-6.

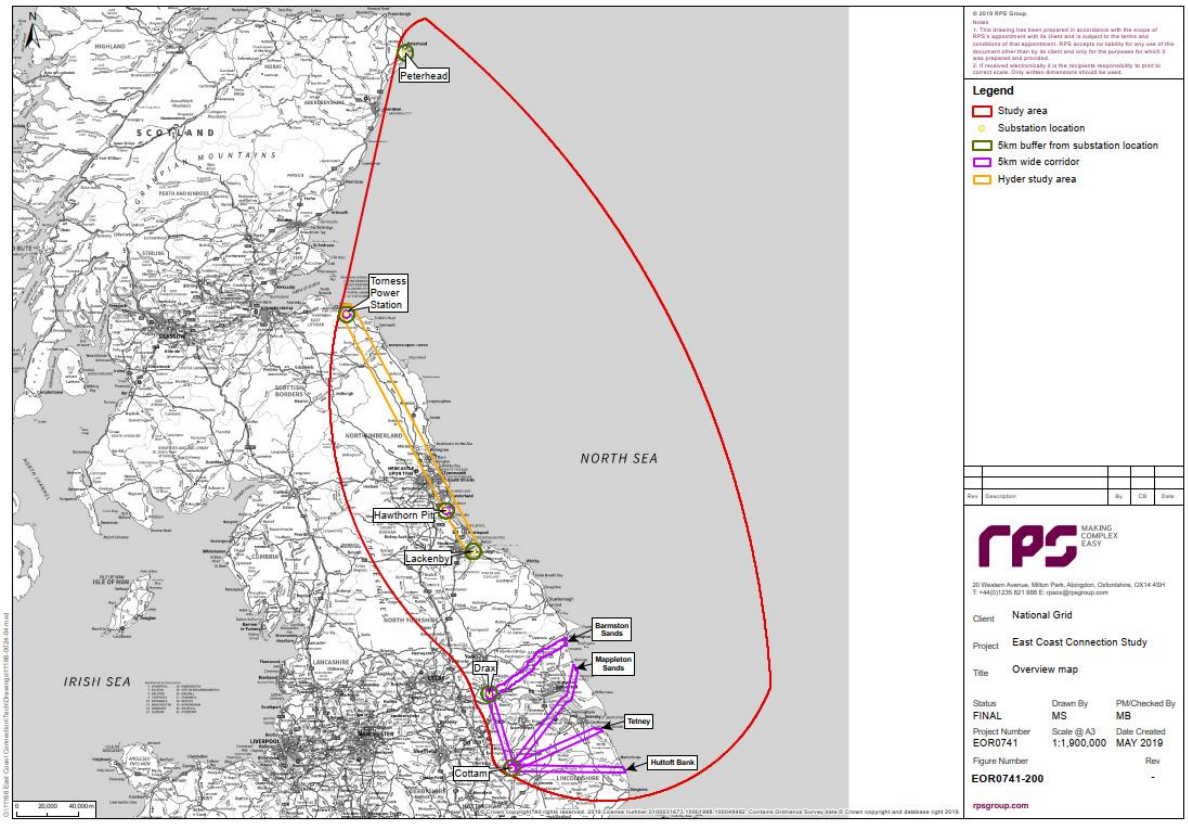

Figure 5-1: Connection points and the offshore study area (Source: RPS, 2019)

The 'start' point for EGL2 was assumed to be at Peterhead in Scotland, due to the proximity of the transmission network to the coast and previous study work completed in support of a new network reinforcement between Scotland and England (RSK, 2013. The Peterhead Converter Station Environmental Appraisal, produced for SHE Transmission, provides the landfall location and onshore route section for this connection route option (RSK, 2013). Options 1, 3 and 5, highlighted in Table 5-1, were therefore taken forward for further appraisal for EL2. Options 2, 4, 6 and 7 relate to the appraisal of options for SEGL1 / EL1, and so are not discussed further in this chapter.

Table 5-1: Strategic Marine Route Options Considered During Phase 1

Option	Sub-routes	Connection Point		Type
		North	South	
1	1 1x	Peterhead	Hawthorn Pit	HVDC Onshore / offshore
2	2 2x	Torness	Hawthorn Pit	HVDC Onshore / offshore
3	3a-d 3x 3y	Peterhead	Drax	HVDC Onshore / offshore
4	4a-d 4x	Torness	Drax	HVDC Onshore / offshore
5	5a-e **5x**	Peterhead	Cottam	HVDC Onshore / offshore

Option	Sub-routes	Connection Point		Type
		North	South	
6	6a-k	Torness	Cottam	HVDC Onshore / offshore
	6x			
7	n/a	Torness	Lackenby	HVAC Onshore

The potential onshore connections from the English landfall to the substations were appraised in accordance with National Grid's Approach to Options Appraisal (National Grid, 2012) with four main topics examined as part of the routeing study, namely; network capability and technical considerations, environmental and socio-economic impacts, programme and cost implications and boundary transfer capability. A route corridor of 2 km (1 km either side of a centreline) was used to allow for adjustments where possible during further route development. Constraints were classed as 'Hard' or 'Soft' constraints based on a series of definitions.

Hard constraints were those where the level of consenting, installation, legal and / or physical and operational risks were significant enough to warrant their avoidance entirely. These included such constraints as oil and gas infrastructure, safety zones, offshore windfarms, shipping, dredging locations, military danger / practice areas, and aquaculture sites.

Soft constraints were ranked either Major, Medium or Minor, with Major constraints to be avoided, if possible, Medium constraints to be avoided at the initial stage but can be considered if routeing around is not possible, and Minor constraints requiring no avoidance. The categorisation of the rankings was:

- **Major**: considered to be of major significance due to their legal, financial and physical implications for the project that can cause serious delays, extra cost and other risks;
- **Medium**: considered to be of medium significance and which will have limited legal, financial and physical implications for the project. These constraints are expected to be manageable but can be expected to require some efforts to deal with; and
- **Minor**: considered to be of minor importance and which have only limited legal, financial and physical implications for the project. These constraints are easy to manage and are expected to be possible deal with on a routine level.

This information was captured in a detailed Geographic Information System (GIS), colour coding each category and allowing the constraints to viewed across the geographic area and overlap between constraint layers to be identified.

The outcomes of this SOA (Phase 1) report are summarised below.

5.4.1 HVDC Onshore / Offshore Strategic Marine Route Options

The 14 sub-routes associated with Options 1, 3 and 5 were each appraised. A summary of the outcomes of these appraisals is presented below.

5.4.1.1 Peterhead to Hawthorn Pit (Option 1)

At the northern end of the route of Option 1, the Scottish offshore wind leasing areas have broad coverage and it was thought they would pose significant risk to the asset throughout its operational life. There were few other Hard constraints with the exception of unavoidable linear features such as pipelines and other cables.

Two sub-routes were appraised, Route 1 and 1x. Route 1 was 21 km longer than the Route 1x and had has six Soft constraints ranging from Minor to Major. There were interactions identified with three wind farms export corridors for Route 1x, and eight Soft constraints ranging from Minor to Major.

5.4.1.2 Peterhead to Drax (Barmston Sands) (Option 3)

Six sub-routes were appraised; routes 3a-d, 3x and 3y. There were few differentiating numbers of Hard constraints, with four wind farm export corridors common across all routes as well as ten other crossings (pipelines, cables and fibre optics). The number of Soft Major interactions ranged from six to nine, with

route 3x having the most at nine and 3y had seven. The route length benefit was the main consideration which ranged from 417 km to 498 km landfall to landfall.

5.4.1.3 Peterhead to Cottam (Mappleton Sands / Tetney / Huttoft Sands) (Option 5)

Six sub-routes were appraised, Routes 5a-e and 5x. The option routes were kept away from the nearshore environmental constraints for as much of the route as possible. Route 5d was routed further offshore, reducing the number of expected crossings and proximity to environmental constraints. There were three Soft Major interactions for routes 5a-e, whereas option 5x had six. The route length, ranging from 447 km to 554 km landfall to landfall, the wind farm export corridors encountered, ranging from three to four, and the pipelines, cables and fibre optic crossings, ranging from nine to 14, were the main differentiating factors.

5.4.2 Landfalls

5.4.2.1 Scottish Landfall (Scotland)

As detailed in Section 5.2.2, Peterhead was the only Scottish grid connection point identified by the 2019 NOA report for EGL2. SHE Transmission and NGET had previously started developing an HVDC link between Peterhead and Hawthorn Pit, which included the execution of landfall identification studies, and associated surveys. The Peterhead to Hawthorn Pit link was subsequently cancelled due to changes in network requirements, however the site selection studies were used as the basis for the EGL2 Phase 1 SOA (RPS, 2019). The proposed Peterhead landfall is located at Sandford Bay, approximately 2 km south of Peterhead, and within the Peterhead Port statutory harbour limits. Previous study work (RSK, 2013) identified Sandford Bay as the preferred landfall as it minimises the distance for the onshore cable route between the landfall and the existing transmission infrastructure associated with Peterhead Power Station, which lies at the top of cliffs immediately south of Sandford Bay. Furthermore, the Sandford Bay landfall avoids direct interactions with the breeding bird colonies located on the sea cliffs to the south of Sandford Bay (within the Buchan Ness to Collieston Coast SPA), while also avoiding interactions with Peterhead Port's infrastructure, and the conurbation of Peterhead Town to the north. Figure 5-2 shows how the offshore route aligns centrally at Sandford Bay, providing the maximum options opportunity heading offshore.

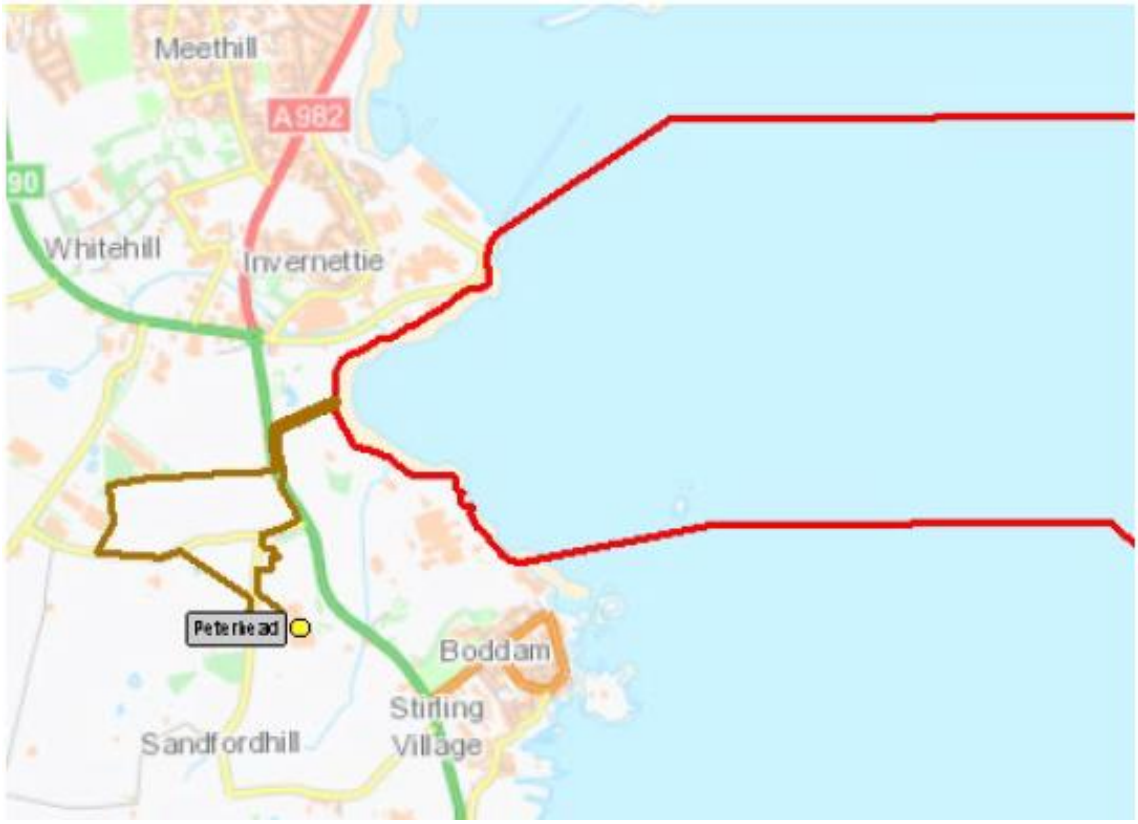

Figure 5-2: Peterhead onshore and offshore landfall route alignment

5.4.2.2 English Landfall Options

The Strategic Options Appraisal (RPS, 2019) identified a number of alternative 'end' points at substations on the network in England, in an area from Blyth in Northumberland as far south as Middlesbrough, both on the coast and inland. The objective of the strategic options appraisal was to identify a preferred Strategic Proposal which would best meet the need case by providing additional network capability when it is needed while also taking account of TO statutory and licence obligations.

The process of identifying feasible landfall areas considered:

- Situations where the connection point is already at the coast;
- Ensuring the landfall is as close to site as possible;
- Avoidance of steep changes in relief from the transition joint bay to the beach (requirement to be >15 m); and
- Where a landfall option has already been established from previous study reports.

For connection points inland, which included Drax and Cottam, the possible routes to landfall were established using the methods of:

- Following existing corridors;
- Identifying the shortest route; and
- Utilising similar landfall location for similar projects.

A key consideration was coastal height, as large cliffs would present a substantial constraint to making landfall.

Hawthorn Pit Landfall

The Hawthorn Pit landfall (for the grid connection point at Drax which is approximately 7 km inland), and the coastal height is greater than 15 m above sea level at the potential landfall location as is shown in Figure 5-3.

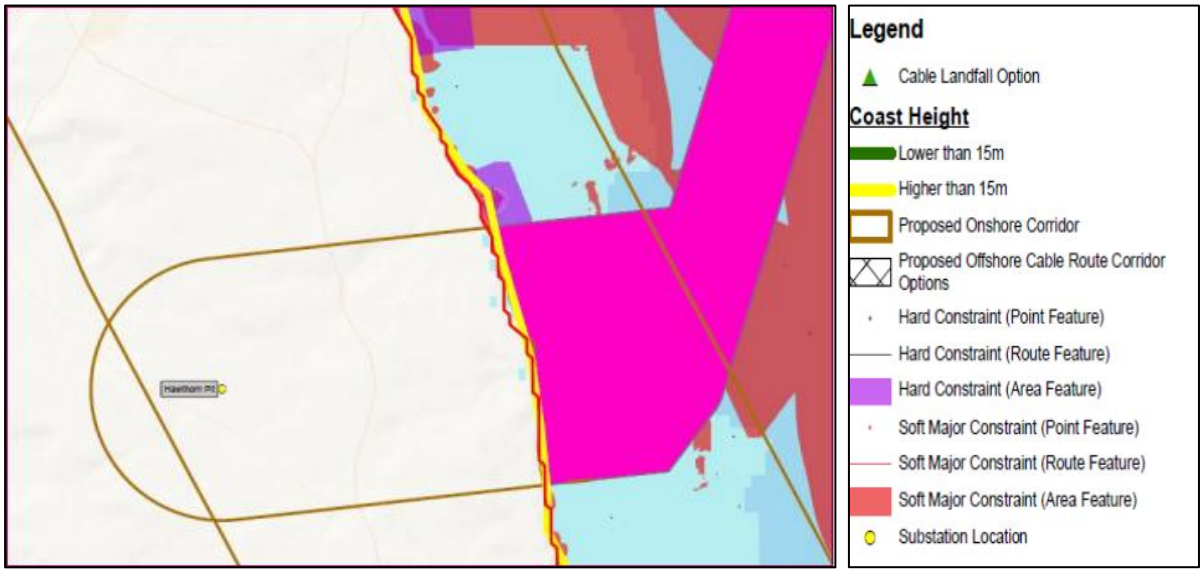

Figure 5-3: Hawthorn Pit Onshore and Offshore landfall route alignment snapshot (RPS, 2019)

Drax Landfall

An onshore route to the potential coastal landfall from the Drax substation was identified at over 70 km utilising the former White Rose Carbon Capture and Storage (CCS) onshore pipeline route, which was never used. The route meets the coast at Barmston Sands, East Yorkshire, where coastal height is less than 15 m as shown on Figure 5-4.

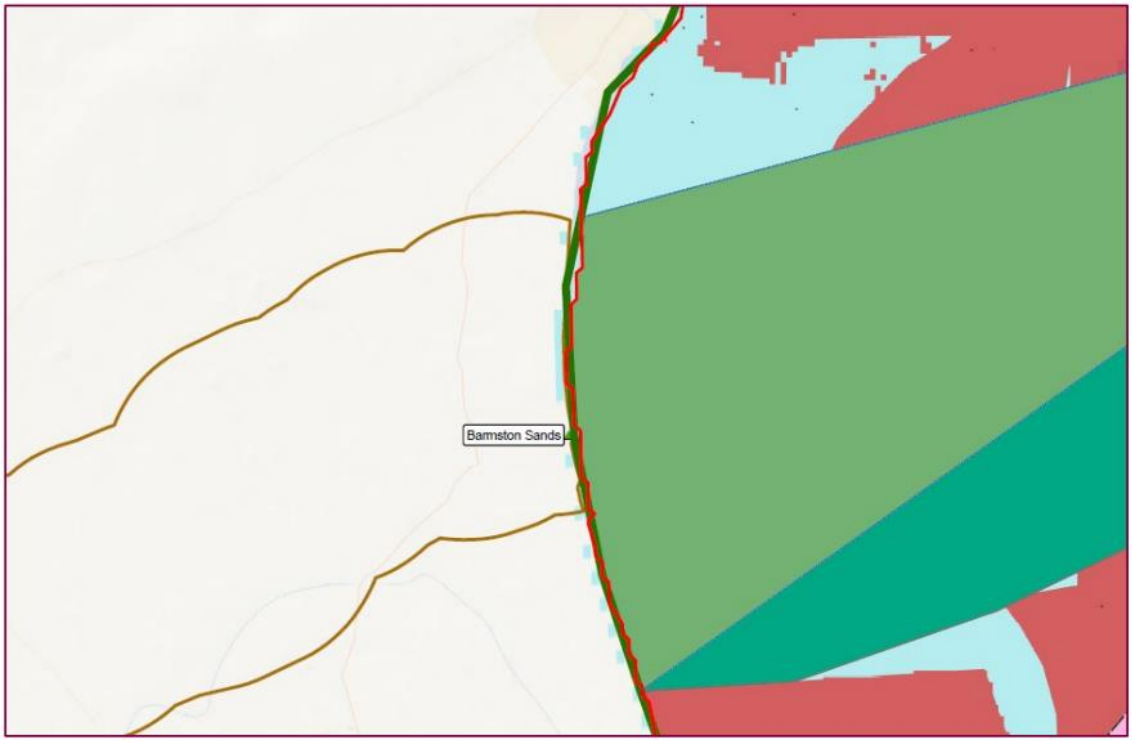

Figure 5-4: Drax to Barmston Sands Onshore routes and Landfall snapshot (RPS, 2019)

Cottam Landfall

A potential landfall location at Mappleton Sands was considered for onward connection to the grid at Cottam substation following an onshore route in excess of 80 km. The potential landfall identified was at one of the few areas below 15 m on the Holderness Coast as shown on Figure 5-5.

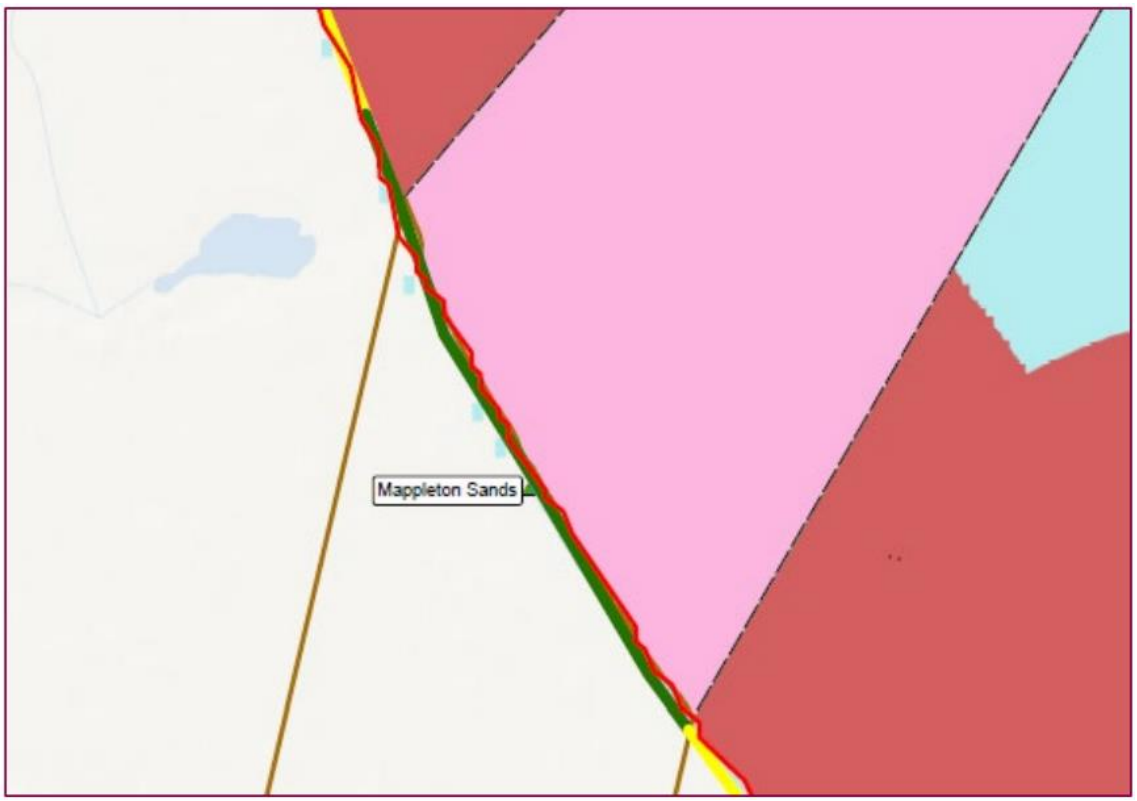

Figure 5-5: Cottam – Mappleton Sands Landfall snapshot

5.5 Technology

The Marine Scheme proposes the use of HVDC technology because it is more effective at transmitting high electricity capacity over longer distances with lower energy losses than an equivalent High Voltage Alternating Current (HVAC) system. Additionally, a HVDC technology system provides a greater degree of control over the magnitude and the direction of power flow, eliminating the requirement for synchronisation between the electricity systems at either end of the link. This will be converted to HVAC through the converter stations which form part of the Scottish Onshore Scheme and English Onshore Scheme.

5.5.1 Phase 1 Conclusion

The Phase 1 Strategic Options Report (RPS, 2019) provided a desktop study of the consenting and environmental constraints with the objective of presenting Strategic Options with feasible cable corridors in the onshore and offshore study areas and each of the requested connection options were provided with a high-level feasible route or routes with a landfall zone initially defined for each option.

5.6 Phase 2 - Marine Route Optioneering

Phase 2 involved the development of a Marine Route Refinement & Selection report, which was completed in March 2020 (RPS, 2020) to further develop the route options from the Phase 1 (RPS, 2019) scope of work. A route refinement exercise was undertaken, reducing the 2 km wide route corridor to a 1 km wide route corridor, to avoid or minimise the constraints for each sub-route option. In some cases, sub-routes were refined outside the original 2 km route corridor to avoid larger constrained areas. A review of the Phase 1 dataset was initially undertaken to identify datasets that could be updated with more contemporary datasets. Additional datasets that were not included at Phase 1 were also identified.

As part of the Phase 2 report, a more detailed analysis of the technical, socio-economic and environmental constraints analysis was undertaken to identify a preferred sub-route for each of the six strategic marine route options (see Figure 5-6). The study took into consideration several routeing and engineering principles which were defined as environmental and social constraints (presenting a risk to gaining consent), and technical constraints (presenting a physical obstruction to the development of the route). They were used during the refinement of each route, being scored on a scale of 0 to 5 (good to bad). The Phase 2 report concluded with a preferred sub-route recommendation for each of the six strategic marine route options. These were used to inform stakeholder engagement and formed the basis of the planned seabed survey of up to two of these routes, preferred sub-route options, which was further developed in Phase 3 (see Section 5.7 below).

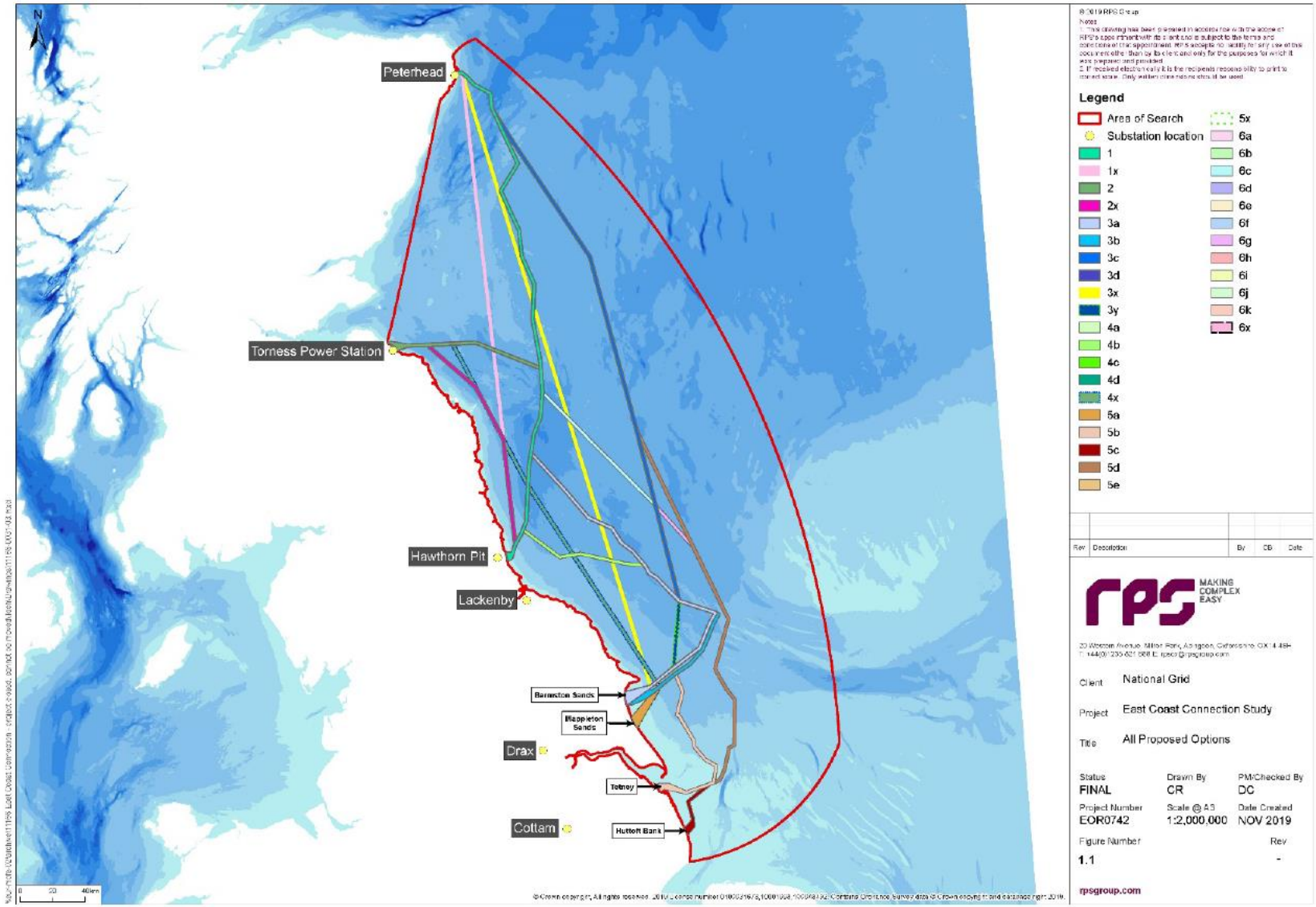

Figure 5-6: Map showing the six potential offshore routes (1-6) and their sub-route options. (Source: RPS, 2020)

5.6.1 Landfall study

The Phase 2 report (RPS, 2020) included an environmental and socio-economic, and technical constraints analysis and refinement of each landfall location zone identified at Phase 1 at the Mean High Water Spring mark as per the landfall route corridors identified as part of Phase 1 (see Figure 5-2 and Figure 5-3). The route corridors near to each landfall were extended out into a 'fan' shape from the 2 km route corridor to allow flexibility in identifying a suitable location.

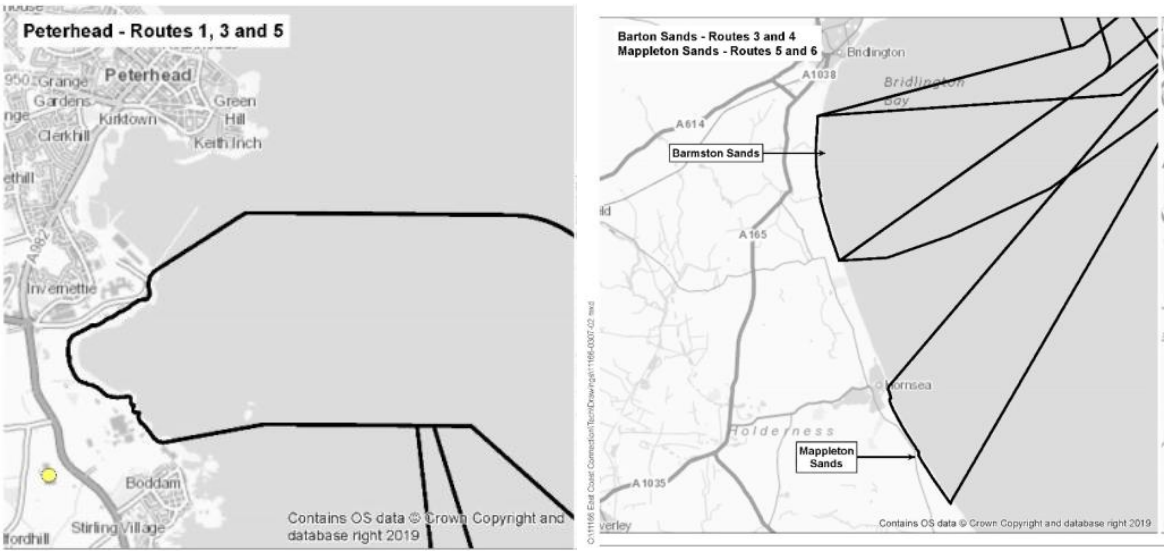

Figure 5-7: Landfall area of search for Peterhead and Drax connection points (Source: RPS, 2020)

5.6.2 Phase 2 Conclusion

Phase 2 concluded with a recommendation relating to each sub-route identified at Phase 1. As there were no clear factors to differentiate between the English landfall route options, further optioneering and appraisal work was undertaken at Phase 3 to determine a preferred landfall point (see Section 5.7).

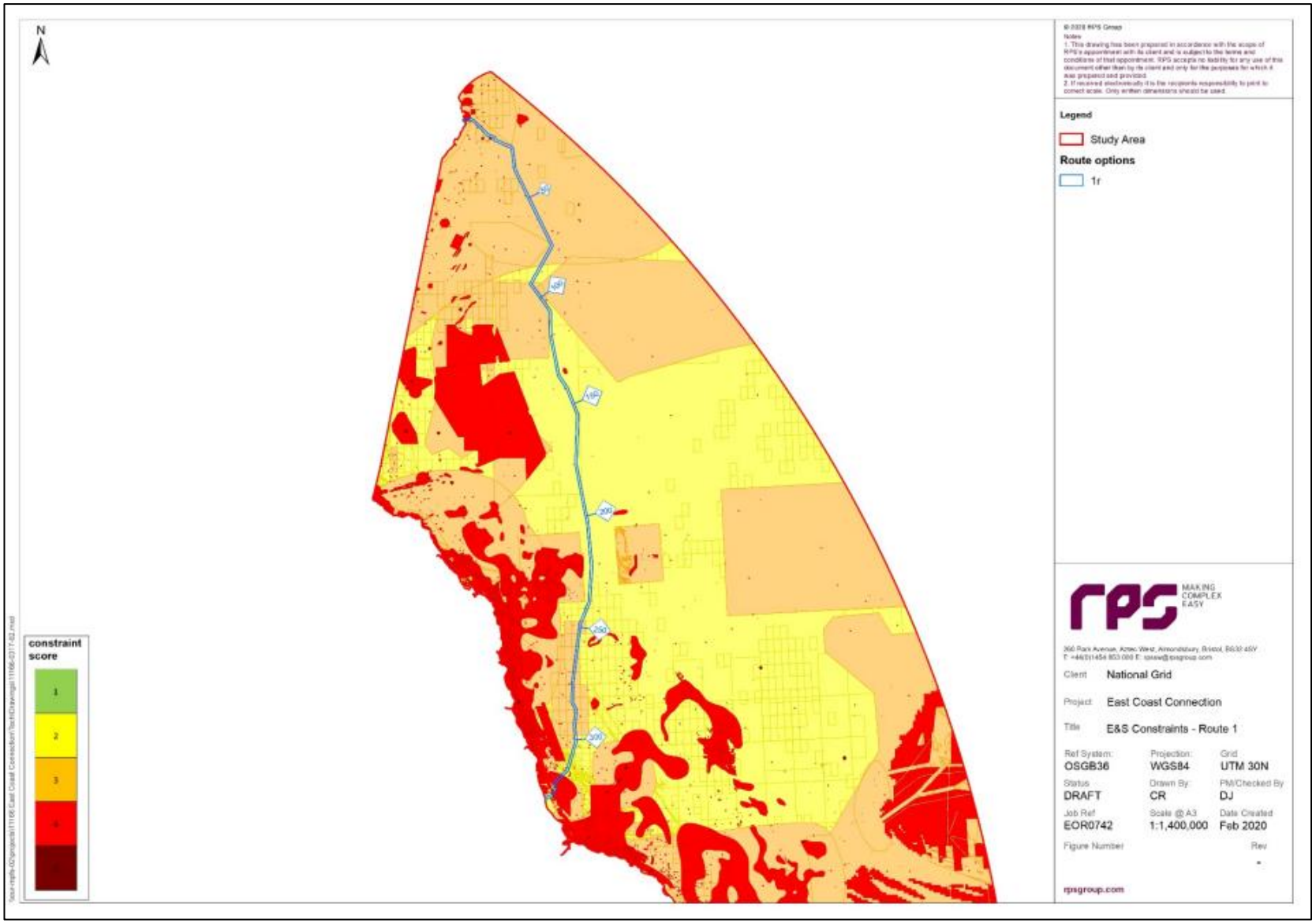

Figure 5-8: Proposed offshore landfall locations A, B, C, D and E with heat mapping of technical and E&S constraints (Source: RPS, 2020).

5.7 Phase 3 - Marine Survey Corridor Development and Selection

In the NOA 2020 report, released January 2020, Peterhead to Drax offshore HVDC and Peterhead to the South Humber offshore HVDC were given notice to proceed. As the former had an earliest in-service date (EISD) of 2029, whilst the latter a date of 2031, Eastern Scotland to England link: Peterhead to Drax offshore HVDC was prioritised and taken forward, noted as one of the 'Critical' options to proceed. Peterhead to Hawthorn Pit offshore HVDC was signalled to stop and Peterhead to Cottam offshore HVDC was signalled to not start (National Grid ESO, 2020).

The Eastern Link – Phase 3 Marine Survey Corridor Development and Selection report (RSK, 2020) looked in greater detail at the preferred Phase 2 routes for Peterhead to Drax and included consideration of available high-resolution bathymetry data, and where relevant, the results of the previous 2012 MMT marine survey (MMT, 2012).

Phase 3 sought to further develop proposed installation corridors to optimise routeing in accordance with the following high-level principles (DNV-GL, 2021):

- Minimise total cable length;
- Minimise interaction with environmentally sensitive areas[1];
- Seek to avoid areas of mobile sediments - where this is not possible, optimise routeing to minimise possible future cable exposure;
- Seek to avoid obstacles (e.g., boulder areas, rock outcrop / subcrop, pockmarks, plough marks, wrecks, paleo-landscapes, debris areas, potential free-span areas, potential unexploded ordnance (pUXO));
- Seek to avoid unstable/steep slopes;
- Cross in-service pipelines and cables as near to 90˚ as possible, but in any event not less 60˚ or more than 120˚ (unless crossing agreements state otherwise); and
- Minimise anchoring/navigation restrictions.

During Phase 3, meetings were held to provide marine stakeholders with an update of the route optioneering and corridor development (refer to Chapter 6: Consultation and Stakeholder Engagement for further information). The issues raised at these meetings were considered in the final appraisal of options.

5.7.1 Peterhead to Drax Marine Survey Corridor

This section summarises the main characteristics of the marine survey corridor defined in Phase 3 extending approximately 440 km from a Scottish landfall south of Peterhead (KP0) to the English landfall (KP440) at Bridlington.

5.7.1.1 Scottish Landfall (KP0)

The proposed Scottish landfall is located in Sandford Bay, approximately 2 km south of the centre of Peterhead. The landfall location allowed the possibility for both open cut trenching as well as the use of HDD (RSK, 2020), the use of HDD has been taken forward.

5.7.1.2 KP0 to KP440

The proposed route requires the crossing of two sewage outfalls within Sandford Bay. The route also interacts with the Peterhead power station cooling water outfall. It is known that thermal influence[2] of the outfall can sometimes extend across the proposed route as far as the opposite (north) shore of the

[1] *A constraint which presents an obstruction to gaining consent for the development of the route, such as the route crossing through an area which is designated for benthic features, areas of high fishing activity or areas of high fish spawning activity. These constraint types are typically legal, social or environmental barriers to development (RPS, 2020)*
[2] Peterhead Power Station utilises seawater to assist with cooling. Seawater with an elevated temperature is discharged via the identified outfall into Sandford Bay.

bay (RSK, 2020). This interaction has been appraised to ensure that there are no adverse thermal impacts on the proposed cable.

The first 80 km of the route crosses both large isolated sandwaves (up to 12 m high) and sandwave fields. For most of the rest of the route (from KP80 to KP200) varied thicknesses of sands and gravels overlie predominantly glaciomarine sands and clays (RSK, 2020).

One of the greatest challenges to the constructability of this route is the presence or otherwise of boulder fields. The route has been designed to minimise crossing such areas of obvious subcropping/outcropping rock. However, the detailed bathymetry around the Scottish landfall, as well as extensively between KP250 and KP420, clearly indicates these features (RSK, 2020).

The proposed route has been designed to minimise interactions with spoil grounds, offshore aggregate areas, wrecks, harbour limits, military training areas and key fishing grounds where possible. The proposed route intersects two Scottish Draft Plan Development Zones (E3 between KP68.7 and KP77.3 and E1 between KP88.3 and KP96.9), a military practice and exercise area (D513/D513B) between KP202.7 and KP293 (KP214.2 to KP263.8) and passes through the Flamborough submarine exercise area between KP360 and KP403. A total of 17 crossings with existing and planned infrastructure were identified at the time of writing (a total of 24 assets have since been identified as crossing the Marine Installation Corridor, refer to Chapter 2: Project Description). The majority of the route is relatively lightly fished, with the exception of the first 70 km (KP0 to KP70) and the last 50 km (KP390 to KP440) (RSK, 2020).

The cable route crosses the Buchan Ness to Collieston Coast Scottish Special Protection Area (SPA) between KP0 and KP0.8 but avoids any other marine designated areas. At the time of writing, the Phase 3 report (RSK, 2020) identified a possible environmental interaction with the South Smithic Bank within Bridlington Bay, which is a potential Annex 1 sandbank as identified by the Joint Nature Conservation Committee (JNCC), but it is currently not designated. There is another possible interaction with South Trench, a proposed (and now designated) MPA located close to the Peterhead landfall (RSK, 2020).

5.7.1.3 English Landfall (KP440)

As outlined in Section 5.7 the Peterhead to Drax offshore HVDC was prioritised and taken forward and is noted as one of the ‘Critical’ options (National Grid ESO, 2020). A landfall zone was defined at Phase 1 (refer to Section 5.4.2.2) and whilst the cable landing could be undertaken using open cut trenching techniques it was advised that consideration should be given to the use of a HDD landing, with the entry of the HDD located well inland of the current coastline (RSK, 2020). The Holderness coastline is one of the most rapidly eroding in Europe with coastline retreat rates of up to 6 m/year with a predicted retreat of 80 m in the medium term (20 to 50 years).

The Phase 3 report (RSK, 2020) concluded with a proposed marine survey corridor between the Peterhead and Drax landfalls as shown on Figure 5-9.

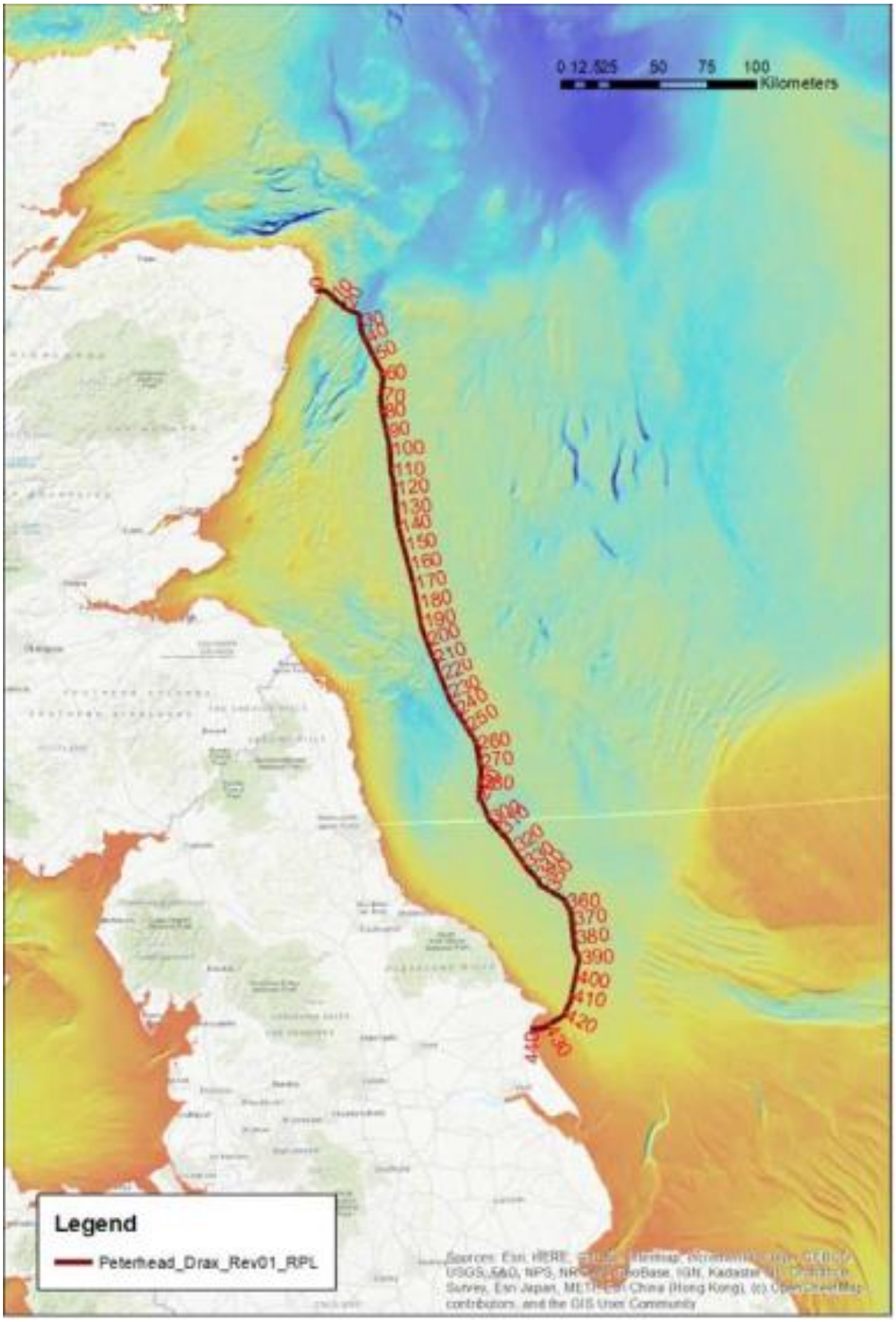

Figure 5-9: Peterhead to Drax route overview (RSK, 2020) Phase 3 Conclusion.

5.8 Eastern Link 2 – English Onshore Scheme Routeing and Siting Report (AECOM, 2021)

The Eastern Link 2 – English Onshore Scheme Routeing and Siting Report (AECOM, 2021)) was produced during the SOA Phase for the marine route. Part of the purpose of this report was to consider the suitability of the coastline within the landfall zones established in SOR Phase 1 (RPS, 2019) to accommodate a landfall site. This holistic study considered physical space requirements for construction of the landfall in line with a wide range of environmental factors within both the terrestrial and marine (nearshore) environments and produced six landfall options (LF01 – LF06) (Figure 5-10).

The landfall is where the submarine cables connect to onshore cables at a buried transition joint pit (TJP). As shown in Figure 5-10, six potential landfall sites between Bridlington to Hornsea were identified and assessed. The assessment considered a range of environmental and engineering constraints including proximity to settlements, scattered military remains, landfall accessibility, coastal erosion rates, designated sites including Flamborough Head Special Area of Conservation (SAC) and Holderness Marine Conservation Zone (MCZ), as well as other infrastructure such as offshore wind farm export cables which come ashore in the area.

Based on an initial review, landfalls LF05 south of Barmston Sands and LF06 at Skipsea were discounted. While both are technically feasible, they would have greater potential for environmental effects due to crossing the Holderness Inshore MCZ and/or the Greater Wash Special Protection Area (SPA). A more detailed appraisal was undertaken of the remaining four landfalls: LF01 and LF02 located north and south of Fraisthorpe respectively and LF03 and LF04 located to the north of Barmston.

A key differentiating factor between the four landfall locations is the potential interaction with the proposed Hornsea 4 Offshore Wind Farm export cable route. The avoidance of this cable route, either in the marine or terrestrial environment, is preferrable in order to ensure that there are no additional engineering requirements, such as rock protection in shallow waters to protect the subsea cables, as this increases the potential for adverse environmental impacts. Both LF03 and LF04 would need to cross the export cables associated with the Hornsea 4 Offshore Wind Farm as well as potentially interact with the Dogger Bank Offshore Wind Farm export cables (which make landfall just south of Barmston). Due to a combination of the potential environmental effects and engineering constraints, landfalls LF03 and LF04 were discounted. While LF01 and LF02 are both located to the north of Hornsea 4, LF02 is in much closer proximity. This reduced separation makes it less preferable due to potential environmental effects and engineering constraints.

Because it avoids the requirement to cross the proposed Hornsea 4 export cables (offshore and onshore) and avoids environmental designations and settlements, LF01 to the north of Fraisthorpe was identified as the preferred landfall site. It is located on open agricultural land, outside of areas at risk of coastal erosion with good access from the A165 and provides a technically feasible landfall with fewer engineering challenges.

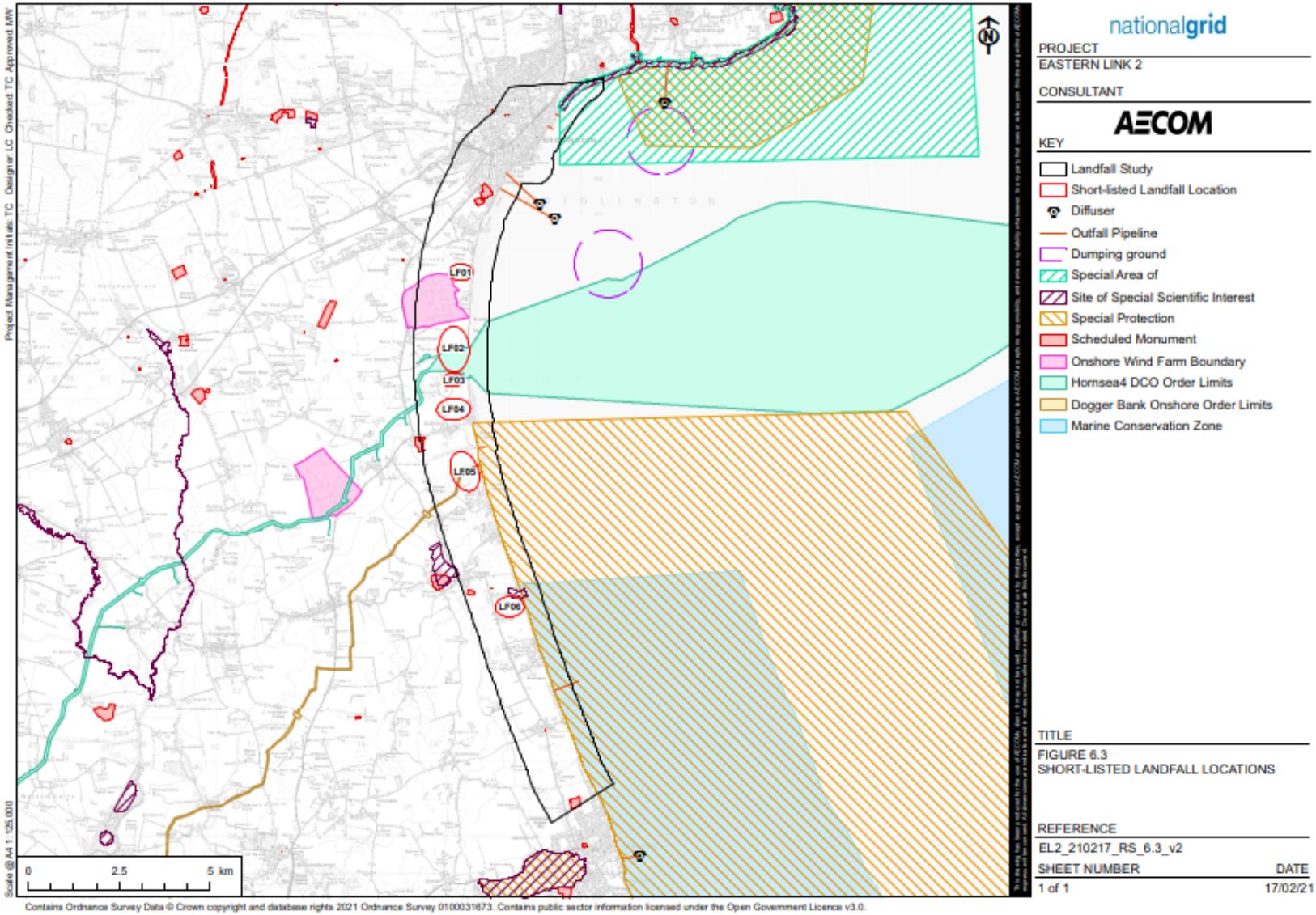

Figure 5-10: Potential landfall areas within the landfall study area (AECOM, 2021)

5.9 Design based route development

Further route development was completed by 4C Offshore Ltd between 2020-2021 alongside the strategic options phases 1-3. The further route developments and justification for changes are presented in Table 5-2.

Table 5-2: Route developments post Strategic Options Phases 1-3

KP	Change and justification
KP1.3 to KP2.9	A change was made in the nearshore section of the Marine Installation Corridor to avoid rock outcrops found in 2012 MMT survey.
KP12.2 to KP69	The cancellation of the Site 3 East Aberdeen Development zone allowed the Marine Installation Corridor to revert to the original route from 2012, which allowed for more certainty in ground conditions, a shorter cable route and minimises sandwave field interaction around KP50.
KP12.1 to KP28.9	The Marine Installation Corridor was re-routed to avoid large sandwaves identified in the 2012 MMT survey.
KP46.8 to KP52.8	
KP56.8 to KP61.1	
KP109 to KP134.7	Route moved back to original 2012 route alignment to optimise use of data and maximise trenchable sediments.
KP418 to KP436	There was a change in the English landfall location (from LF02 to LF01), moving it further north to deconflict from Hornsea Four Offshore Wind Farm project.
KP431 to KP436	Minor change in English landfall location from Wilsthorpe Beach landing to Fraisthorpe Sands landing circa 200 m southeast.

5.10 Consultation and Stakeholder Engagement

Following on from the engagement discussed in Section 5.6 the preferred option was further developed and was the subject of public consultation on the proposed option. Marine based stakeholders including the Maritime and Coastguard Agency, The Crown Estate and Crown Estate Scotland, Trinity House, Inshore Fisheries and Conservation Authorities , Inshore Fisheries Groups and National Federation of Fishermen's Organisations and Scottish Fishermen's Federation were consulted on the preferred marine cable route and landfalls.

For further information on consultation and engagement, refer to Chapter 6: Consultation and Stakeholder Engagement.

5.11 Summary

In identifying the Marine Scheme, the TOs have considered a range of alternatives at both a strategic and project-specific level, including alternative landfalls and cable route corridors. In appraising these alternatives, the TOs have undertaken a series of specialist studies considering technical, environmental and economic factors as well as undertaken consultation with statutory and non-statutory consultees, stakeholder organisations, landowners and members of the public.

The results of these specialist studies and feedback received from consultation have informed decision making. Through consideration of alternatives, the TOs have established a preferred Marine Scheme which is considered to best balance technical, environmental and economic factors with feedback received from consultation. The Project team has revisited the work undertaken to date following the Project refinement and considers that each of the decisions remains valid in light of the final Project.

The preferred Marine Scheme consequently comprises a 'start' point at a landfall site at Peterhead and an 'end' point at a landfall at Bridlington with approximately 436 km of subsea HVDC cable, comprising 150 km in Scottish waters and 286 km in English waters, between the two landfalls. The full description of the Marine Scheme is detailed in Chapter 2: Project Description. This proposed development meets the primary objective which is to reinforce the electricity network and increase transmission network capability between Scotland and northern England by 2029 in order to enable the efficient and economic transmission of electricity.

5.12 References

AECOM. (2021). *Eastern Link 2 - English Onshore Scheme Roueting & Siting Report.*

DNV-GL. (2021). *Recommended Practice for Subsea power cables in shallow water.* DNVGL-RP-0360. March 2016.

MMT. (2012). *Integrated Geophysical and Geotechnical Report, Anglo-Scottish Eastern HVDC Link, Marine Survey, Peterhead-Seaham, June – July 2012.* pREPARED FOR National Grid and SSE. Document No:100995-N2S-MMT-SUR-REP-SURVEY01. Final Report March 2013.

National Grid ESO. (2020). *Network Options Assessment.*

RPS. (2019). *East Coast Connection Strategic Options Appraisal.* Report prepared for National Grid, Scottish Power and Scottish Hydro Electric Transmission by RPS Group. May 2019.. EOR0741, Rev 02.

RPS. (2020). *EASTERN LINK - PHASE 2 MARINE ROUTE REFINEMENT & SELECTION. Route Selection Report.* Report prepared for National Grid, Scottish Power and Scottish Hydro Electric Transmission by RPS Group. EOR0752. March 2020.

RSK. (2013). *Peterhead Converter Station Environmental Appraisal.*

RSK. (2020). *Eastern Link – Phase 3 Marine Survey Corridor Development and Selection.* Report prepared for National Grid, Scottish Power and Scottish Hydro Electric Transmission. Rev 03. May 2020.