RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

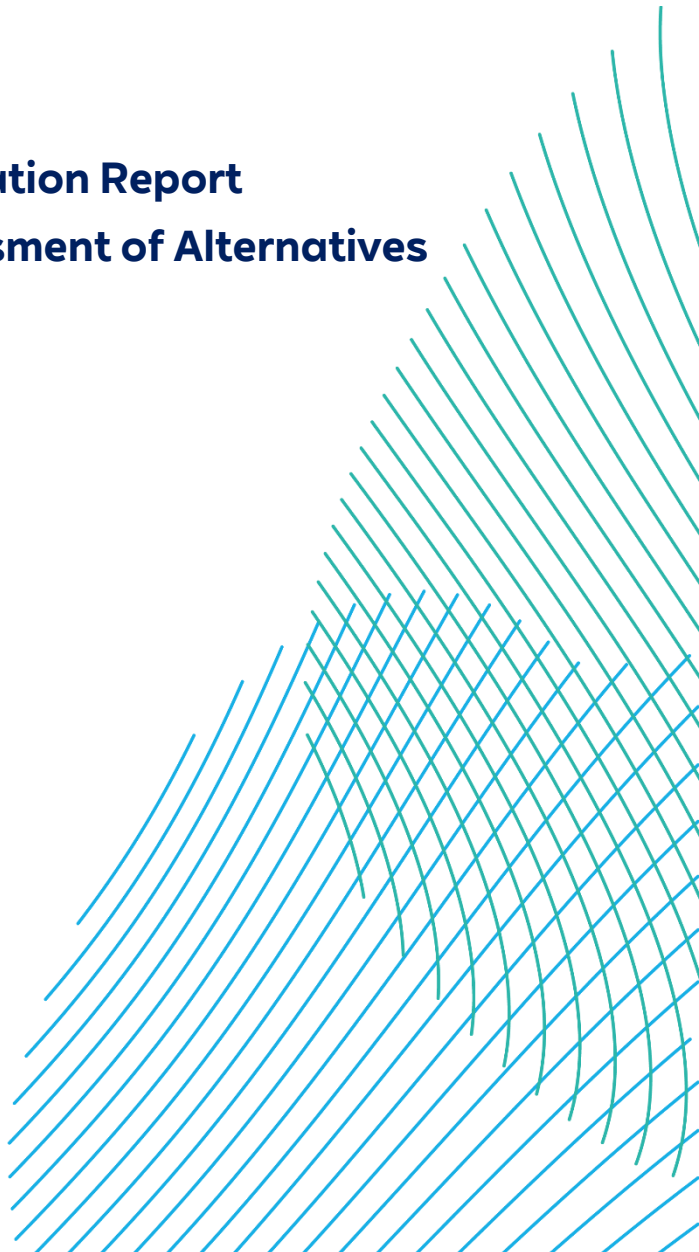
Preliminary Environmental Information Report

Chapter 4 – Site Selection & Assessment of Alternatives

27/04/2023

Document Reference: 004300111

Revision: 04



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Company:	**RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited**	Asset:	**Development**
Project:	**Dogger Bank South Offshore Wind Farms**	Sub Project/Package:	**Consents**
Document Title or Description:	Preliminary Environmental Information Report – Chapter 4 – Site Selection and Assessment of Alternatives		
Document Number:	004300111-04	Contractor Reference Number:	PC2340-RHD-XX-ZZ-RP-Z-0044

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Rev No.	Date	Status/Reason for Issue	Author	Checked by	Approved by
01	20/02/2023	First Issue	JF	PP	AP
02	14/03/2023	Second Issue	SS	JF	RH
03	29/03/2023	Third Issue	JF	HC	HC
04	27/04/2023	Fourth Issue	JF	HC	DB

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Glossary

Term	Definition
Accommodation Platform	An offshore platform (situated within either the DBS East or DBS West array area) that will provide accommodation and mess facilities for staff when carrying out maintenance activities for the Projects.
Array Areas	The DBS East and DBS West offshore array areas, where the wind turbines and array cables will be located. The array areas do not include the offshore export cable corridor.
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.
Electrical Switching Platform (ESP)	The electrical switching platform (if required) will provide a link to a co-ordinated east coast transmission system which is planned to run from Scotland to England, as per National Grid ESO's Holistic Design Network. This platform may be located either within one of the array areas (alongside a converter station) or mid-way along the export cable corridor (likely next to the Reactive Compensation Platform if required).
Haul road	The track used by traffic to access different sections of the onshore export cable corridor for construction.
Horizontal Directional Drilling (HDD)	HDD is a trenchless technique to bring the offshore cables ashore at the landfall and can be used for crossing other obstacles such as roads, railways and watercourses onshore.
Jointing Bays	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The point on the coastline at which the offshore export cables are brought onshore, connecting to the onshore export cables at the Transition Joint Bay.

Term	Definition
Offshore Converter Platforms (OCPs)	Offshore Converter Platforms (OCPs) will be required for the HVDC option. The OCPs are fixed structures located within the array area that collect the AC power generated by the wind turbines and convert the power to DC, before transmission through the offshore export cables to the Project's onshore grid connection points.
Offshore Development Area	The Offshore Development Area encompasses the wind farm site and the options for the offshore transmission works.
Offshore Export Cable Corridor	This is the area which will contain the offshore export cables (and potentially the ESP and / or RCP) between the offshore substation/converter platforms and Transition Joint Bays at the landfall.
Offshore Substation Platforms (OSPs)	Offshore Substation Platforms (OSPs) will be required for the HVAC option. These are fixed structures located within the array areas that contain electrical equipment to aggregate the power from the wind turbines, followed by conversion into a more suitable voltage for transmission through the offshore export cables to the Project's onshore grid connection points.
Onshore Development Area	The Onshore Development Area for PEIR is the boundary within which all onshore infrastructure required for the Projects will be located including landfall, onshore export cable route, accesses, construction compounds and onshore substations. The Onshore Development Area is to be refined through the consultation and engineering review process.
Onshore Export Cable Corridor	This is the area which includes cable trenches, haul roads, spoil storage areas, and limits of deviation for micro-siting. For assessment purposes, the cable corridor does not include the onshore substations, Transition Joint Bays or temporary access routes; but includes construction compounds (purely for the cable route).
Onshore Export Cables	Onshore export cables take the electricity from the Transition Joint Bay to the onshore substations.

Term	Definition
Onshore Substations	A compound containing electrical equipment required to transform and stabilise electricity generated by the Projects so that it can be connected to the electricity transmission network. There will be one onshore substation for each Project.
Reactive Compensation Platform (RCP)	A Reactive Compensation Platform (RCP) will be required for a HVAC solution. The RCP will host the shunt reactors required to provide reactive compensation, in order to limit the electrical losses which occur with HVAC transmission over long distances.
Onshore Substation Zone	Parcels of land within the Onshore Development Area where the onshore substation infrastructure (including the haul roads, temporary construction compounds and associated cable routeing) may be located.
Temporary Construction Compound	An area set aside to facilitate construction of the Projects. These will be located adjacent to the onshore export corridor and within the Onshore Substations Zones, with access to the highway.
The Applicant	RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited as the owners of DBS West and DBS East respectively are the named undertakers that will have the benefit of the Development Consent Order. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited.
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South offshore wind farms).
Transition Joint Bay (TJB)	The Transition Joint Bay (TJB) is an underground structure at the landfall that houses the joints between the offshore export cables and the onshore export cables.

Acronyms

Term	Definition
AfL	Agreement for Lease
AoS	Area of Search
BEIS	Department of Business, Energy and Industrial Strategy
BRAG	Black-Red-Amber-Green
CION	Connection and Infrastructure Options Note
DBS	Dogger Bank South
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ESO	Electricity Systems Operator
ESP	Electrical Switching Platform
ETG	Expert Topic Group
HDD	Horizontal Directional Drill
HND	Holistic Network Design
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IEMA	Institute of Environmental Management and Assessment
IPC	Infrastructure Planning Commission
MCZ	Marine Conservation Zone
MLWS	Mean Low Water Springs
NETS	National Electricity Transmission System

Term	Definition
NPPF	National Policy Planning Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
OCP	Offshore Converter Platform
OS	Ordinance Survey
OSP	Offshore Substation Platform
OTNR	Offshore Transmission Network Review
PEIR	Preliminary Environmental Information Report
RCP	Reactive Compensation Platform
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TJB	Transition Joint Bay
UK	United Kingdom
UXO	Unexploded Ordinance

4. Site Selection & Assessment of Alternatives

4.1. Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) provides a description of the site selection and alternatives assessment process and the approach taken by the Applicant to refine the design of Dogger Bank South (DBS) East and DBS West offshore wind farms (the Projects). The process includes consideration of both the offshore and onshore infrastructure, and the assessment of reasonable alternatives as the proposals for the Projects have developed through the pre-application process to date.

2. This chapter outlines the staged approach to defining the spatial boundaries and constituent parts of the Projects. It also explains and details the main alternatives considered for the Projects, including location and infrastructure options, in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations); the Marine Works (Environmental Impact Assessment) Regulations 2007; the Conservation of Habitats and Species Regulations 2017 (the Habitat Regulations); and the Offshore Marine Habitats and Species Regulations 2017 (the Offshore Habitat Regulations).

4.2. Key Components of Dogger Bank South

3. The Projects will comprise the following main offshore components:

- Wind turbines;
- Offshore substation platform/s (OSP) and/or offshore converter platform/s (OCP) ;
- Other offshore platforms such as Reactive Compensation Platform (RCP), Electrical Switching Platform (ESP), and Accommodation Platform;
- Foundation structures for wind turbines and offshore platforms;
- Array cables;
- Inter-platform cables; and
- Export cables from the wind farm sites to the landfall.

4. The main onshore components of the Projects will include:

- Landfall and associated transition joint bays;
- Onshore export cables installed underground from the transition joint bays (TJBs) to the onshore substation and associated joint bays and link boxes;
- Onshore substations and onward 400 kilovolt (kV) connection to the newly constructed National Grid substation to the south of Beverley near to Creyke Beck;
- Trenchless crossing zones (e.g. Horizontal Directional Drilling (HDD));
- Construction and operational accesses; and
- Construction compounds.

5. Further details of the key components of the offshore and onshore infrastructure can be found in **Chapter 5 Project Description**.

4.3. Legislation, Policy and Guidance

6. Site selection for offshore wind farms in the UK is governed by the existing legislative, policy and guidance framework for the development of electrical infrastructure and for environmental assessment in the UK (see **Chapter 3 Policy and Legislative Context** for further detail). The key pieces of legislation, policy and guidance which set the framework for site selection and the assessment of alternatives for offshore wind farms in the UK, which informed this methodology, are summarised in **Table 4-1.**

7. The Planning Act 2008 makes provision for National Policy Statements (NPSs). NPSs are designed to set the policy framework for determination of nationally significant infrastructure project (NSIP) applications. The three which are relevant to the Projects are:

   - The Overarching NPS for Energy (NPS EN-1) (DECC, 2011a);
   - The NPS for Renewable Energy Infrastructure (NPS EN-3) (DECC, 2011b), which covers nationally significant renewable energy infrastructure (including offshore generating stations in excess of 100 MW); and
   - The NPS for Electricity Networks Infrastructure (NPS EN-5) (DECC, 2011c), which covers the electrical infrastructure associated with an NSIP.

8. It is noted that all of these NPSs are in the process of being revised. A draft version of each NPS was published for consultation in September 2021 (Department for Business Energy and Industrial Strategy (BEIS), (2021a), BEIS, (2021b) and BEIS (2021c), respectively). The updates contained in these drafts have been considered throughout the site selection process.

9. Following the consultation in 2021 on the draft energy NPS, a new consultation opened on the 30 March 2023 on revised drafts of the energy NPSs, including EN1, EN3 and EN5. Due to the timing of this consultation, and finalisation of this PEIR we have been unable to review and take these revised draft NPS into account within these documents. However, these will be reviewed and incorporated into the final ES where relevant.

Table 4-1 Legislation, Policy and Guidance Considered During the Site Selection and Assessment of Alternatives Process

Legislation, Policy or Guidance	Details
Legislation	
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017	The consideration of alternatives and major design decisions made during the development of a project has been part of Environmental Impact Assessment (EIA) Legislation since the adoption of the original EIA directive in UK law under the European Union (EU) EIA Directive 85/337/EEC (as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC). The original Infrastructure Planning (Environmental Impact Assessment) Regulations (2009) required the applicant to provide "*an outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for his choice, taking into account the environmental effects*". The new EIA Regulations (2017) update the wording slightly but do not significantly change the position. The 2017 Regulations, at Schedule 4, paragraph 2, require an ES to include "*a description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects*".
The Electricity Act 1989	Schedule 9 of The Electricity Act 1989 sets out the obligations for a generation installation to mitigate the effects on the environment, including "*shall have regard to…preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest*".

Legislation, Policy or Guidance	Details
The Planning Act 2008	The Planning Act 2008 is the primary legislation that established the legal framework for applying for, examining and determining applications for NSIPs taking into account the guidance in NPSs.
National Policy	
Overarching NPS for Energy (EN-1) (2011)	The Overarching NPS for Energy (EN-1): • is clear that although "*from a policy perspective this NPS EN-1 does not contain any general requirement to consider alternatives or to establish whether the proposed project represents the best option*" (paragraph 4.4.1); • in the execution of a competent EIA "*applicants are obliged to include in their ES, as a matter of fact, information about the main alternatives they have studied*" (paragraph 4.4.2); • "*in some circumstances there are specific legislative requirements, notably under the Habitats Directive, for the IPC to consider alternatives. These should also be identified in the ES by the applicant*" (paragraph 4.4.2); and • "*in some circumstances, the relevant energy NPSs may impose a policy requirement to consider alternatives (as this NPS does in Sections 5.3 - Biodiversity and Geological Conservation, 5.7 - Flood Risk and 5.9 - Landscape and visual impacts)*" (paragraph 4.4.2).
Draft Overarching NPS for Energy (EN-1) (2021) [currently under consultation]	The text quoted from the current Overarching NPS for Energy (EN-1) above remains unchanged within the Draft Overarching NPS for Energy (EN-1). Despite that, the following provision has been added to the set of guiding principles upon which the Secretary of State applies weight to alternatives: "*Only alternatives that can meet the objectives of the proposed development need be considered*" (paragraph 4.2.13).

Legislation, Policy or Guidance	Details
NPS for Renewable Energy Infrastructure (EN-3) (2011)	The NPS for Renewable Energy Infrastructure (EN-3), which relates to renewable energy generation infrastructure (transmission infrastructure is covered by EN-1 and EN-5) states that, in relation to consideration of alternatives, the "*specific criteria considered by applicants and the weight they give to them will vary from project to project. The choices which energy companies make in selecting sites reflect their assessment of the risk that the [Infrastructure Planning Committee] IPC* [now the Secretary of State], *...will not grant consent in any given case. But it is for energy companies to decide what applications to bring forward and the Government does not seek to direct applicants to particular sites for renewable energy infrastructure*" (paragraph 2.1.3). NPS EN-3 outlines that for offshore wind farm sites, the IPC (now the Secretary of State) should be satisfied that the site selection process has been undertaken in a way that reasonably minimises adverse effects on a variety of environmental parameters.
Draft NPS for Renewable Energy Infrastructure (EN-3) (2021) [currently under consultation]	There have been no material changes in provisions set out within the Draft NPS for Renewable Energy Infrastructure (EN-3) from the currently adopted NPS for Renewable Energy Infrastructure (EN-3). The text quoted from the current NPS EN-3 above remains unchanged within the updated draft.
NPS Electricity Networks Infrastructure (EN-5) (2011)	The NPS for Electricity Networks Infrastructure (EN-5) states that, in relation to consideration of alternatives, "*the choices which energy companies make in selecting sites reflect their assessment of the risk that the IPC* [now the Secretary of State], *following the principles set out in paragraph 4.1.1 of EN-1, will not grant consent in any given case*" (paragraph 2.2.1).

Legislation, Policy or Guidance	Details
Draft NPS Electricity Networks Infrastructure (EN-5) (2021) [currently under consultation]	Section 2.2 of the Draft NPS Electricity Networks Infrastructure (EN-5) has been rewritten. Draft EN-5 highlights the constraints on site selection imposed by "*i) the location of new generating stations or other infrastructure requiring connection to the network, and/or ii) system capacity and resilience requirements determined by the Electricity System Operator*" (paragraph 2.2.1), together with the Government's legally-binding Net Zero commitment and directs the Secretary of State to consider these in the decision-making process. Whilst the revised NPS EN-5 directs that "*Applicants retain substantial control over routing and site selection within the identified macro-level location or development zone*", this does not "*exempt Applicants from their duty to consider and balance the site-selection considerations [place in the local landscape, including characteristics such as local topography and/or the possibilities for screening of infrastructure], much less the policies on good design and impact mitigation detailed in Sections 2.7-2.14*" (paragraph 2.2.2).
Planning Inspectorate Advice Note Seven: EIA	The Planning Inspectorate Advice Note Seven suggests the EIA needs to explain "*the reasonable alternatives considered and the reasons for the chosen option taking into account the effects of the Proposed Development on the environment*" (paragraph 9.3).
Planning Inspectorate Advice Note Nine: Rochdale Envelope	The Rochdale envelope enables and facilitates a degree of flexibility within the project design at consent. Planning Inspectorate Advice Note Nine: Rochdale Envelope states "*The need for flexibility is identified in a number of National Policy Statements (NPS) which suggest the Rochdale Envelope as an approach to address uncertainties inherent to the Proposed Development e.g. changing market conditions. However, Energy (EN-1), the NPS for Renewable Energy Infrastructure (EN-3) and the NPS for National Networks all stress the need to ensure that the significant effects of a Proposed Development have been properly assessed*" (paragraph 1.3).

Legislation, Policy or Guidance	Details
BEIS Energy White Paper	The BEIS Energy White Paper sets out how the UK will clean up its energy system and reach net zero emissions by 2050, reiterating the UK Government target of achieving 50GW of offshore wind by 2030, of which the Projects could make a significant contribution (see **Chapter 3 Need for the Project**). Seeking the appropriate balance between environmental, social and economic costs is a key component of the white paper.
Marine Policy Statement	The Marine Policy Statement adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans, establishing how decisions affecting the marine area should be made in order to enable sustainable development.
East Inshore, East Offshore, North East Inshore and North East Offshore Marine Plans	The approach taken to offshore wind renewable energy infrastructure and subsea cabling outlined in the plans and associated policies. With specific reference to subsea cabling, engagement has been undertaken to understand potential impacts on navigation lanes and deep water channels, with the offshore export cable corridor subsequently adapted to minimise impact.
The Crown Estate's Cable Route Protocol	The Cable Route Protocol comprises a set of principles and requirements for offshore wind developers in the planning of offshore export cable routes. Compliance with these principles and requirements is secured within the offshore array Agreement for Lease (AfL). Compliance with these requirements must be demonstrated within the Corridor Identification and Approval for Linear Activities document which will accompany an application to The Crown Estate for a transmission assets AfL.
National Planning Policy Framework (NPPF)	The NPPF does not contain specific policies for NSIPs (for which particular considerations apply, determined in accordance with the decision-making framework set out in the Planning Act 2008 and relevant NPSs) but may be considered as a relevant and important matter.

Legislation, Policy or Guidance	Details
Guidance	
The Horlock Rules	In order to identify the most appropriate location to site the onshore substation, National Grid Electricity Transmission's Guidelines on Substation Siting and Design ('The Horlock Rules') (National Grid Company (NGC), 2006) are considered. These guidelines document National Grid Electricity Tranmission's best practice for the consideration of relevant constraints associated with the siting of onshore substations.
The Holford Rules	National Grid Electricity Transmission employs the rules on overhead line routeing. Since the formulation of the Holford rules, formal requirements for environmental assessment have been introduced. Whilst environmental assessment for overhead lines addresses wider topics than the visual amenity issue on which the Rules concentrate, they remain a valuable tool in the selecting and assessing potential route options as part of the environmental assessment process. While there will be no overhead lines in the Projects' design envelope, the Holford Rules provide the context for the National Grid connection point. They also inform the Project decision to select buried rather than overhead cables.
The Pathway to 2030 Holistic Network Design	The Holistic Network Design (HND) sets out National Grid ESO's plan to connect 23GW of planned offshore wind to the grid. The HND dictates where and how the Projects will connected to the grid.

Legislation, Policy or Guidance	Details
EIA Guide to Shaping Quality Development (Institute of Environmental Management and Assessment (IEMA))	IEMA's EIA Guide to Shaping Quality Development (2015) states that considering the key environmental and consenting risks alongside the engineering requirements of a project can influence design in many ways. The earlier the interaction commences, the more likely it is that cost effective, positive outcomes will be achievable. This can be considered in several ways: • The review of site selection of alternative development sites to avoid key sensitive receptors; • Alternating the layout to work within a site's existing natural systems; • Amending the design of a specific aspect of the development to manage impacts; • Specifying construction techniques to avoid effects on receptors; and • Changing materials to reduce volume and/or transport impacts.

4.4. Site Selection Process

10. The siting, design and refinement of the Projects offshore and onshore infrastructure has followed a site selection process, taking account of environmental, physical, technical, commercial and social considerations and opportunities, as well as engineering requirements. The details of the approach taken to select the array areas; offshore export cable corridor; possible landfall locations; onshore export cable corridor and the location of the onshore substations are provided in sections 4.7 to 4.13. The aim was to identify locations that would be environmentally acceptable, deliverable and consentable, whilst also being economic and efficient.

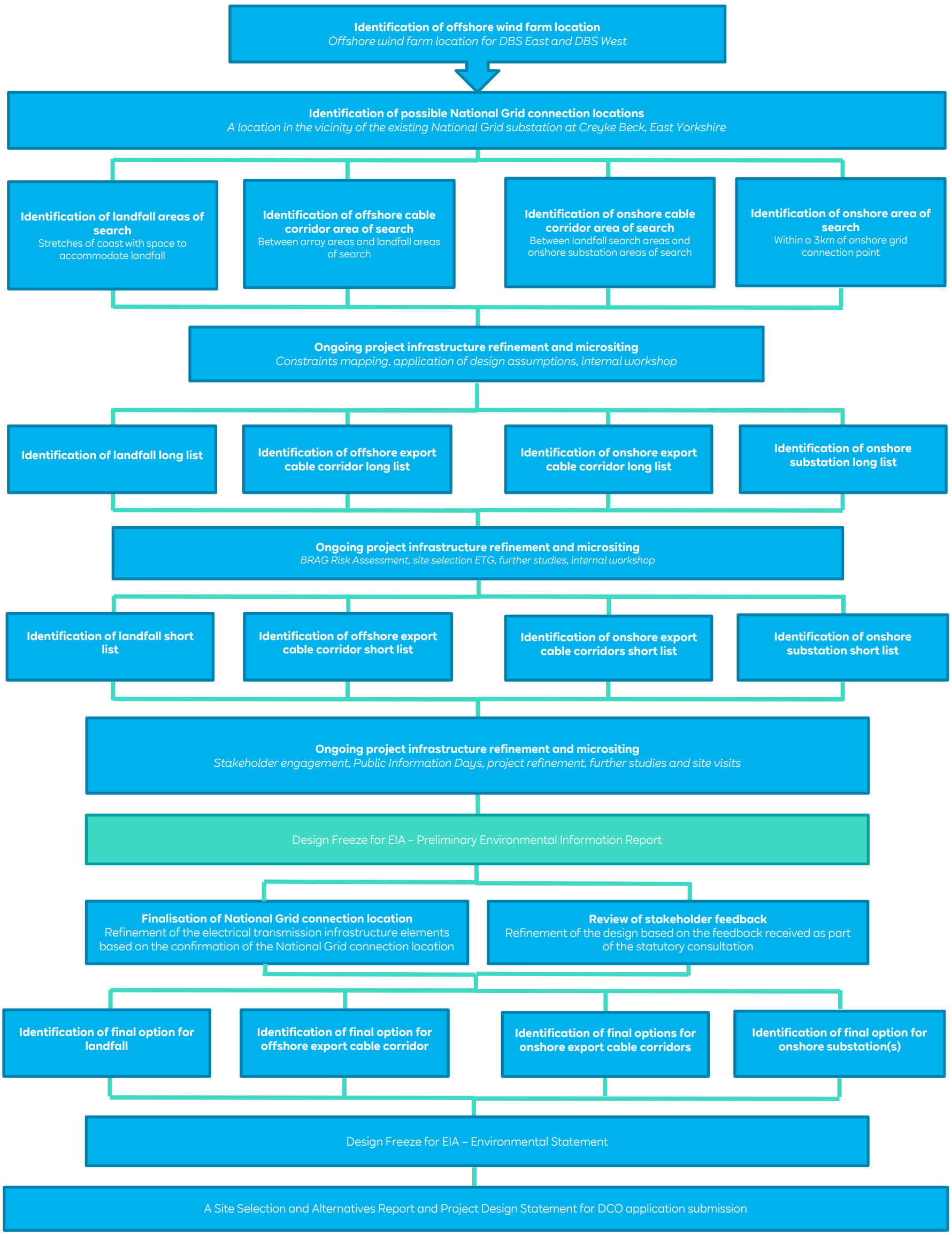
11. A multi-disciplinary team was formed to undertake the site selection process, which included a team of specialists including engineers, planners, land agents, landscape architects, legal advisors and EIA consultants.

12. The site selection process commenced with the identification of the offshore wind farm locations as part of The Crown Estate's Offshore Wind Leasing Round 4 process (discussed further in section 4.7). Subsequently, National Grid Electricity Systems Operator (ESO) advised that the onshore grid connections for the Projects would be in the vicinity of the exiting National Grid Electricity Transmission substation at Creyke Beck, East Riding of Yorkshire (section 4.8), which enabled a selection process to be undertaken to identify possible locations for landfall (section Landfall4.10), onshore substations (section 4.11), offshore export cables (section 4.12) and onshore export cables (section 4.13).

13. Throughout the site selection process options have been subject to a comparative assessment of engineering and environmental risk, consisting of a Black-Red-Amber-Green (BRAG) test, to identify the risks associated with each option identified. High risk options are given a red rating, whilst those with medium risk are coded amber and those with the least risk are assigned green. Black options are those which are not feasible from an engineering or environmental perspective. The aim of the BRAG tests was to ascertain which options carried the least risk with respect to the assessment criteria applied and based upon the professional judgement of the multi-disciplinary team of experts.

14. **Plate 4-1** provides an overview of the site selection process undertaken for the Projects. It is important to note that whilst the site selection process is illustrated and described as a linear approach in this chapter for ease of presentation, the reality of any project development is that site selection is a complex, iterative process with decisions made having considered multiple factors. Decisions on site selection are required at various stages to enable the Projects to progress and are based on the best information available at the time.

Plate 4-1 Overview of the DBS Site Selection Process



4.5. Consultation

15. The Applicant has undertaken pre-application engagement with stakeholders, communities and landowners in order to seek input to refine the Projects' design and to communicate key project updates.

16. Consultation on refinements to the Projects' site selection, layout and configuration have been undertaken through the informal and formal pre-application stages to date including (but not exclusively limited to):

- Consultation on the Scoping Report;
- Expert Topic Group (ETG) meetings with statutory and non-statutory technical stakeholders;
- Introductory Public Consultation;
- Parish Council briefings; and
- Direct discussions with landowners.

17. **Table 4-2** details the comment received on the site selection process as part of the consultation on the Scoping Report.

Table 4-2 Key Scoping Responses Regarding Site Selection and Assessment of Alternatives

Comment	Project Response
Scoping Opinion (Planning Inspectorate, September 2022)	
The Inspectorate acknowledges the Applicant's description of work undertaken to date regarding site selection as set out in Section 1.6 of the Scoping Report. No reference to alternatives in relation to turbine array layout is made, however it is noted that Paragraph 35 in Section 1.5 discusses factors that will influence the final layout. The ES should explain how these factors have been considered within the discussion of alternatives, where alternative layouts have been assessed. *The Inspectorate would expect to see a discrete section in the ES that provides details of the alternatives studied and the reasoning for the selection of the chosen option(s), including a comparison of the*	This chapter outlines the options studied for each element of the Projects and the reasons for selecting the preferred options presented in this PEIR. It is not anticipated that any final decisions will be made in relation to the layout of turbines until after project consent has been achieved. The potential worst case options for turbine layouts are provided in **Chapter 14 Shipping and Navigation**, with a minimum spacing between turbines confirmed as 830m.

Comment	Project Response
environmental effects, with reference to the Black-Red-Amber-Green ranking referenced in Paragraph 78.	
"Paragraph 92 of the Scoping Report indicates that the onshore cable corridor scoping boundary comprises five route variations. These routes are not provided, either within a figure or accompanying text, and as such it is not clear where the routes would be. *Paragraph 97 indicates that there are three onshore substation location zones, which are also not represented on a figure.* *The ES should clearly describe any alternative cable routes and substation locations assessed, including the use of appropriate figures, and provide a justification for the chosen options."*	Section 4.11 and section 4.13 outline the options considered for the onshore substations and onshore export cable route respectively.
"The Scoping Report describes the potential use of alternatives in the place of a 'conventional' connection (Section 1.1 Paragraph 5). The Inspectorate expects the ES supporting the application for the Proposed Development to describe the preferred option for connection and an assessment of the alternatives considered."	The Applicant is still in discussions about the final form of connection. There is no current intention to include an alternatives to conventional connection solutions.
"The ES should provide specific information on where any restricted working widths or seasonal restrictions are to apply during construction. The choice of construction methodology e.g., through open-cut trench or Horizontal Directional Drilling (HDD) or other trenchless methods, should be justified and explained in the ES. The Inspectorate advises that effort is made to commit to a construction method particularly in sensitive locations, and for the ES assessment to be	**Chapter 5 Project Description** provides details of the current assumptions around construction methods. Details of consultation with stakeholders and how this has influenced the site selection process are included throughout this chapter.

Comment	Project Response
based on the chosen method rather than introduce unnecessary uncertainty by retaining multiple options. *The Inspectorate would expect the ES to explain how the outcomes of consultation with stakeholders has been used to refine the site selection options. This is likely to be particularly important where options for micro-siting infrastructure are limited by the presence of other existing or planned infrastructure proposals."*	
Environment Agency Scoping Response (September 2022)	
"When narrowing site selection, we would ask the applicant to consider whether any locations could interact with any planned coastal flood or erosion schemes. This should include the Humber Strategy for any location(s) in the locality of Spurn Point. An example would be Tunstall Drain. It should also be ensured that, as part of data collection, the most recent scheme information is obtained, for example the Withernsea South coastal defence extension. We recommend both East Riding of Yorkshire Council and the Environment Agency are contacted again as the landfall options are refined."	East Riding of Yorkshire Council and the Environment Agency have been consulted throughout the site selection process and planned schemes have been considered where relevant.
"There are a number of 'main rivers' that outfall directly to the North Sea or have catchments that are near the existing coastline, as per para. 628 and Figure 3-16. We would expect to see the landfall options to avoid any main river channels or flood infrastructure (e.g., outfalls and flood defences) by at least 20 metres. As per para. 632, some of these 'main rivers' also have statutory designations."	The preferred landfall options selected for PEIR avoid statutory main rivers and flood infrastructure. Further details are available in **Chapter 20 Flood Risk and Hydrology**.

Comment	Project Response
"As there are three potential landfall areas identified at this stage, there is a vast amount of data and information to be considered in the time allowed for this consultation. We therefore encourage the applicant to continue to engage with us as the site selection process progresses, to ensure we can provide specific and relevant advice."	The Environment Agency has been consulted throughout the site selection process. Details of feedback on how this has been addressed in the site selection process is included throughout this chapter.
Ministry of Defence Scoping Response (September 2022)	
"Through paragraph 443 of the Scoping Report, it is acknowledged that the offshore array may fall wholly or partially within Southern Managed Danger Area (MDA) Practice and Exercise Areas (PEXA) D323B, D323C, and D323D. The lower vertical limits of blocks of danger area airspace are also noted. In addition, the cable route indicated in the Scoping Report passes through Practice and Exercise Areas (PEXA) D323K, D323D, and D323C. The applicant should be advised to take account of the current published MOD Practice and Exercise Areas (PEXA) in preparation of their development proposal. The MOD has highly surveyed routes which maybe relevant to the installation of the export cables & associated infrastructure. MOD should be consulted at the next stage of any application."	PEXA have been considered a constraint as part of the site selection process. Further details on the potential impacts upon PEXA are detailed in **Chapter 15 Aviation and Radar** and **Chapter 16 Infrastructure and Other Users**.

18. In addition to the response received as part of the Scoping Opinion, the technical stakeholders were invited to attend an ETG meeting in May 2022 to discuss the short-listed options and provide further feedback. The ETG meetings were attended by:

- East Riding of Yorkshire Council;
- Environment Agency;
- Historic England;
- Marine Management Organisation;
- Natural England;
- North Eastern Inshore Fisheries and Conservation Authority;
- RSPB;
- Yorkshire Wildlife Trust; and
- York Consortium of Drainage Boards.

19. Details of the feedback received and how this has been incorporated into the site selection process are reported in sections 4.10 to 4.13.

20. An introductory public consultation was held between 9 September and 14 October 2022. Feedback from members of the local community has been addressed separately by the Applicant and will be presented in the Consultation Report which will be submitted with the Development Consent Order (DCO) application, alongside the results of the statutory consultation. Consideration of local community comments has been undertaken throughout the site selection process.

4.6. Project Alternatives

21. A number of strategic-level project design alternatives have been considered as part of the site selection and project design decision-making process. This strategic consideration of alternatives, which fed directly into the Projects' site selection process, are detailed in **Table 4-3**.

Table 4-3 Strategic-Level Project Design Alternatives Considered

Alternatives Considered	Decision	Environmental Benefits
• A single application for development consent for DBS East and DBS West; or • Separate consent applications.	A single development consent application to address both projects.	Consistency in the approach to the environmental assessment, consultation and examination; reduced burdens on stakeholders as only one application will be consulted on and subject to examination; and increased transparency for potential compulsory acquisition process.
• Coordinating the design for DBS East and DBS West where possible; or • Developing separate designs for each Project.	Pursuing a coordinated design for the Projects where possible. However, as they are still two separate Projects some flexibility has been built into the design for certain elements to remain individual e.g. haul roads.	By collocating the infrastructure for both Projects (where possible) the number of receptors impacted by the Projects can be reduced.

Alternatives Considered	Decision	Environmental Benefits
• Overhead lines along the onshore export cable route between landfall and the grid connection location; or • Buried cables within ducts along the onshore export cable route between landfall and the grid connection location.	Buried onshore export cables within ducts	The environmental benefit of burying cables as opposed to overhead lines and pylons is a significant reduction of permanent visual impacts.

4.7. Identification of the Array Areas

22. In November 2017, The Crown Estate announced a new round of offshore wind leasing. In September 2019, the final bidding areas were announced and the Offshore Wind Leasing Round 4 was launched. As part of the Round 4 process, developers were able to identify preferred sites within bidding areas defined by The Crown Estate. Applications were submitted by developers under a competitive bidding process, culminating in an auction held in February 2021. The Applicant undertook its own analysis of environmental and technical constraints to identify preferred project locations. Economic assessment was then undertaken to understand the Applicant's competitive advantage associated with the shortlist of project options that the Applicant had identified, leading to the preference to co-locate two 1500MW projects. The Applicant was successful in the commercially driven auction process, securing preferred bidder status for the DBS East and DBS West projects.

23. The array areas are located more than 100km offshore on the Dogger Bank in the southern North Sea and each covers approximately 500km^2.

4.8. Onshore Grid Connection

24. National Grid Electricity Transmission own and maintain the high voltage electricity transmission network in England and Wales. National Grid ESO is responsible for operating the electricity transmission system in Great Britain.

25. In July 2020, the UK Government launched the Offshore Transmission Network Review (OTNR) to ensure offshore wind generation is delivered in the most appropriate way, taking into consideration the environment, cost to consumers, local communities and deliverability. Since its launch, the UK Government has set out its ambition to deliver 50GW of offshore wind by 2030.

26. In order to allow the site selection process for the Projects to progress alongside the OTNR, National Grid ESO provided the Applicant with an indicative location for the new National Grid substation. This location is shown on **Figure 4-1**.

27. As part of the OTNR, in July 2022 National Grid ESO published a holistic and coordinated network design (Holistic Network Design (HND)) to support delivery of 2030 offshore wind ambitions. The HND integrates connecting offshore wind farms to shore with the capability to transport electricity around Great Britain. It balances deliverability and economics, plus environmental and community impacts, and is a first and significant step towards a more centralised and strategic approach to electricity network planning (National Grid ESO, 2022).

28. The HND recommended design is broken into regional zones, and the Projects fall within the East Coast Region covering the east of England and east of Scotland. The recommended HND for the East Coast Region has identified clear value in transferring power through the offshore network from the Eastern ScotWind zone to the south via the offshore wind developments off the east coast of England (including both DBS East and DBS West), resulting in a design with substantial coordination with other offshore windfarms and Transmission Owners. The value is provided by avoiding costs that would be incurred curtailing generation and re-dispatching generation due to insufficient network capacity to transport power to where it will be consumed (National Grid ESO, 2022). Further benefits arise through co-ordinated delivery reducing environmental and community impacts and disruption.

29. The recommended HND identified a new National Grid substation near the existing Creyke Beck substation in the East Riding of Yorkshire as the optimum location to connect the Projects to the National Electricity Transmission System (NETS). This design solution provides the benefit of co-ordinating the development, construction, operation and connection of both Projects, while also offering potential benefits of integrated connections to Scotwind and another UK offshore wind projects. This coordinated development is critical to achieving the UK government's target to reach 50GW of installed offshore wind capacity by 2030.

30. Due to the substantial coordination with other developers and Transmission Owners, the next phase of the HND is the Detailed Network Design. This stage is expected to commence in early 2023.

31. While the HND recommends that the Projects are both connected via a HVDC connection this is only a high level concept therefore the Applicant has retained the flexibility for one of the Projects to be connected via a HVAC connection as both technologies have different advantages in terms of infrastructure size and requirements, operability, efficiency and economics.

32. The design of the Projects will continue to be refined as more information is made is available by National Grid ESO through the Detailed Network Design.

4.9. Areas of Search

33. Areas of Search (AoS) for the landfall, onshore substations, offshore export cable corridors and onshore export cable corridors we identified in parallel as part of an iterative site selection process.

4.9.1. Identification of the Landfall Area of Search

34. The landfall AoS identified a potential area where the offshore export cables could be brought onshore. It was based on the DBS East and DBS West array areas and the indicative grid connection point that was provided to the Applicant by National Grid ESO.

35. The landfall AoS stretched from the south of Bridlington to north of the Dimlington Gas Terminal. Environment Agency LiDAR data was used to assess cliff height in this region. It was determined that the area north of Bridlington would not be practicable as the average cliff height is between 20 and 30m. These cliff heights present thermal constraints on the cables resulting in limited ampacity which ultimately constrains the power output of the wind farm. There were also environmental constraints, including the Flamborough Head and Filey Coast Special Protection Area (SPA) and the Flamborough Head Special Area of Conservation (SAC) which helped to eliminate the area north of Bridlington from the AoS. The area south of the Dimlington Gas Terminal was ruled out due to a high number of pipeline crossings (see **Figure 4.2**).

36. The landfall AoS was drawn to Mean Low Water Springs (MLWS). It is shown in **Figure 4-2**.

4.9.2. Identification of the Onshore Substation Area of Search

37. The onshore substation AoS (see **Figure 4-3**) was defined using a 3km radius from the grid connection point provided by National Grid ESO.

38. The 3km radius was set to minimise the length of the connection between the onshore substations and onshore grid connection points. Minimising this distance as far as is reasonably practicable is beneficial because it minimises the cable reactive power component and losses.

4.9.3. Identification of the Onshore Export Cable Corridor Area of Search

39. The onshore export cable corridor AoS (see **Figure 4-4**) was drawn by connecting the onshore substation AoS (section 4.9.2) to the landfall AoS (Section 4.9.1).This area was then refined in the south to avoid urban areas including Hull, Hedon, Preston and Bilton. After reviewing the proposed route of the Hornsea Project Four offshore wind farm onshore cable corridor, the AoS was also expanded in the west to allow more room to route the onshore export cable corridor west of Hornsea Project Four onshore cable corridor if necessary.

4.9.4. Identification of the Offshore Export Cable Corridor Area of Search

40. The offshore export cable corridor AoS (see **Figure 4-5**) connected the landfall AoS (section 4.9.1) to the northern and southern most points of the Projects' array areas. Operational wind farms (such as Westermost Rough and Hornsea Two offshore wind farms) within the area were excluded from the offshore export cable corridor AoS.

4.10. Landfall

4.10.1. Landfall Design Principles and Engineering Assumptions

41. Potential areas where the offshore cables could be brought onshore were identified based on the following:

- Avoidance of areas with substantial infrastructure or urban land use e.g. areas of housing, coastal defences, other energy infrastructure; and
- Avoidance of areas with a cliff height over 20m, where possible.

42. All the potential areas identified were larger than the footprints required at the landfall to allow flexibility to refine the options at a later stage in the process when more information was available.

43. The process identified a long list of 28 potential landfall options which are shown on **Figure 4-6**.

4.10.2. Review of the Landfall Long List

44. Engineering and environmental BRAG assessments were completed for the long list of 28 possible landfalls. The assessments were then reviewed by the multi-disciplinary team and a number of options were not taken forward in the process.

45. **Table** 4-4 outlines which landfalls were not taken forward at this stage and reasoning for each decision.

46. A key engineering decision made at this stage of the process was to decrease the target cliff height to 15m. This was based on a Horizontal Directional Drill (HDD) depth of 20m below ground level and an assumption that the HDD would be at least 5m below the toe of the cliff. This design requirement was applied because HDDs over 20m below ground level could impact on cable ampacity and project viability.

Table 4-4 Landfalls Removed Following Multi-Disciplinary Review of the Long List

Landfall	Reason for Removal
CB2	Constraints to onward cable routeing including: • The Earl's Dike watercourse to the south; • Fraisthorpe Onshore Wind Farm to the north; and • Earthworks recorded on OS mapping immediately south of Fraisthorpe.
CB5	The construction compound at landfall would need to be west of Southfield Lane, reducing distance achievable offshore for the HDD exit point. Onward cable routeing crosses flood zones and is closer to other constraints. Landfall 6 considered preferable.
CB7	This option was removed due to the constraints of Seaside Caravan Park and Skipsea Sands Holiday Park which meant there was not space to host the TJB. This landfall would also require a HDD under the woodland to the west to facilitate the onward routeing, which is unfavourable.
CB10	Although the landfall was considered technically and environmentally viable, the presence of Atwick and the Atwick Gas Storage Facility meant that there was insufficient space to facilitate the onward routeing from this landfall location and thus Landfall 10 was not considered further.
CB11	Cliff height over 15m.
CB12	This landfall results in the need for the offshore export cable route to traverse across and have pipeline crossings within both the Holderness Inshore and Offshore Marine Conservation Zones (MCZs), plus proximity to a known area of high unexploded ordinance (UXO) concentrations and higher numbers of cable and pipeline crossings than options retained in the process. As such it was discounted from the process.
CB13	Flood zones, foul ground and potential UXO constraints limited the space available in this area.
CB14	Cliff height over 15m.

Landfall	Reason for Removal
CB15	Cliff height over 15m.
CB16	Predicted coastal erosion extents reduces space available for landfall HDD compounds, due to set back distance bringing compound closer to Thorpe Garth Farm. This could also impact on onward onshore export cable routeing. Additional constraints including steep slopes and drains would impact on suitable space for compounds. Other options considered preferable and therefore this option was removed.
CB17	Cliff height over 15m.
CB19	Cliff height over 15m.
CB20	Cliff height over 15m.
CB21	Constraints associated with Westermost Rough offshore and onshore infrastructure could constrain space available for landfall HDD and compound. Landfall Zone could be extended northwards slightly to avoid Westermost Rough infrastructure and possible pond on western side of Pastures Lane. However, other options preferable, and therefore this option was removed.
CB22	Onshore export cable route is considered to be very constrained by residential properties and therefore there are other preferable options.
CB23	This landfall results in the need for the offshore cable route to traverse across and have pipeline crossings within both the Holderness Inshore and Offshore MCZs, plus higher numbers of cable and pipeline crossings than options retained in the process. As such it was discounted from the process.
CB24	This landfall results in the need for the offshore cable route to traverse across and have pipeline crossings within both the Holderness Inshore and Offshore MCZs, plus higher numbers of cable and pipeline crossings than options retained in the process. As such it was discounted from the process.
CB25	Limited space and conflicted with an old / disused airfield.

Landfall	Reason for Removal
CB26	Predicted coastal erosion extents means that areas available for landfall HDD compounds and orientations of drill alignment is more constrained than within original assessment. To the north of the sewage works the landfall compound would need to be located west of Holmpton Road and HDD alignments would be constrained by residential properties to the north and sewage works and likely outfall to the south. In the south the space available for HDD compounds is very constrained due to the presence of residential properties along Holmpton Road, which would also impact onward cable routeing immediately following landfall.
CB27	Based on the review of the offshore cable route options, the option that connects to this landfall was considered less favourable than those that connected to the northern cluster of landfalls, namely 1 – 9, due to cable length and number of crossings, some of which may need to be in the Holderness offshore MCZ. These drawbacks and the potential length of the onshore route made this option unattractive
CB28	Cliff height over 15m.

4.10.3. Review of the Landfall Short List

47. Following the removal of a number of options seven possible landfall locations were taken forward as part of the short list, as shown on **Figure 4-7**.

48. The short list was reviewed again by the multi-disciplinary design team and the following options were removed from the process (**Table 4-5**).

Table 4-5 Landfalls Removed Following Multi-Disciplinary Review of the Short List

Landfall	Reason for Removal
CB3	At this stage in the process it was confirmed that the permanent infrastructure associated with Hornsea Project Four would take up the majority of this landfall option, therefore it was discounted from the process due to the lack of space.
CB4	This location was removed from the process due to the uncertainty over the space requirements of Hornsea Project Four and Continental Link and the risk that there would not be adequate space left to accommodate the Projects.
CB6	This location was removed due to the uncertainty over the space requirements for Dogger Bank A & B offshore wind farm and the risk that there would not be adequate space left to accommodate the Projects.
CB18	This landfall resulted in the need for the offshore cable route to traverse across and have pipeline crossings within both the Holderness Inshore and Offshore MCZs. In addition, the associated onshore cable corridor from this landfall option would be constrained by the SSE Aldbrough storage facility and associated infrastructure. As such, it was discounted from the process.

4.10.3.1. Technical Consultation on Landfall

49. The remaining options (Landfall 1, 8 and 9) were presented to the ETG in May 2022 (**Figure 4-8**). **Table 4-6** outlines the comments received from stakeholders regarding landfall.

Table 4-6 ETG Comments on Landfall Options

Organisation	Comment
Environment Agency	The coastline at CB 8/9 may be subject to the Coastal Transition Accelerator Programme.
Natural England	Significant concerns over potential offshore impacts to Smithic Bank (CB 1) and indicated a preference for CB 8/9 as it would be preferable to cross Holderness Inshore MCZ if required.
North Eastern Inshore Fisheries and Conservation Authority	Further investigation needed into potential impacts on the Flamborough Head reef if CB 1 is taken forward.
Yorkshire Wildlife Trust	Further investigation needed into potential impacts on the Flamborough Head reef if CB 1 is taken forward.

4.10.4. Preferred Options for Landfall

50. Following the stakeholder engagement with the ETG the preferred options for landfall were selected. **Table 4-7** outlines this decision making. **Figure 4-9** presents the preferred options for landfall.

Table 4-7 Landfall Preferred Options

Landfall	Status	Reason
CB1	Removed	This option was discounted following feedback from Natural England and others that there was a strong preference to avoid crossing Smithic Bank. Removing this option also removed the potential interaction of the cable corridor with the Flamborough Head SAC.
CB8	Preferred option	These landfalls provide options with optimal cliff height, sufficient space to co-locate the Projects and avoid Smithic Bank.
CB9		

4.11. Onshore Substations

4.11.1. Onshore Substation Design Principles and Engineering Assumptions

51. Initially the onshore substation AoS was refined to:

- Avoid residential properties (including whole gardens) where possible;
- Avoid housing land allocations identified in local plans where possible;
- Avoid direct impacts to internationally and nationally designated areas (e.g. SACs, SPAs and Sites of Special Scientific Interest (SSSI) etc.) where possible;
- Avoid significant impacts to the special qualities of Areas of Outstanding Natural Beauty where possible;
- Avoid mature woodland and historic woodland;
- Avoid areas that fall within Flood Zone 3 and where possible preference was given to locating infrastructure in Flood Zone 1; and
- Avoid recreation spaces such as golf courses where possible.

52. The refined onshore substation AoS is shown on **Figure 4-10**.

53. The next step was to identify large substations zones within the refined AoS which were suitable for siting substation infrastructure. As a minimum, all of the substation zones could accommodate the minimum footprint scenario for one HVDC substation (200 x 180m) and a temporary construction compound (250 x 150m). The majority of zones were large enough to allow multiple configurations of the required infrastructure.

54. Nine potential substation zones were identified as shown on **Figure 4-11**.

4.11.2. Review of the Onshore Substation Zone Long List

55. Engineering and environmental BRAG assessments were completed for the long list of nine substation zones. The assessments were then reviewed by the multi-disciplinary team and a number of options were not taken forward in the process. **Table 4-8** outlines which substation zones were not taken forward from the process at this stage and reasoning for each decision.

Table 4-8 Substation Zones Removed Following Multi-Disciplinary Review of the Long List

Substation Zone	Reason for Removal
Substation Zone 2	This option was ruled out due to its small size, being unable to accommodate a HVAC substation (250 x 200m plus a temporary construction compound). In addition, this location had limited suitable access options for the delivery of the required transformers and limited options for routeing of the associated onshore export cable corridor.
Substation Zone 8	A review of the location of a nearby ethylene pipeline revealed it would be a significant constraint on this substation zone, therefore it was agreed to discount this substation zone from the process.

56. The multidisciplinary team also undertook an exercise to assess if the location provided by National Grid ESO (**Figure 4-1**) would be suitable for the Projects' onshore substations in the case National Grid ESO choose to locate their infrastructure in a different field parcel. This review concluded that it would not be possible to site the substation at this location due to the existing pipelines in the area.

4.11.3. Review of the Onshore Substation Zone Short List

57. Following the removal of a number of the options seven substation zones were taken forward as part of the short list, as shown on **Figure 4-12**.

58. The short list was reviewed again by the multi-disciplinary design team and the following options were removed from the process (**Table 4-9**).

Table 4-9 Substation Zones Removed Following Multi-Disciplinary Review of the Short List

Substation Zone	Reason for Removal
Substation Zone 3	A planning application for a solar farm was approved by East Riding of Yorkshire Council, which covers the same parcels of land as this zone. As such, this zone was removed from the process.
Substation Zone 7	The zone is in an elevated location which would make the substations themselves more prominent in the surrounding landscape. The zone is also located within the Yorkshire Wolds Important Landscape Character Area.
Substation Zone 9	The settlement of Woodmansey is very close to this substation zone and there are limited options for mitigation / screening. Landscape and visual impact issues would pose a high risk for consenting. Onward routing to the grid connection points is difficult for this site and the railway crossing would be very constrained, making it difficult to engineer. As such it was discounted from the process.

59. Substation Zone 5 and Substation Zone 6 were also refined with the aim of reducing potential impacts on landscape and visual impacts. **Table 4-10** summarises these decisions.

Table 4-10 Substation Zone Refinement

Substation Zone	Refinement
Substation Zone 5	The engineering team assessed the western part of this substation zone to be unsuitable as significant earthworks would be required to form a substation platform. The Landscape team identified the north eastern part of this substation zone to be the most preferable as it is the lowest lying and screened by the Platwoods Bar Plantation. The north eastern part of the zone was also identified as the most preferable by the heritage team as it was the furthest away from the heritage assets associated with Risby Hall and Park. Therefore the zone was reduced to the north eastern section of the original zone.
Substation Zone 6	The engineering team assessed the northern part of this substation zone to be unsuitable as significant earthworks would be required to form a substation platform. In comparison the southern part of the substation zone is gently sloping and was therefore considered to be a more suitable location. The Landscape and Heritage teams identified the southern part of the substation zone to be more suitable as the existing landscape features (e.g. woodland at Folly Wood, Gorse Plantation, Blackdike Plantation and Sodwall Plantation) could be used to contain the development and provide screening. Therefore the zone was reduced to the southern section of the original zone.

60. **Figure 4-13** shows the substation zones which remained in the process.

4.11.3.1. Technical Consultation on Onshore Substations

61. The remaining options (Substation Zones 1, 4, 5 and 6) were presented to the ETG in May 2022. **Table 4-11** outlines the comments received from stakeholders regarding the substation zones.

Table 4-11 ETG Comments on Substation Zones

Organisation	Comment
East Riding of Yorkshire Council	View from Beverley Minster will be a key consideration if Substation Zone 1 is taken forward. There has been significant interest in the areas being considered from solar farm developers and recommend discussions are held with developers to better understand what other projects are being considered for the land within the substation zones.
Natural England	The proposed new Yorkshire Wolds Area of Outstanding Natural Beauty does not need to be given material consideration by the Projects until the proposals are submitted to the Secretary of State, which is currently timetables for mid-2024.

4.11.3.2. Updated Onshore Substation Parameters

62. As part of the HND process National Grid ESO increased the grid connection requirements for the substations from 1500MW per project to 1800MW per project. In line with the co-ordinated element of the HND process the capacity increases will promote grid stability, whilst also allowing capacity generated from other projects to reach the national grid in a co-ordinated way. The co-ordinated approach to grid championed by the HND process reduces the need for additional landfall and cable corridor disturbances which would be associated with all projects connecting to the grid individually. Therefore the overall footprint (permanent and temporary works) required for the Projects was increased. The minimum footprint scenario for one HVDC substation was increased from 200 x 180m to 244 x 264m with a construction compound of 30,000m^2 (compared to the initial 37,000m^2). The minimum footprint scenario for one HVAC substation was also increased to 450 x 300m with a 45,000m^2 construction compounds.

63. As a result of the increased substation footprint requirements the substation zones were reviewed in order to identify the preferred footprint locations within the remaining zones. This process was led by the engineering team who considered earthworks, drainage and access requirements alongside the increased footprints. As a result of this work Substation Zones 1 and 4 were increased.

64. At this stage Substation Zone 6 was not taken forward as the space available could not accommodate the larger footprint requirements and the surrounding ground conditions meant it was not possible to increase the zone any further.

4.11.4. Preferred Options for Onshore Substations

65. Following the stakeholder engagement with the ETG and the review of the updated substation parameters, the preferred options for the onshore substations were selected. **Table 4-12** outlines this decision making. **Figure 4-14** presents the preferred onshore substation zones.

Table 4-12 Substation Preferred Options

Landfall	Status	Reason
Substation Zone 1	Preferred Option	This zone is taken forward to PEIR as there is enough space to accommodate one substation, either a HVAC or HVDC. It is in close proximity to similar development including the Dogger Bank A & B offshore wind farm substation. There are a limited number of receptors from a landscape and visual perspective. This zone is the closest to the onshore grid connection points for the Projects and would require the least amount of earthworks.
Substation Zone 4	Preferred Option	This zone is taken forward to PEIR as there is enough space to accommodate either a HVAC or HVDC substation, or two HVDC substations. This zone has slightly lower elevation and the existing woodland in the area provides opportunity for screening.
Substation Zone 5	Removed	This option was removed as it was recognised that there was potential for significant landscape and visual impact in comparison to the other remaining substation zones to the relatively prominent area of high ground. In addition, heritage setting and unknown archaeology concerns surrounding this site posed a material consenting risk. Therefore this option was removed from the process.

4.11.4.1. Onshore Substation Scenarios

66. In order to allow the Applicant to consider the benefits and disadvantages of co-locating the substations vs locating them on separate sites a number of potential electrical solutions are considered within the assessments presented in the topic chapters (**Chapters 8 – 30**):

- Two HVDC substations in Substation Zone 4 (co-located);
- One HVDC substation in Substation Zone 1 and one HVAC substation in Substation Zone 4;
- One HVDC substation in Substation Zone 4 and one HVAC substation in Substation Zone 1; or
- One HVDC substation in Substation Zone 1 and one HVDC substation in Substation Zone 4.

67. See **Chapter 5 Project Description** for more information.

4.12. Offshore Export Cable Corridor

4.12.1. Offshore Export Cable Corridor Design Principles and Engineering Assumptions

68. Using the following design principles, a set of potential offshore export cable corridors were drawn within the offshore export cable corridor AoS to connect the array areas to the landfall options:

- Be able to connect to viable landfall locations;
- Be as short as possible;
- Minimise number of crossings of existing offshore cables and pipelines, where crossing is required, cables and pipelines to be crossed at approximately 90°;
- Maintain required separation distances with other offshore cables and pipelines;
- Maintain sufficient space for offshore cable installation (including anchor spread of installation vessels whilst maintaining an appropriate safety buffer with existing sub-sea cables and pipelines);
- Avoid known historic wrecks as far as possible;
- Minimise sterilisation of aggerate dredging areas and other lease areas;
- Avoid direct significant impacts to sites designated for nature conservation as far as possible (SACs, SPAs, MCZs); and
- Avoid direct significant impacts to ecologically important sandbanks and potential reefs as far as possible.

69. In addition, the information presented by Dogger Bank A & B offshore wind farms as part of their site selection work was also reviewed (Forewind, 2014). This helped to identify additional corridors which avoided areas identified by Dogger Bank A & B as 'preferable to avoid' due to ground conditions.

70. The offshore export cable corridors were 2km wide, with funnels close to the array areas to allow flexibility and branches in the nearshore area to connect each option to the individual landfall option (**Figure 4-15**).

4.12.2. Review of the Offshore Export Cable Corridor Long List

71. Engineering and environmental BRAG assessments were completed for the long list of 21 offshore export cable corridors. The assessments were then reviewed by the multi-disciplinary team and a number of options were not taken forward in the process. **Table 4-13** outlines which offshore export cable corridors were not taken forward from the process at this stage and reasoning for each decision.

Table 4-13 Offshore Export Cable Corridors Removed Following Multi-Disciplinary Review of the Long List

Offshore Export Cable Corridor ID	Reason for Removal
8	This corridor connected to Landfall 12 which was in close proximity to an area of foul ground. Landfall 12 was also adjacent to a UXO disposal area, increasing the likelihood of ordnance on and offshore. This corridor also involved crossing of and the installation of pipeline crossings in both the Holderness Inshore and Offshore MCZs. This would add an additional consenting risk, with the potential need for implementing 'measures of equivalent environmental benefit' if the impacts on the MCZ were deemed to hinder the achievement of the conservation objectives of the MCZs. If this was the case, the Projects would need to demonstrate there was no other way to proceed in another manner, or at another location, which could be difficult based on the alternative landfall locations available.
9	This corridor connected to Landfall 17 which was in close proximity to an area of foul ground. This corridor also involved crossing of and the installation of pipeline crossings in both the Holderness Inshore and Offshore MCZs. Rationale as per Corridor 8 above.
10	This corridor connected to Landfall 21 and 22 which were discounted from the process as part of the review of the landfall long list (see **Table 4-4**).

Offshore Export Cable Corridor ID	Reason for Removal
11	This corridor was less favourable as it was longer in length than those retained in the process and required greater numbers of infrastructure crossings. Two of these would potentially lie in close proximity, or within, the Holderness Inshore and Offshore MCZs. Rationale as per Corridor 8 above.
12	This corridor connected to Landfall 25, 26 and 27 which were discounted from the process as part of the review of the landfall long list (see **Table 4-4**).
13	This corridor was less favourable as it was longer in length than those retained in the process and required greater numbers of infrastructure crossings. Two of these would potentially lie in close proximity, or within, the Holderness Inshore and Offshore MCZs. Rationale as per Corridor 8 above.
14	This corridor connected to Landfall 25, 26 and 27 which were discounted from the process as part of the review of the landfall long list (see **Table 4-4**).

4.12.3. Defining the Offshore Export Cable Corridor Short List

72. Further reviews of the offshore export cable corridors indicated the potential to re-incorporate branching routes from the array site to connect the remaining offshore export cable corridors. As a result, a new 'fan' area was developed to allow additional options to be explored.

4.12.3.1. Offshore Export Cable Corridor – Fan Options

73. The offshore export cable corridor fan was broadly split into options routing to the north and/or west, and options routing to the south and /or east. The options to the north and/or west were included as there was greater confidence on the available information. However, they were longer and had potentially greater transits through and crossings within the Dogger Bank SAC. The options to the south and /or east were either shorter or had fewer crossings within/shorter transits through the Dogger Bank SAC but there was less confidence on the ground conditions on the basis of available information. The route options within the fan were labelled:

- Fan Option A;
- Fan Option B;
- Fan Option C;
- Fan Option D;
- Fan Option E;
- Fan Option F;
- Fan Option G; and
- Fan Option H.

74. A preliminary geophysical survey was undertaken on the options within the fan to provide additional information which would be used in deciding which option to take forward.

4.12.3.2. Offshore Export Cable Corridor – Nearshore Options

75. While the majority of the offshore export cable corridor options did not change in the nearshore area an additional option (ID 22) was added to allow an connection to Landfalls 18.

76. **Table 4-14** details the offshore export cable corridor options, including the routes within the fan, which were taken forward as part of the short list. The short list is also presented in **Figure 4-16**.

Table 4-14 Offshore Export Cable Corridor Short List

Offshore Export Cable Corridor Fan Option	Offshore Export Cable Corridor ID
Fan Option A	1
Fan Option B	2
Fan Option C	3
Fan Option D	4
Fan Option E	5
Fan Option F	6
Fan Option G	7
Fan Option H	22 (added to provide an option to connect to Landfall 18)

4.12.4. Review of the Offshore Export Cable Corridor Short List

4.12.4.1. Landfall Refinement

77. Due to the iterative nature of the site selection process when options were removed from the landfall short list (section 4.10.3) a number of offshore export cable corridors were also removed as outline in **Table 4-15**.

Table 4-15 Offshore Export Cable Corridors Removed Following Landfall Option Refinement

Landfall Removed	Offshore Export Cable Corridor Removed
Landfall 3	3
Landfall 4	4
Landfall 6	6
Landfall 18	22

4.12.4.2. Technical Consultation on Offshore Export Cable Corridors

78. The remaining offshore export cable corridor options were presented to the ETG in May 2022. **Table 4-16** outlines the comments received from stakeholders regarding the offshore export cable corridors, which are similar to those received on the landfall short list.

Table 4-16 ETG Comments on Offshore Export Cable Corridors

Organisation	Comment
Natural England	Significant concerns over potential offshore impacts to Smithic Bank (Offshore Cable Routes 1 and 2) and indicated a preference to cross Holderness Inshore MCZ instead (Offshore Cable Routes 5 and 7).
North Eastern Inshore Fisheries and Conservation Authority	Further investigation needed into potential impacts on the Flamborough Head reef if Landfall Option 1 is taken forward.
Yorkshire Wildlife Trust	Further investigation needed into potential impacts on the Flamborough Head reef if Landfall Option 1 is taken forward.

79. Following the ETG meetings and the advice from Natural England that Smithic Bank should be avoided offshore export cable corridors 1 and 2 were not taken forward in the process.

4.12.4.3. Refinement of the Fan Options

80. Survey results from initial reconnaissance surveys were then reviewed by the engineering team. It was decided to drop the southernmost option within the fan due to the widespread presence of large high amplitude bedforms (sandbanks), the addition of the extra pipeline crossing and the length of the route making this option the least economically and technically viable. Therefore the following cable route options within the fan were removed from the process:

- Creyke Beck Fan Option D;
- Creyke Beck Fan Option E;
- Creyke Beck Fan Option G; and
- Creyke Beck Fan Option H.

4.12.5. Preferred Options for Offshore Export Cable Corridor

81. Following the removal of options from the short list, the width of the remaining cable corridors were refined from 2km to an optimized 1km wide corridor within the 2km. The offshore export cable will be located within this 1km wide corridor. A 500m wide buffer lies on either side of the 1km corridor to allow for construction activities such as anchor placement. The design assumptions outlined in section 4.12.1 were applied alongside identifying optimised crossings of infrastructure and providing space for the HDD splays around the landfall.

82. The preferred options for the offshore export cable corridor are presented in **Figure 4-17**.

83. Within the preferred options for the offshore export cable corridor an area was identified where a reactive compensation platform (RCP) could be located if a HVAC solution is utilised for DBS West. An electrical switching gear platform could also be located next to the RCP.

84. To identify the area of search for the RCP and electrical switching gear platform the distance between the array site and the onshore connection point was considered to position the RCP approximately half way between the two to minimise loses in the electrical transmission. The area of search is shown on **Figure 4-17**.

85. Landscape and Visual impacts from the coastline were also considered in determining the potential locations for the platforms. It was determined that the location should be at least 40km from the landfall to avoid any significant effects on the onshore receptors. The potential location is therefore over 52km from the landfall and 37km from the closest land at Flamborough Head.

86. Vessel densities in the potential area were also reviewed to ensure the proposed area was avoiding areas of higher vessel densities. This ensures the potential area is within areas that were identified as low or medium-low risk for any vessels within the area.

4.13. Onshore Export Cable Corridor

4.13.1. Onshore Export Cable Corridor Design Principles and Engineering Assumptions

87. Using the following design principles, a set of onshore export cable corridors were drawn to connect the landfall options to the refined onshore substation AoS:

- Routing should be kept as straight and as short as practicable – avoiding tight bends;
- Avoid residential titles (including whole gardens) where possible;
- Avoid areas identified in local plans for housing development where possible;
- Avoid direct significant impacts to internationally and nationally designated areas (e.g. SACs, SPAs, and SSSIs, etc.) where possible;
- Avoid direct significant impacts to mature woodland and historic woodland;
- Minimise the number and length of trenchless crossings;
- Minimise the number of crossings of assets (e.g. utilities);
- Minimise the number of road and rail crossings;
- Minimise the number of hedgerow crossings; and
- Minimise the number of watercourse crossings.

88. Initially 1km wide onshore export cable corridors were drawn to allow flexibility to refine the options at a later stage to avoid potential engineering and environmental considerations.

89. This process identified nine broad onshore export cable route options with variations to link each landfall option to the refined substation AoS. There were 54 individual onshore export cable corridor options taken forward as part of the long list, as presented in **Figure 4-18**.

4.13.2. Review of the Onshore Export Cable Corridor Long List

4.13.2.1. Brandesburton Pinch Point

90. Engineering reviewed the long list of 54 onshore export cable corridors and identified a series of pinch points which could impact the viability of the options.

91. At this stage, onshore export cable corridors which passed through the ponds immediately west of Brandesburton were removed from the process. The ponds are likely to be representative of former sand and gravel quarries which following excavation were abandoned and left to flood. The engineering team assessed crossing these ponds to be unviable. This was due to the following reasons:

- Uncertainty in depth of former sand and gravel quarries and therefore required HDD depth;
- Nature of any backfill of former sand and gravel quarries which would effect HDD suitability and depth requirements;
- Risk of break out of drilling fluids into the pond due to decreased overburden pressures; and
- Risk associated with collapse of the HDD bore from drilling through unconsolidated granular deposits.

92. Following the removal of the onshore export cable corridors at Brandesburton, additional onshore export cable corridors were added in order to maintain onshore export cable route flexibility from Landfall 8 and 9.

93. The onshore export cable corridors which were removed or added to the process at this stage are shown on **Figure 4-19**.

4.13.2.2. Landfall Refinement

94. Due to the iterative nature of the site selection process when options were removed from the landfall short list (section 4.10.2) a number of onshore export cable corridors were also removed as shown in **Figure 4-20**.

95. In order to maintain flexibility for cable routes from Landfall 18 to route around the north of Beverley new cable route were also added at this stage (**Figure 4-20**).

4.13.3. Review of the Onshore Export Cable Corridor Short List

4.13.3.1. Wansford and A1147 Pinch Points

96. Following further engineering assessment an additional pinch point was identified at Wansford. At Wansford the crossing of the River Hull, Driffield Canal and Main Drain is impacted by the shallow chalk aquifer with artesian groundwater expected at this location (i.e. the groundwater is under pressure and HDD would risk flooding the local area). Detailed intrusive and geophysical investigation would be required to confirm feasibility. Even if the crossing was feasible, it would likely require 24 hour work in close proximity to residential properties. It was deemed this crossing would be too complex and therefore all onshore export cable corridors associated with this pinch point were not taken forward.

97. All onshore export cable corridors which followed the southern crossing of the A1147 were also not taken forward as it was confirmed that a SABIC Ethylene pipeline and a National Gas High Pressure Gas Main ran though the only feasible gap for crossing the road.

98. **Figure 4-21** shows which options were removed at this stage and which remained in the process.

4.13.3.2. Corridor Width

99. The remaining onshore export cable corridor were refined down from 1km to 500m, as show in **Figure 4-22**. The design assumptions outline in section 4.13.1 were applied alongside identifying engineering preferences for complex crossings and considering newly acquired utilities data and preliminary land information.

4.13.3.3. Landfall Refinement

100. As the short list for landfall was refined (section 4.10.3) the corresponding onshore export cable corridors were also removed from the process.

4.13.3.4. Lisset Pinch Point

101. The onshore export cable corridors that ran through the village of Lisset were removed from the process as the engineering and environmental BRAG assessments identified them as less favourable as they required acute bends, a crossing of a high pressure gas main and construction traffic to be routed through the village.

4.13.3.5. Greengrass Caravan Park / Leven Canal Pinch Point

102. The onshore export cable corridors which passed the Greengrass Caravan Park and crossed the Leven Canal were removed from the process. From an engineering perspective, there was limited space available between the ponds at Greengrass Caravan Park with an existing pumping station located in one of the only viable gaps. From an environmental perspective there was an ecology risk as these options required a crossing of the Level Canal SSSI and from a traffic perspective this option required a higher number of roads to be widened and a number of sensitive communities would be impacted by traffic movements.

103. **Figure 4-23** shows the remaining onshore export cable corridors following the refinements outlined above.

4.13.4. Preferred Option for Onshore Export Cable Corridor

104. Following the selection of the preferred options for landfall (section 4.10.4) a single preferred corridor between Landfalls 8 and 9 and Routh was identified. From Routh the onshore export cable corridor split into five possible routes around Beverley, these options were labelled 1 to 5 (**Figure 4-24**) and presented to the technical stakeholders.

4.13.4.1. Technical Consultation on Onshore Export Cable Corridors

105. The five possible routes around Beverley were presented to the ETG in May 2022. **Table 4-17** outlines the comments received from stakeholders regarding the offshore export cable corridors.

Table 4-17 ETG Comments on Onshore Export Cable Corridors

Organisation	Comment
East Riding of Yorkshire Council	Construction on Figham Common could be limited to summer months only as land gets particularity wet in the winter. Any crossing of Figham Common would require consultation with Beverly Pasture Masters.
Environment Agency	Construction on Figham Common could be limited to summer months only as land gets particularity wet in the winter. A preference for all main rivers, in particularly River Hull and Barmston Drain should be crossed using trenchless techniques.

106. Following the stakeholder engagement with the ETG and the selection of the preferred option for onshore substation zones (section 4.11.4) the preferred onshore export cable corridor was selected. **Table 4-18** outlines this decision making. **Figure 4-25** presents the preferred options for the onshore export cable corridor.

Table 4-18 Onshore Export Cable Route Options

Onshore Export Cable Route	Status	Reason
Option 1	Removed	This option was assessed as least favourable due to poor ground conditions, the crossing of a residential property, increased flood risk in comparison to other options and difficult access and therefore was removed from the process.
Option 2	Removed	This onshore export cable corridor option was not taken forward as it would require a crossing of Figham Common which is common land and therefore the Projects may require Special Parliamentary Procedures to undertake the work.
Option 3	Preferred Option	This option could accommodate a connection to both substation zone 1 and substation 4 and was therefore taken forward as the preferred option.
Option 4	Removed	This onshore export cable corridor option was removed as the available gap between the Hornsea Project Four DCO application boundary and the houses on Beverley Road was not sufficient to accommodate both DBS East and DBS West.
Option 5	Removed	Once substation zone 5 was removed from the process (section 4.11.4) this route became the longest and therefore least favourable option and was not taken forward in the process.

4.14. Summary

107. The site selection process has enabled the refinement of the Projects to the point of PEIR assessment. The applicant considers that these options and refinements are sufficiently justified and narrowed down to enable stakeholders (through the statutory consultation process) to provide meaningful comment on the Projects and any potential impacts on the receiving environment.

108. The Applicant will continue to develop and refine the design of the Projects as they progress towards the final application for Development consent and beyond this as they move towards construction.

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RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire, SN5 6PB