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# Growth and Innovation in the Ocean Economy: North Sea Checkpoint

Data Adequacy Report - Wind Farm Challenge



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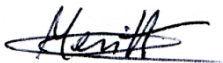
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Project manager	Olivia Merritt
Project director	Keiran Millard

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## Executive Summary

This document summarises the findings of the Wind Farm challenge, conducted as part of the North Sea Checkpoint project (NSCP). This is the first of the project challenges to be completed; therefore the report will seek to provide a template for reporting the results of successive challenges.

This report is deliverable 05 to DG Mare under the North Sea Check Point project (Growth and Innovation in the Ocean Economy – Gaps and Priorities in Sea Basin and Observation Data MARE/2012/11: North Sea) contract reference [SI2.658142]. The work was undertaken by HR Wallingford Ltd with input from the project members IMARES and McAllister-Elliot & Partners (MEP).

Although this document reports on the data challenge for possible wind farm sites, it should be stressed that this does not endorse or warrant the sites identified as suitable for development.

# Contents

1.	Introduction	1
2.	Aim	1
3.	Context	2
4.	Method	2
5.	Data	6
6.	Results	8
6.1.	Challenge output	8
6.1.1.	Introduction	8
6.1.2.	Area A	8
6.1.3.	Area B	10
6.1.4.	Outcome	12
6.2.	Data Adequacy	12
6.2.1.	Contribution – Does the data contain the right parameters?	12
6.2.2.	Location – Does the data cover the correct time / space location?	14
6.2.3.	Commercial – Are the commercial terms acceptable?	14
6.2.4.	Attributes – Does the data have the correct attributes?	14
6.2.5.	Delivery - Can the data be provided to match the timeframe of the challenge?	15
6.2.6.	Usability – Is the data format and supporting information suitable?	15
6.3.	Key Data Gaps	16
7.	Discussion and Conclusions	17
7.1.	Discussion	17
7.2.	Conclusions	18
8.	References	18
	Appendices	19
	A. Figures	
	B. Data Assessment	
	Tables	
	Table 4.1: Site suitability scoring index	3
	Table 4.2: Data Requirements and Site Suitability classifications	5
	Table 5.1: Data suitable in meeting the wind farm siting challenge	6



# 1. Introduction

This report is the fifth deliverable to DG Mare under the North Sea Check Point project (Growth and Innovation in the Ocean Economy – Gaps and Priorities in sea basin and observation data MARE/2012/11: North Sea) contract reference SI2.658142. The work was undertaken by HR Wallingford Ltd with input from the project members IMARES and McAllister-Elliot & Partners (MEP). This document is the first Data Adequacy Report (DAR) presenting the findings for a completed challenge.

The Wind Farm Challenge has addressed the stages of work required for a desk-based assessment to identify potential wind farm development sites along National Territorial Water boundaries in the North Sea Basin. The assessment was made using available data.

All data gathered has been recorded in the data adequacy assessment database, providing a searchable record of each of the datasets reviewed and the results of its evaluation where considered for one or more challenges. The database is in the process of being made available via the project website.

Although each of the challenges requires a result to be produced from the exercise being undertaken, it is the process of gathering, appraising and using the data to meet that outcome which is most important in informing the overall objectives of the North Sea Checkpoint project.

In this context it should be noted that assessing data quality within a challenge is a continuous process through each stage of a challenge: data gathering, initial appraisal of the data, analysis and quality assurance of results, providing different insights into the accessibility and usefulness of a datasets at each stage.

# 2. Aim

The primary aim of the wind farm siting challenge is to assess whether the data currently available across and near territorial boundaries in the North Sea is appropriate in undertaking the preliminary assessment required to identify potential new wind farm sites.

The main aim of the challenge as specified in the project brief was to:

- Determine the suitability of sites for wind farm development along national marine boundaries in the North Sea Basin, where:
  - Norwegian, UK, Danish, German and Dutch waters meet
  - UK, Dutch and Belgian waters meet
  - UK, Belgian and French waters meet
- Consider all factors used for wind farm siting, even if one of those factors makes the site unsuitable for development.

The challenge is being undertaken from the perspective of a wind farm operator assessing suitable locations for offshore wind sites. As such it takes into consideration factors that affect generating capacity, construction and maintenance, potential environment impacts, and current sea-use.

### 3. Context

EU “2030 framework for climate and energy policies” has a target to reduce EU domestic greenhouse gas emissions by at least 40% below the 1990 level by 2030 along with an objective of increasing the share of renewable energy to at least 27% of the EU's energy consumption by 2030. The latter objective is addressed by the EU Renewable Energy Directive (2009/28/EC). Offshore wind farms are expected to provide a significant contribution toward both of these aims. Investment decisions by renewable energy developers require a minimisation of risks that can be achieved if adequate data is available to inform any such risk assessment.

The study areas specified for the challenge were designed to consider data adequacy when dealing with:

- Differing requirements for Marine Spatial Planning for offshore development between EU nations; and
- The potential challenges of using data for site selection across national boundaries.

There is no internationally accepted definition of Marine Spatial Planning or currently any EU legislation on Marine Spatial Planning. Accordingly, the policies outlining the processes required for license area site selection, and the data to be considered, differ between the EU member states. In this context, the SeaEnergy 2020 project was initiated to consider how to best address and remove obstacles, whilst promoting an integrated and coordinated approach to Marine Spatial Planning. A report “Delivering offshore electricity to the EU: Spatial planning of offshore renewable energies and electricity grid infrastructures in an integrated EU maritime policy” was published in May 2012. This recognises that longer term planning frameworks are needed to deal with the significant increase in demand for space that is anticipated, as offshore renewables will be competing with other uses of sea areas.

The drivers for the gathering and archiving of marine data, the data gathering methods and standards employed and delivery formats also differ between EU countries. The process of identifying potential marine development licence sites requires the consideration of a broad range of marine data. EU programmes to make data more accessible such as EMODnet and Copernicus have improved the discoverability of marine data for users, while highlighting the difficulties in compiling definitive comprehensive data from nation states into a usable format.

### 4. Method






The method used for this challenge is based on the approach used by HR Wallingford on commercial projects for the offshore wind industry to aid companies in selecting potential wind farm sites. The method is well-established and has been successfully used in identifying licence areas for other sea uses<sup>1</sup>.

The approach classifies data by their level of suitability, ranging from a grade 5 for exclusion zones, to a grade 1 for areas deemed appropriate for wind farm development. Buffers zones are used to limit site proximity to sensitive areas, allowing an efficient analysis of the interaction of the constraints and opportunities to produce an overall picture of the suitability of different parts of the area of interest for a wind farm. For each of the environmental features and marine activities mapped, a high level assessment is applied to determine the suitability (ranging from Very High to Very Low) within the two study areas (Table 4.1).

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<sup>1</sup> The HR Wallingford approach can be regarded as a ‘best practice’ as we are unaware of any published guidelines for offshore renewable site selection.

Table 4.1: Site suitability scoring index

Grade	Level	Symbol	Description
5	Very High		The presence of a variable makes the area unsuitable for wind farm development
4	High		The proximity to a suitability receptor or marine activity is adversely affected by the new wind farm or may put the wind farm at risk
3	Medium		The marine activity or sensitive receptor may be adversely affected by the installation and presence of a wind farm although the site may be suitable for development
2	Low		The site is suitable for development and there are only minor adverse impacts anticipated on the sensitive receptor or marine activity
1	Very Low		The site is suitable for development and there are no adverse impacts anticipated on the sensitive receptor or marine activity

A list of data groups required for the site selection process was provided by DG Mare in the project outline. The data analysis has been undertaken in two stages:

#### 1. Mapping of current sea-use

In the first instance, to avoid siting a wind farm in an area of seabed already in use through existing license areas, seabed obstructions, infrastructure or human activities, the following datasets were mapped and defined as exclusion areas:

- Existing sea-use, including:
  - Administrative/legislative boundaries
  - Cables and pipelines
  - Other wind farms and renewable energy devices
  - Oil and gas installations
  - Marine aggregate dredging grounds
  - Offshore disposal sites
  - Military training and disposal grounds
- Seabed obstructions, e.g. wrecks
- Shipping lanes
- Environmental sensitivities:
  - Marine Protected Areas.

Where necessary, buffers were used to grade distance from some marine features.

#### 2. Mapping of Environmental parameters

The resulting layers were overlaid with data, to which a grading was applied where appropriate, to make an assessment, based on available data, of the suitability of an area of seabed for the construction and running of a wind farm and its likely energy. These datasets included:

- Bathymetry
- Seafloor geology
- Distance from grid/supply chain

- Wind strength, including:
  - Maxima
  - Averages
  - Gusting
  - Long-term data
  - Direction where available
- Tidal data
- Topography.

The following data was also gathered and reviewed to consider potential environmental impacts of a wind farm:

- Environmental sensitivities:
  - Bird migration routes
- Commercial fishing grounds
- Distance from shore (visibility).

To define study areas for the work, the intersection points between national marine boundaries were given a 100km buffer (Figure 1). This was considered to be large enough to provide a suitable search area for identifying new wind farm licence areas of commercially viable size, while being small enough to meet the brief by remaining in proximity of the boundaries between National waters.

The output of the wind farm siting assessment is a series of individual GIS layers which considered existing sea use and the suitability of a site for development, each one graded using the suitability index displayed in Table 4.1. The classifications applied to data and suitability grades applied to them are presented in Table 4.2 and shown in Figures 2a and 2b. These were determined based on prior knowledge, documentary research and the default parameters used on the Windspeed project.

The classification of data and discussion of results take account of the potential for co-existence/ shared use with other sea-uses such as fishing and shipping, or the possible of relocation of other sea uses such as military practice areas. The areas selected are not dismissed on the basis of overlaps with shipping routes unless they are traffic management areas. It is also assumed that the presence of wrecks within an area does not preclude it as a potential wind farm license area. The potential development areas identified are not crossed by cables or pipelines although it is recognised that pipeline and cables can run through licence areas as long as a safe distance is agreed between them. The industry standard for the separation distance between a National Grid High Pressure gas pipeline and a wind farm turbine is 1.5 times the mast hub height. The safety advice can be found on the UK Onshore Pipeline Operators Associations website ([www.ukopa.co.uk](http://www.ukopa.co.uk)). There would therefore be could be scope for seabed co-use with the possibility of combining several of these smaller areas into a single larger licence area.

It is assumed that some data would only be expected to provide an initial impression of a site's suitability and that more accurate data would be gathered from potential sites following the initial site selection process. These datasets include seabed geology, wind and wave data, tidal data, ecological data and fishing activities.

The classification of existing sea use data enabled the identification of a series of potential licence areas, (Figures 3a & 3b).

Table 4.2: Data Requirements and Site Suitability classifications

<ul style="list-style-type: none"> <li>• Existing Infrastructure:               <ul style="list-style-type: none"> <li>– Pipelines, submarine cables</li> <li>– Anchorage Areas</li> <li>– Disposal sites</li> <li>– Marine Aquaculture sites</li> <li>– Wind farm sites</li> <li>– Aggregate extraction areas</li> <li>– Military firing areas</li> </ul> </li> <li>• Ordnance Disposal sites 0.5km buffer</li> <li>• Distance to Grid Over 371 km</li> </ul>	<ul style="list-style-type: none"> <li>• Commercial Navigation               <ul style="list-style-type: none"> <li>– Shipping traffic regulation areas</li> <li>– Ferry routes</li> <li>– Motorways of the sea</li> </ul> </li> <li>• Wrecks 0.5 km buffer</li> </ul>
<ul style="list-style-type: none"> <li>• Designated Conservation Areas               <ul style="list-style-type: none"> <li>– Natura 2000</li> <li>– MPAs</li> </ul> </li> <li>• Commercial Navigation 1km buffer</li> <li>• Distance from shore 0-16km</li> </ul>	<ul style="list-style-type: none"> <li>• Distance to Grid 100 - 371 km</li> <li>• Bathymetry Depth over 60m</li> </ul>
<ul style="list-style-type: none"> <li>• Commercial Navigation 3km buffer</li> <li>• Bathymetry Depth between 50-60m</li> <li>• Existing infrastructure Cables and pipelines – 1 km buffer</li> </ul>	<ul style="list-style-type: none"> <li>• Distance to Grid 50 - 100 km buffer</li> <li>• Distance from shore 16 - 29km buffer</li> </ul>
<ul style="list-style-type: none"> <li>• Bathymetry Depth between 30-50m</li> <li>• Distance from shore 29 - 40km buffer</li> </ul>	<ul style="list-style-type: none"> <li>• Distance to Grid 20 - 50km buffer</li> </ul>
<ul style="list-style-type: none"> <li>• Bathymetry Depth between 0-30m</li> <li>• Distance from shore over 40km</li> </ul>	<ul style="list-style-type: none"> <li>• Distance to Grid 0 - 20km buffer</li> </ul>

Source: HR Wallingford

The assessments of each dataset recorded in the data register for the wind farm siting challenge are provided in Appendix B.

## 5. Data

A broad range of data has been identified, downloaded where possible and reviewed for the challenge. The data was sourced primarily through online resources including:

- EU funded websites (EMODnet portals, Atlas of the sea, EEA);
- Government funded resources (BODC, NOC resources);
- Commercial spatial data products (SeaZone Hydrospatial products);
- Industrial websites (4COffshore, FINO).

As the wind farm site selection process is primarily based on spatial analysis, the challenge required data to be made available in formats which could easily be used in a Geographic Information System (GIS). This was the case for most data identified and reviewed for the challenge, although the discoverability and accessibility of the data, format and usability of data varied a great deal.

As the study areas for the wind farm siting covered the boundaries between national waters, the data used needed either to be sourced from each country or sourced from a location where the data had already been compiled into one or more datasets covering the North Sea. All data identified has been recorded in the data register (Appendix B). Following an initial assessment of data accessibility and fitness for purpose, a small number of datasets have been used in the analysis for the wind farm siting exercise. The data considered suitable for use in the challenge is listed in Table 5.1. Details of the datasets reviewed and either excluded or considered but not-used are provided in Appendix B.

Table 5.1: Data suitable in meeting the wind farm siting challenge

Data	Inspire theme	Sources Suitable
Wind strength	3.13 Atmospheric conditions	DT.Wind.NS103-CCMP wind data DT.Wind.NS101-Met Office
Wave data	3.13 Atmospheric conditions	DT.Wind.NS083-European Atlas of the Seas - Average coastal wave height and direction DT.Wind.NS098-NOAA Climate Forecast System
Seafloor geology	2.4 Geology	DT.Wind.NS027-One Geology - geology for European seabeds DT.Wind.NS026-EUSeaMap - predicted seabed habitat for Celtic, North, Baltic and western Med
Designated sites	1.9 Protected sites	DT.Wind.NS090-European Environment Agency - Natura 2000 - spatial data DT.Wind.NS076-European Atlas of the Seas - Natura 2000 sites DT.Wind.NS021-OSPAR map of protected areas
Fisheries and mariculture	3.19 Species distribution 3.9 Agricultural and aquaculture facilities	DT.Wind.NS015-CEFAS spawning and nursery grounds DT.Wind.NS107-SeaZone Hydrospatial One - Aquaculture and Fisheries DT.Wind.NS013-MMO fishing density grids

Data	Inspire theme	Sources Suitable
Bird and Cetacean migration	3.19 Species distribution	DT.Wind.NS116-JNCC Cetacean database 2013
Distance from grid/supply chain	3.20 Energy resources	DT.Wind.NS001-ENTSO-E electronic grid map DT.Wind.NS004-National Grid Sub-station sites
Distance from shore	3.11 Area management / restriction / regulation zones & reporting units	DT.Wind.NS119-ESRI land areas
Topography	2.1 Elevation	DT.Wind.NS029-EEA elevation map 1000m cell size
Bathymetry	1.8 Hydrography	DT.Wind.NS003-EMODNET Bathymetry Gridded Bathymetry. 1 arc second resolution DT.Wind.NS104-SeaZone Hydrospatial One - Bathymetry
Seabed infrastructure (Cables and pipelines)	3.20 Energy resources	DT.Wind.NS109-SeaZone Hydrospatial One - Cable and Pipeline installations
Commercial license areas (wind farms, dredging, oil & gas)	3.20 Energy resources 3.21 Mineral resources	DT.Wind.NS112-SeaZone Hydrospatial One - Licenced Areas DT.Wind.NS114-SeaZone Hydrospatial One - Renewable energy activity DT.Wind.NS118-The Crown Estate Wind farm Licence Areas
Military training and disposal grounds	3.11 Area management / restriction / regulation zones & reporting units	DT.Wind.NS115-SeaZone Hydrospatial One - Military activity
Seabed obstructions, e.g. wrecks	1.8 Hydrography	DT.Wind.NS105-SeaZone Hydrospatial One - Wrecks
Administrative boundaries	3.11 Area management / restriction / regulation zones & reporting units	DT.Wind.NS089-European Environment Agency - Maritime boundaries
Shipping	1.7 Transport networks	DT.Wind.NS084-European Atlas of the Seas - Ferry routes DT.Wind.NS085-European Atlas of the Seas - Motorways of the sea DT.Wind.NS110-SeaZone Hydrospatial One - Traffic Regulation
Tidal data	3.13 Atmospheric conditions	DT.Wind.NS080-European Atlas of the Seas -tidal amplitude DT.Wind.NS120-BODC tidal range data



Reasonably long term numerical model datasets for wind and waves are available for the North Sea either at a cost per point (e.g. Met Office ReMAP, NORA10, OceanWeather products), making them expensive for a site selection survey, or have a coarse resolution making their usefulness debatable for wind farm siting (e.g. ERA-Interim). Wind fields have been analysed from the Cross-Calibrated Multi-Platform (CCMP) wind dataset derived and distributed by NOAA/NASA. This dataset is readily available, with documentation and related scientific articles available only and data hosted on a well maintained data server (at PODAAC) with a variety of access methods available including OpenDAP – which was used here. The dataset is global, with a 25km spatial resolution, and 6 hour temporal resolution covering 1987 to 2011. It is distributed free of charge.

The regional wave models of the Climate System Forecast Reanalysis (CFSR) project have been used to estimate wave climate at the sites. These are thought to provide good estimates of wave climate in general, and sufficient accuracy for site selection studies, while needing additional detailed validation and calibration of extremes before use in design. Spatial resolution varies between 4 and 18km in the wave model (forced by a 50km resolution atmosphere model). Temporal resolution is 3 hours, with coverage from 1979 to 2009.

The dataset is distributed free of charge, and is hosted on a data server at NOAA. Metadata, in terms of study reports, is readily available. The dataset is available to download in full, and takes considerable effort to download and decode, with some clarification on coordinates needed through communication with the dataset owners. Tidal range data was downloaded from the BODC website and from the Europa.eu website via the European Atlas of the Sea. Tidal data provided through the Europa.eu website was based on tidal range at the 237 locations extrapolated from the database distributed by ARGOSS. This database combines tidal harmonics assimilated from approximately 7300 coastal stations into a shallow-water tidal model with satellite measurements used to give a good overview of the tidal patterns in deep water, to provide a tidal model in shallow coastal seas where tidal effects are most prominent. Measures of maximum and minimum mean spring and neap tides were also reviewed from the NERC website (<http://www.ntsif.org/tides>).

## 6. Results

### 6.1. Challenge output

#### 6.1.1. Introduction

The wind farm site selection exercise was successful in identifying potential sites across the two study areas specified in the project brief. Limitations were expected for both of the study areas as the territorial boundaries between Norwegian, UK, Danish, German and Dutch waters (Area A) lies in the middle of the North Sea to the east of Dogger bank, a long way offshore in relatively deep water, while the boundaries where UK, Dutch and Belgian waters meet and UK, Belgian and French waters meet lie close together towards the eastern extent of The Channel (Area B) in an area of heavy sea-use.

#### 6.1.2. Area A

Area A lying to the East of the Dogger Bank (Figure 1) is already home to a large offshore license area, designated by the UK for development. The Dogger Bank is listed as an MPA and under Natura 2000 in UK waters, designated for the EU Habitats Directive interest feature ‘Sandbanks which are slightly covered by sea water all the time’.



An initial mapping of existing sea-use within the area (Figure 2a) showed some existing licence areas including the expansive Dogger Bank wind farm licence area. This area is expected to see considerable shipping traffic running from the Channel and southern North Sea ports, up towards the Baltic and is known to be popular with the fishing industry.

The assessment of existing sea-use identified approx. 5,637.84 km<sup>2</sup> of seabed currently unutilised for which further assessment of potential for wind farm licencing could be undertaken (Figure 3a). Much of the study area is characterised by moderate to deep water and is of considerable distance from the existing grid. Water depth and distance to shore are two of the most important cost drivers for offshore wind farm development.

An assessment of the bathymetry data showed that the areas identified for potential development lie at a depth of between -20 and -120m. In areas with a depth of less than 45m, there could be scope for installation of jacket foundation turbines. For areas with depths over 45m, the use of floating turbines would need to be considered. Technology for floating turbines is currently being trialled in several areas although still remains in its infancy.

The distance to the existing grid of any of potential wind farms in Area A would be considerable, with distances expected over 250 km. To put this in perspective, the average water depth of wind farms completed, or partially completed, in 2013 was 20 metres (m) and the average distance to shore was 30 km (EWEA, 2014). A plot produced by EWEA of planned, licensed and built wind farms showing average distance from shore against water depth showed that online, under construction and consented wind farms focus on water depths of less than 60m and consider a maximum distance from shore of 120km. Although these maxima are expected to increase with developments in technology, the cost of construction and maintenance also increase with depth and distance from shore.

Offshore wind farms located near the coast, to date, tend to be connected to the grid using conventional alternating current transmission systems. This approach is most economical for distances under 80 kilometres from the grid. Over longer distances, however, energy is lost due to reactive power losses through the submarine cable's insulation layer. The development of High Voltage Direct Current (HVDC) technology, would enable large amounts of direct current can be transmitted over hundreds of kilometres with almost no losses, reducing the costs of developing wind farms further offshore. The offshore grid, currently under development for the North Sea, is expected to be constructed to produce 40GW by 2020 and 150GW by 2030.

Therefore, the cost implications of developing wind farms in this area, primarily guided by whether depth and distance from shore are expected to be high, though the technology will soon make such developments economically viable. The existing licence area on the Dogger Bank is expected to produce 7200MW across six wind farms within the licence area, making it one of the largest planned developments to date. The size of the area licenced would need to be large enough for the construction, laying of cables and long-term maintenance to be economic.

Wind speed data was extracted from the CCMP database for turbine heights of 10m (Figure 4). An indication of hub height winds can be gained by applying a roughness length based height correction, e.g. A factor of 1.23 applied to a 10m height wind speed can be used to estimate a 120m height wind speed. The wind roses extracted from the data showed similar patterns in wind characteristics across the Southern North Sea, suggesting a prevalent wind direction with 40% of conditions ranging from WSW to SWS and wind speeds ranging from 0-40m/s most commonly in the range 5-10 m/s. The wind speed averages range from 7 to 10m/s which are within a range which would be a firm basis for a more in-depth assessment of wind

parameters to be undertaken using higher resolution commercial products such as the Met Office 35 year re-analysis or the NORA10 dataset.

The regional wave models of the CFSR project used to estimate wave climate (Figure 5) suggested a fairly consistent mean significant wave height across the site ranging from 2.3 to 2.5m. Assuming a maximum significant wave height of 1.5m to maintain site access, a more detailed analysis of potential sites would need to be undertaken to estimate the numbers of days per annum where significant wave height exceeds 1.5m as these would be expected to be relatively high. Based on the data gathered by the National Tidal and Sea Level facility for Whitby, tidal range was estimated for the Dogger Bank with B with mean spring tidal predictions calculated between 2008-2026 ranging from 1.0-5.60m and mean neap tidal ranges of between 2.25 - 4.50m. These values would be expected to be lower offshore with a tidal range estimated between 2-3m.

The geology data available from the EMODnet OneGeology portal provided only a rough indication of the character of superficial sediments in the area. Although a higher resolution of data would have been available from The British Geological Survey (BGS) for UK waters, this would only have provided partial coverage of the study area. Focussed geotechnical sampling would be expected to be undertaken in advance of any licence application being pursued. The data showed that the majority of the North Sea is characterised by fine grained sediments with banks of coarser gravel beds running out towards the Dogger Bank.

An assessment of the distance from the sea for potential licence areas showed that none were close enough to the coast to be visible and would therefore not be expected to have an impact on the landscape character. The seascape character would only be affected from the perspective of passing shipping traffic and would be dependent on the distance between the vessels and the turbines.

The most accessible data for assessing fisheries, commonly used in wind farm environmental assessments in combination with on-site sampling was the data published by CEFAS using ICES rectangles (Figure 6). The data provided an overview of spawning and nursery site records which would benefit from being viewed alongside VMS data and be supported by ecological survey to provide a more detailed and up-to-date reflection of fish habitats and fishing activity. A review of fishing nursery and spawning data published by CEFAS suggested Area A to be a high intensity spawning ground for Cod with low intensity spawning and nursery sites for Spurdog, Herring, European Hake, Ling, Mackerel, Sandeels, Anglerfish, blue whiting and Whiting.

### 6.1.3. Area B

Area B, located in the northern extremity of the English Channel/La Manche (Figure 1) is characterised by high levels of commercial and recreational navigational activity. Much of the inshore areas are restricted navigational areas such as inshore traffic zones, with traffic separation zones running up the middle of the channel. Ferry routes cross between the major ports of England, France, Belgium and the Netherlands, as well as running out towards the North Sea and Baltic ports. The area is divided up by an extensive network of pipelines and cables running between England and mainland Europe (Figure 2b).

The exclusion of seabed areas where existing features would restrict the development of a wind farm leaves numerous small potential license areas ranging from 3km<sup>2</sup> in size. All areas with an area of less than 20km<sup>2</sup> were removed from the resulting analysis as these were considered to be too small to be viable as potential wind farm licence application areas. The assessment of existing sea-use identified approx. 3,262.90 km<sup>2</sup> of seabed currently unutilised for which further assessment of potential for wind farm licencing could be undertaken (Figure 3b).

The bathymetry across much of the area is relatively shallow exhibiting depths of –0 to -55m, with most areas exhibiting depths under 30m able to accommodate a range of wind farm designs, though most of those shallower coastal areas are already occupied by navigational restriction areas, existing licence areas and environmental protection areas, restricting scope for further development. The mid channel depths range from -30to -50m, much of which could accommodate wind farm development.

Distances to the grid are small enough to enable a new wind farm to be connected using conventional alternating current transmission systems, for which an extensive network is already in place. A large number of wrecks lie on the seabed in the Channel. The position of these and potential for unrecorded wrecks and obstructions would need to be taken into account during the design of a wind farm but do not significantly affect the licencing process.

Despite the narrow reaches of the English Channel, none of the remaining potential development areas are within close enough proximity to the coastlines of England, France, Belgium or the Netherlands to present a significant impact to the character of the coastal landscape though would affect the seascape in the vicinity of a wind farm development.

Sediment depth and grain size affect the likely stability of a wind farm site and the likelihood of experiencing problems of erosion. The geology data available from the EMODnet OneGeology portal provided only a rough indication of the character of superficial sediments in the area, with no indication of sediment depth. Although more detailed geological data can be purchased for part of the North Sea from the BGS, a more detailed assessment of geological and geotechnical data would still need to be made using on-site geophysical and geotechnical sampling. The data from EMODnet substrate map suggested the presence of extensive gravel banks running along the Channel bed. The selection of seabed areas characterised by coarse grain size or a combination of mud and coarse sediment may be less prone to erosion depending on the tidal regime and sediment depths across potential licence areas.

Wind speed data was extracted from the CCMP database for turbine heights of 10m (Figure 4). An indication of hub height winds can be gained by applying a roughness length based height correction, e.g. A factor of 1.23 applied to a 10m height wind speed can be used to estimate a 120m height wind speed. The wind roses extracted from the data showed similar patterns in wind characteristics across the Southern North Sea, suggesting a prevalent wind direction with 40% of conditions ranging from WSW to SWS and wind speeds ranging from 0-40m/s most commonly in the range 5-10 m/s. The wind speed averages range from 7 to10m/s mid Channel which are within a range which would be a firm basis for a more in-depth assessment of wind parameters to be undertaken using higher resolution commercial products such as the Met Office 35 year re-analysis or the NORA10 dataset.

The regional wave models of the CFSR project (Figure 5) used to estimate wave climate suggested a fairly consistent mean significant wave height across the site ranging from 1.4 to 2.5m Hs. Assuming a maximum significant wave height of 1.5m to maintain access feasibility, a more detailed analysis of potential sites would need to be undertaken to estimate the numbers of days per annum where significant wave height exceeds 1.5m although these would be expected to remain relatively low. Based on the data gathered by the National Tidal and Sea Level facility for Harwich, tidal range was estimated for Area B with mean spring tidal predictions calculated between 2008-2026 ranging from 0.5-4.15m and mean neap tidal ranges predicted between 1.12 – 3.34m.

A review of fishing nursery and spawning data published by CEFAS suggested Area B to be a high intensity nursery ground for Herring and Sole in the mouth of the Thames Estuary and Sole off the Normandy Coast of France (Figure 6), with low intensity spawning and nursery sites for Cod, Tope Shark, Herring, Mackerel, Plaice, Sandeels, Sole, Thornback Ray and Whiting. The CEFAS data provided an overview of spawning

and nursery site records which would benefit from being viewed alongside VMS data and be supported by ecological survey to provide a more detailed and up-to-date reflection of fish habitats and fishing activity.

#### 6.1.4. Outcome

The method used for wind farm siting was adapted from an approach used for site selection for much smaller license areas. Using this approach, it was possible to make an indicative assessment of potential areas for wind farm licencing using available data accessible online. A more detailed evaluation would need to be undertaken through a full environmental assessment using commercial data products combined with a regime of site specific data gathering to make a more accurate evaluation of site potential.

The location of wind farms on Area A would primarily be dependent on the wind farm technology available and therefore the timeframe for development. The development of floating turbines and HVDC technology will open up new areas for potential development.

The greatest challenge for Area B is finding a licence area large enough amidst existing marine activities and infrastructure for a wind farm to be cost effective. Although the cost of installation and maintenance would be relatively small, the size of potential new licence areas would be intersected by cable and pipelines and potentially present conflicts of interest with other sea users such as commercial shipping, recreational seafaring and fishing. The investigation of options for co-use of the seabed would enable larger licence areas to be defined.

## 6.2. Data Adequacy

This section reports on the data adequacy to deliver the challenge. Data adequacy is reported under the six value assessments used for screening the data.

### 6.2.1. Contribution – Does the data contain the right parameters?

On the surface there is a large amount of data available that can contribute to solving the wind farming challenge. The difficulties arise when looking deeper into the study as it is hard to appraise the precise contribution that data can make unless the data is actually used. For example the metadata may be too imprecise to rule data in or out and there may be no lineage information to verify the provenance of the data and hence the value of its contribution.

As a result of the above, the range of data considered, downloaded and reviewed was much broader than the data used as part of the wind farm siting process. Many sites had to be investigated in order to ascertain whether they contained data of potential use to the challenge. For instance, the EMODnet physics and EMODnet biology sites were looked at but data was not considered as the data was found to be too detailed and a broader interpretation of ecology was required respectively.

The core of data used for the wind farm siting was sourced from SeaZone Hydrospatial Base, as anticipated in the project design. The data was delivered as a geodatabase with accompanying mxd and instructions.

Hydrospatial Base supplies S57 navigational chart data, as well as additional information where available in a form suitable for desktop GIS. It contained much of the data needed to provide a characterisation of:

- Existing infrastructure:
  - Wind farm license areas
  - Dumping grounds

- Cables and pipelines
- Wrecks and obstructions
- Bathymetry
- Commercial navigation channels
- Mariculture sites
- Administrative boundaries.

In many cases, data providers sourced their data from different locations, leading to inconsistencies and uncertainty over the definitive versions of data and hence the contribution of one dataset over another. For example, munition dumping grounds provided by SeaZone's Hydrospatial Base were sourced from SHOM, while munition dumping grounds provided through the EMODnet Human Activities portal recorded OSPAR as the source. The SeaZone dataset was in this case used in the wind farm siting exercise as it appeared to contain all of the data in the EMODnet dataset as well as additional records. Some of the data available from EMODnet was available as polygons and others were provided as point data. All points provided by EMODnet were available as polygons from SeaZone; however the spatial locations sometimes varied between individual features (i.e. the point didn't sit within the equivalent polygon).

A series of buffer zones of the coastline were produced to represent the distance from shore to incorporate an assessment of visual impact into the sensitivity assessment. To obtain a representation of distance from grid, data was downloaded from the National Grid for the UK. A more comprehensive map was also downloaded from the ENTSO-E website as a pdf. The National Grid data and buffering of the shoreline were enough to make an initial assessment of the distance to the existing grid for the study areas in question. However, for accurate measurements of distances for specific licence application areas, the underlying data used to produce the map of existing sub-stations would need to be acquired from ENTSO-E or the sites would need to be identified from terrestrial vector maps.

Fishing data was difficult to source. CEFAS spawning and nursery data was downloaded and although the data was coarse and had last been updated in 2010, it proved to be the most accessible data on fisheries available. Beyond ICES, OSPAR, CEFAS data there is little data which is readily available online for planning purposes without needing to contact individual data providers directly with data enquiries.

There are a lot of published reports on bird migration, some EU resources due to become available online in the near future, and some statistical data on fishing effort but the most valuable data for fishing, as shown in the ICES published reports, lies in the VMS data which is difficult to obtain and can be costly. The MMO publish annual datasets providing summaries of fishing activity for UK commercial fishing vessels of 15m and over in length that are deemed to have been fishing within a specified calendar year. The data is referenced to a grid equal to a 0.05 degree sub-rectangle to provide a higher resolution, however now supporting documentation was found to guide how the data should be used. Beyond these datasets, there was no easily accessible resource to be found for making assessments on fisheries and birds.

Although some data exists on bird and cetacean sightings, these do not provide an adequate understanding of migration routes. In most wind farm licencing applications developers would be expected to site specific data on marine species.

Additional data gathered was sourced through the European Atlas of the Seas website, such as ferry routes and Motorways of the sea from the European Atlas of the Sea, used in combination with filtered traffic regulation areas from SeaZone Hydrospatial Base to produce a representation of shipping activity across the North Sea. The data was downloadable following re-direction to the originator's website such as Europa.eu.



### 6.2.2. Location – Does the data cover the correct time / space location?

A large proportion of data identified was accessible through EU-funded websites and therefore had an EU remit. Some of the data portals were already familiar to the project team following the literature survey, while others such as the European Atlas of the Sea were discovered through basic internet searches such as “download natura 2000 +north sea”.

In many cases, there were contrasts in the coverage of data provided from different sources. In some cases EMODnet portals had not received data from all National data providers; accordingly the data downloaded covered only part of the project study area (for example Wind farm license areas covered only Norway, EMODnet Human activities portal), or in some only provided data outside of the North Sea cases (dredge spoil dumping grounds, polygons, EMODnet Human activities portal).

### 6.2.3. Commercial – Are the commercial terms acceptable?

The commercial terms for addressing the challenge were acceptable. However if this challenge was being undertaken for real that considerable sums of money would need to be spent to obtain specific information on the site characteristics. Nevertheless, there is a plethora of information that is either free or available at low cost (<€500).

It is not a case that ‘all data needed is free’ as there is a market and demand for commercial marine data products driven by the difficulties in accessing high quality, definitive and comprehensive marine data. For many of the data types required to meet the challenge, a commercial product was available which reduced the time required in gathering and quality assessing data or provide a higher resolution of information than the data which is freely available online.

In most cases there was enough information held in the free products to make an initial assessment of the characteristics on a potential site. However, the purchase of chargeable data such as VMS data for mapping fishing activities and commercial shipping, commercial seabed geology products produced by the BGS for the North Sea and higher resolution wind and wave data would be necessary and expected in the context of a real marine licence application.

Shipping density data provided by Anatec would have provided a truer reflection of commercial shipping activities in the North Sea than the derived datasets provided via the European Atlas of the Seas website but the data costs were unnecessary in meeting the requirements of the project. The MMO also published a GIS dataset of anonymous AIS tracks via the Environment Agency geostore, which provided a useful insight into ship movements across a single year and a density grid of the movements of fishing vessels over 15m. Further publication of these types of datasets and availability through resources such as the EMODnet human activities portal alongside guidance on how the data should be displayed would provide planners and developers with a valuable resource.

Wind and wave data was sourced and downloaded where data was freely available. Sources of chargeable data were also recorded in the database but not used.

### 6.2.4. Attributes – Does the data have the correct attributes?

During the identification of possible data sources, it was found that there were considerable overlaps between data providers, often offering data from different sources. The data needed to be compared and metadata reviewed to decide whether the datasets were the same or not and to identify the most accurate data.

Where the same data was available from more than one source, it had to be downloaded in duplicate to ensure that the most up-to-date version was used. Data from multiple sources were grouped by type and appraised to identify resources best suited to meeting the challenge.

Some data was too coarse, usually as a result of being compiled into a single dataset alongside data from multiple sources provided at different resolutions. Where point data was provided in the place of extent polygons (e.g. Atlas of Seas Offshore Wind farms, Europa.eu marine energy production facilities) data becomes too imprecise for use in a license area siting exercise, where knowing the spatial extent of existing marine license areas is very important.

In addition there was considerable overlap in the type of data available. Human activity data in particular was often available via multiple EU sites as well as via SeaZone's Hydrospatial products. The data tended to be a compilation from multiple providers and was often derived in order to provide it in a single format and resolution. For instance, commercial license areas depicted as point data rather than showing license area extents.

During the identification of possible data sources, it was found that there were also considerable overlaps between websites, particularly for government and EU funded data. In many cases, the same data was available through different websites, raising questions on which was the most up-to-date and definitive version. There were similarly themed datasets also available through different government funded resources, although the data needed to be compared and metadata reviewed to decide whether the datasets were the same or not.

### 6.2.5. Delivery - Can the data be provided to match the timeframe of the challenge?

The majority of data reviewed for the challenge were easily accessible, downloaded from the internet, sometime following registration to a website. This was the case for all of the freely available resources assessed. The requirement for registration was not considered to be a barrier to data access, though in some instances, where the registration process was not automated, the response from the data provider could be slower.

In the case of commercial products and data derived from commercial activities such as VMS data, the process of putting in a request for a quote, followed by an order could take a little longer, although none of the responses presented a barrier to the challenge.

The ease of use of EMODnet portals was found to vary with the nature of data and access requirements. Portals containing links to the download of zip files such as the seabed habitat portal and the human activities portal were easy to use and enabled fast access to the data.

### 6.2.6. Usability – Is the data format and supporting information suitable?

Some resources were only available as a pdf, kml or as a static image, while others are provided in a format allowing it to be put straight into a dynamic map with no pre-processing required. Much of the biological, chemical and physical datasets are provided in underived formats as they contain sampling results. Some users require the data to be maintained in its original format to enable applications such as time series modelling. This however makes the data more difficult to access for non-experts in these fields who may be looking for interpreted data such as characterisations or density maps.

There were instances where source paths to access datasets were broken. This occurred both during navigation to a data download page (for example the MPAs dataset shown in the European Atlas of the Seas portal could not be downloaded due to a broken link) and in the display of downloaded data, as was the case for the EEA hydrodynamics and sea-level rise data. An mxd was provided to facilitate the viewing of symbolised data. However the source path still led to the originator's C drive and D drive!

Some data such as the Europa.eu wind farm data contained no co-ordinate reference system (CRS) information so that the data displayed in the wrong place when loaded into a GIS workspace, making it difficult to use without having to first identify the projection used in order to assign the data a CRS and apply a transformation to bring it into line with other data. As the data was also displaying point data it was not used for the wind farm assessment.

### 6.3. Key Data Gaps

The main data gaps identified through the wind farm siting challenge were in sourcing spatial datasets for ecology and fishing activities. Although baseline data was found, much of the precise data had to be identified from reports and requested from the authors. There are EU initiatives in progress to make some data available but much of the existing data remains scattered and not very user-friendly. It is important therefore to make the most of data which has been made available. The interpreted AIS and VMS datasets published by the Marine Management Organisation in the UK could be useful to a broad range of users and need to be made more discoverable.

The resources for finding data for the North Sea are numerous. Some data is discoverable through data discovery portals such as those managed by SeaDataNet and MEDIN<sup>2</sup>. These have a strong focus on raw environmental data, such as survey results, though MEDIN are expanding their data archive centres to include other areas such as heritage data.

There are a broad range of data types available through EU-funded portals such as EMODnet, Copernicus, EEA and European Atlas of the Sea. While many of the data resources available provide useful metadata as part of the product download, there are currently limited means for searching the metadata from the contents of the portals for EU funded resources before the data is downloaded. The EMODnet query tool would be a suitable platform for developing capability for users to search through discovery metadata for all EMODnet data products and potentially data from other EU portals.

Better integration between EU-funded marine data resources such as EMODnet and the European Atlas of the Sea would be seen as a benefit. Although these resources have overlapping remits, the data provided is not necessarily sourced from the same providers, particularly in the case of human activities data. A centralised EU data discovery portal or promotion and development of existing discovery resources portals to incorporate data currently not supported such as human activities data would help users differentiate between data products and improve signposting. More information on metadata before pressing the download button could save considerable time spent searching for data.

The loss of data resolution in favour of providing a data product was a re-occurring problem particularly with data relating to sea-use and human activities. The display of extent polygons as point data makes the data useless in the context of marine spatial planning. This is a problem which could be addressed through the delivery of data by provider rather than by data type. Although the user would need to download more

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<sup>2</sup>[MEDIN - Marine Environmental Data and Information Network](#)



datasets and deal with the conflicts between datasets themselves, this would also ensure that the data provided through EMODnet was at its highest available resolution and would make it easier for the portals to publish regular updates.

These are issues which will be considered during the delivery of successive challenges and will be a valuable topic for discussion at the next panel meeting.

## 7. Discussion and Conclusions

### 7.1. Discussion

The data available for the study areas was suitable in meeting the requirements of the challenge though the quality of data differed.

The quality assessment of data was an ongoing process, based on assessing accessibility of data, costs, relevance, usability and usefulness via the data gathering and mapping stages of the challenge. All of these criteria varied a great deal between datasets.

Some key points regarding data adequacy for the North Sea have been identified through the completion of the wind farm challenge.

- The data for wind farm siting is required as far as possible in an accessible format, so that it can be easily viewed and compared to other data using off the shelf GIS products or spreadsheets. Much of the data required to complete the challenge are the same as the baseline information used for most planning assessments and licence applications: **Usability**
- Identifying definitive data for all of the national waters was time consuming, often leading to the investigation of resources which later turned out not to be relevant or which proved too complex to use for planning purposes. The lack of detailed descriptions of the contents of data resources encouraged the use of a commercial product over freely available government and EU funded resources: **Delivery**
- A large proportion of data identified was accessible through EU-funded websites and therefore had an EU remit. It was therefore assumed that the data available from these sites would provide full coverage of EU waters. This was often not the case. Some datasets only contained data submitted by one or two EU nations and did not cover any of the challenge study area: **Location**
- There was considerable overlap in the type of data available. Human activity data in particular was often available via multiple EU sites as well as via SeaZone's Hydrospatial products. On the EU portals, the data tended to be a compilation from multiple provides and was often derived in order to provide it in a single format and resolution. For instance, commercial licence areas depicted as point data rather than showing licence area extents. This reduction in resolution made the data unsuitable in meeting the challenge requirements as the extents of existing licence areas needed to be known: **Attributes**
- In many cases, the same data was available through different EU and nationally funded websites, raising questions on which was the most up-to-date and definitive version. There were similarly themed datasets also available through different government funded resources, although the data needed to be compared and metadata reviewed to decide whether the datasets were the same or not. Although the data was useful, it took time to identify a definitive source: **Contribution**
- Some data, although freely available through EU websites, was not provided in a format which allowed it to be integrated into GIS for analysis alongside the other data. For example, the BGS data provided

through EMODnet Geology was available as a kml, and had to be viewed alongside the challenge output after the analysis of core data.: **Usability**

- There were cases where the cost of data required to undertake a wind farm siting exercise was not justifiable. In these cases, chargeable and freely available data was reviewed for its usefulness to the challenge and the best available low cost or freely available data was used. A license for SeaZone Hydrospatial Base product was used as it had been identified in the proposal as a core dataset and a license has been made available for all of the project challenges. **Commercial**
- Some data such as the Europa.eu wind farm data contained no co-ordinate reference system (CRS) information so that the data displayed in the wrong place when loaded into a GIS workspace, making it difficult to use without having to first identify the projection used in order to assign the data a CRS and apply a transformation to bring it into line with other data. As the data was also displaying point data it was not used for the wind farm assessment: **Attributes**

## 7.2. Conclusions

The key conclusions for the wind farm challenge are as follows:

- The wind farm siting challenge could be delivered, using data readily available across the North Sea basin.
- Delivery of the challenge relied very heavily on the commercial SeaZone Hydrospatial data set than data from EMODnet and Copernicus. This is because the SeaZone data was available as a single package with geometric and semantic inconsistencies addressed. It could be readily loaded as a single entity into a GIS.
- There is a plethora of EU-level websites offered relevant data that can contribute to the project. These data however are often derived from a combination of the same sources. The derivation however is not explicit, requiring considerable detective work to determine the true value of each of the data. There is a need to adopt persistent signposting services (like that being proposed by the North Sea Check Point) to broker the right data to the right application.
- There are very distinct data gaps for data related to fisheries, marine animals (birds and mammals primarily) where reports rather than data services need to be referred to. There is a need to examine how the EMODnet can fill this gap.
- For some EMODnet portals, harmonisation of data structures across suppliers has led to a reduction in data value. If EMODnet is to be a reference others can rely on, we need to encourage data supply as close to source as possible.

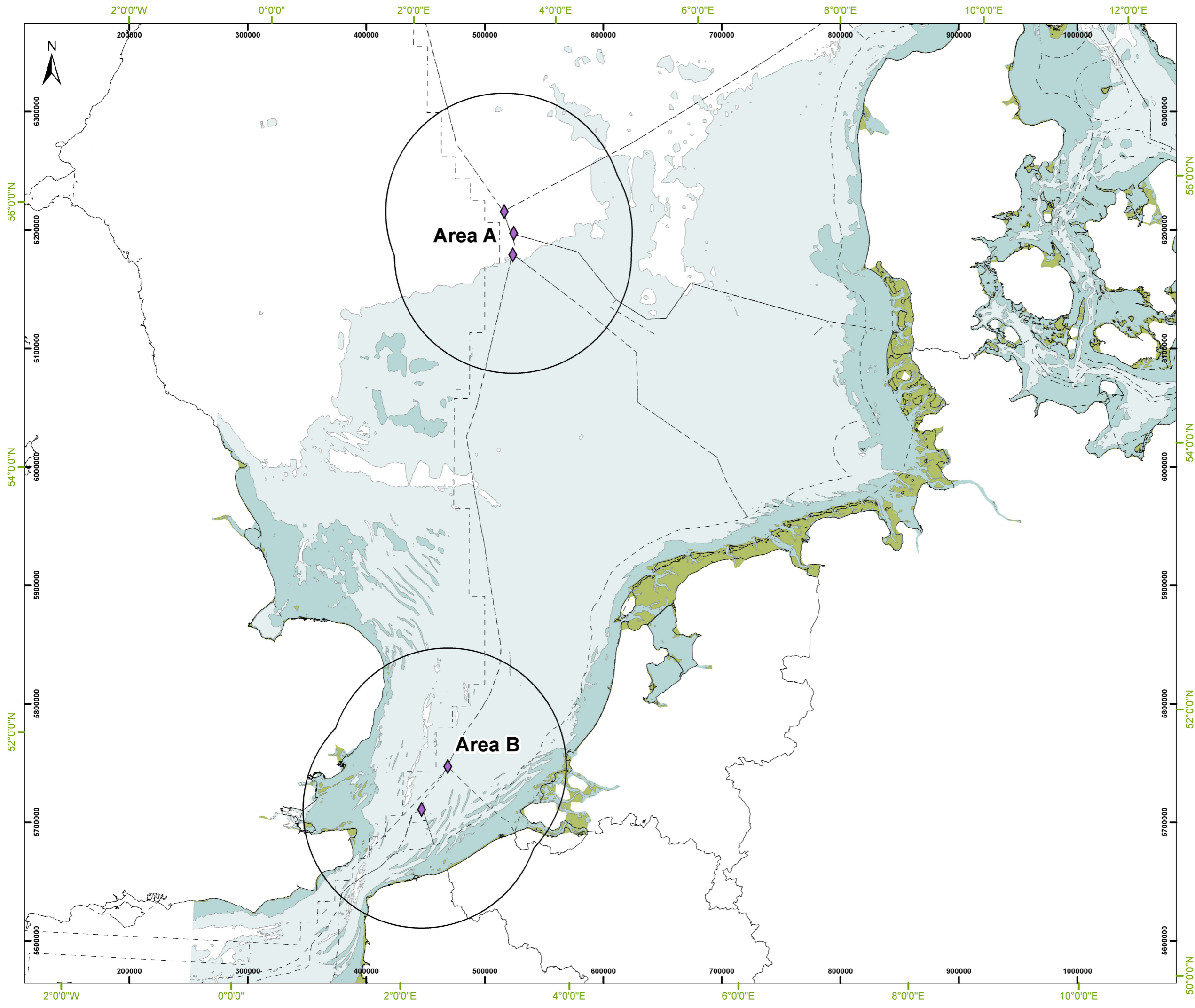
## 8. References

European Wind Energy Association, 2014, The European offshore wind industry -key trends and statistics 2013, January 2014,  
[http://www.ewea.org/fileadmin/files/library/publications/statistics/European\\_offshore\\_statistics\\_2013.pdf](http://www.ewea.org/fileadmin/files/library/publications/statistics/European_offshore_statistics_2013.pdf)

European Wind Energy Association, 2012, SeaEnergy 2020 – Final Project Report, May 2012,  
[http://www.ewea.org/fileadmin/ewea\\_documents/documents/publications/reports/Seanergy\\_2020.pdf](http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/Seanergy_2020.pdf)

# Appendices

## A. Figures



Study Area Location  
 Study Area 100km Buffer  
 EEA Maritime Boundaries

**Bathymetry (m)**

	-2 - 0
	-20 - -2
	-50 - -20
	Less than -50

**GEODETTIC INFORMATION**  
 PROJECTION: UTM 31 NORTH  
 SPHEROID: WGS 1984  
 DATUM: WGS 1984

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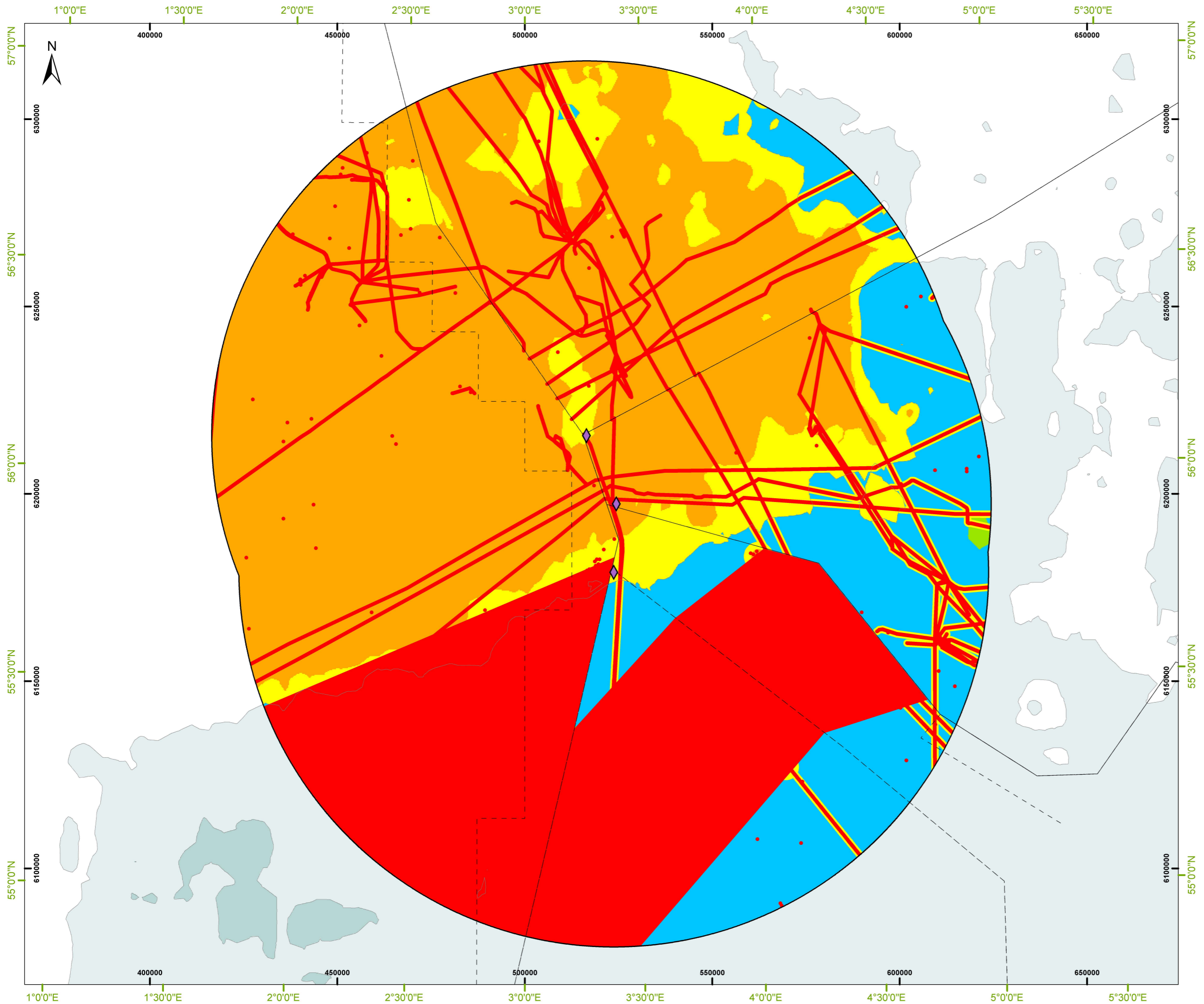


**Figure 1: Wind Farm Siting Challenge Study Areas**

**HR Wallingford**  
*Working with water*

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PROJECT REF: DLS0342		
DRAWING: DLS0342-001-01-DDE		





◆ Study Area Location  
 Study Area 100km Buffer  
 EEA Maritime Boundaries

Bathymetry (m)	
	-2 - 0
	-20 - -2
	-50 - -20
	Less than -50

Site Suitability Scoring Index		
Level	Grade	
	Very High	5
	High	4
	Medium	3
	Low	2
	Very Low	1

- **Existing Infrastructure:**
  - Pipelines, submarine cables
  - Anchorage Areas
  - Disposal sites
  - Marine Aquaculture sites
  - Wind farm sites
  - Aggregate extraction areas
  - Military firing areas
- **Ordnance Disposal sites:**
  - 0.5km buffer
- **Commercial Navigation:**
  - Shipping traffic regulation areas
  - Ferry routes
  - Motorways of the sea
- **Wrecks:**
  - 0.5 km buffer

- **Designated Conservation Areas:**
  - Natura 2000
  - MPAs
- **Commercial Navigation:**
  - 1km buffer
- **Bathymetry:**
  - Depth over 60m

- **Commercial Navigation:**
  - 3km buffer
- **Existing infrastructure:**
  - Cables and pipelines (1 km buffer)
- **Bathymetry:**
  - Depth between 50-60m

- **Bathymetry:**
  - Depth between 30-50m

- **Bathymetry:**
  - Depth between 0-30m

**GEODETTIC INFORMATION**  
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 SPHEROID: WGS 1984  
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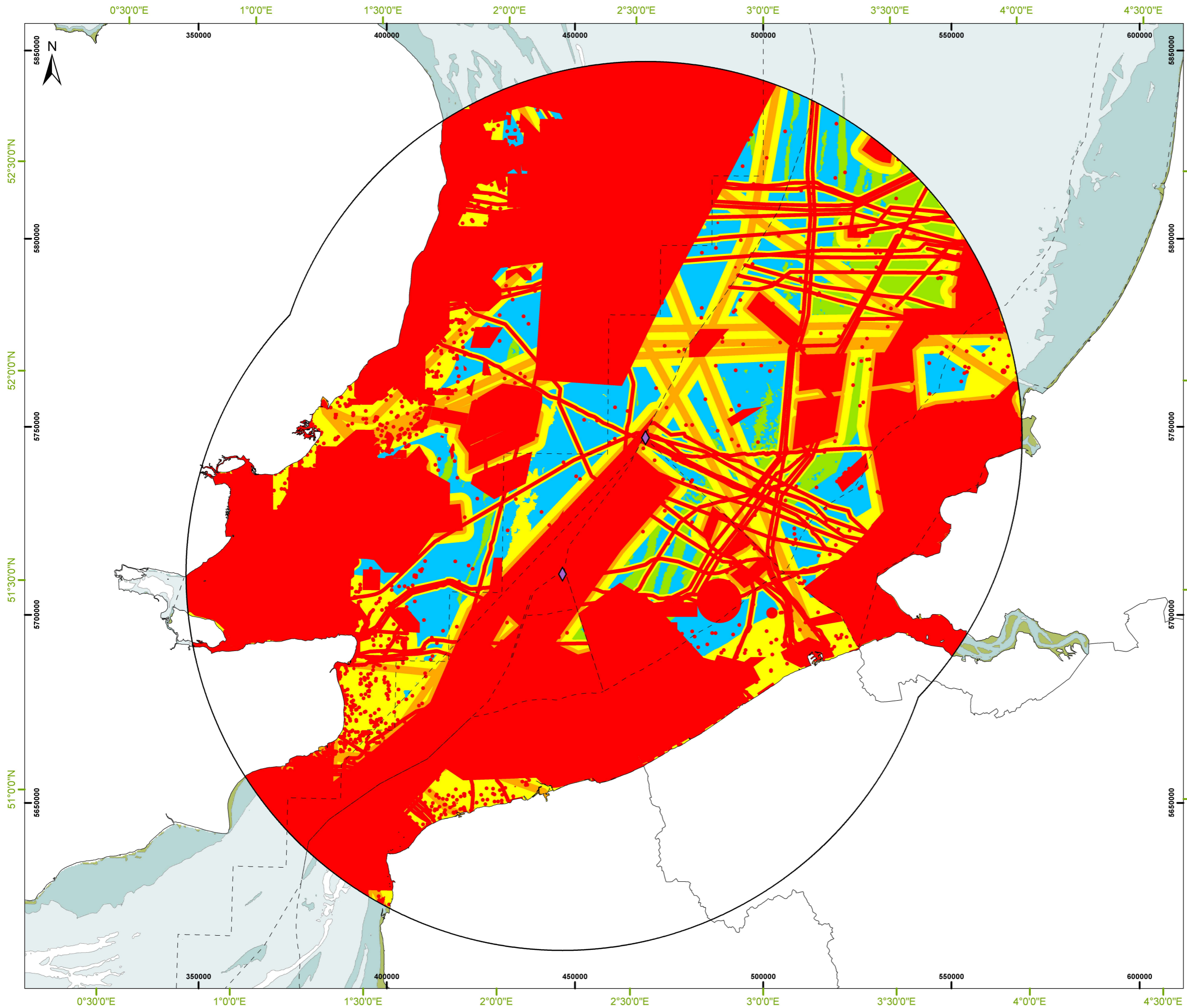
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Figure 2a: Study Area A Site Suitability Scoring Assessment



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DRAWING: DLS0342-002-A-01-DDE		



◆ Study Area Location  
 Study Area 100km Buffer  
 EEA Maritime Boundaries

Bathymetry (m)	
	-2 - 0
	-20 - -2
	-50 - -20
	Less than -50

Site Suitability Scoring Index		
Level	Grade	
	Very High	5
	High	4
	Medium	3
	Low	2
	Very Low	1

- **Existing Infrastructure:**
  - Pipelines, submarine cables
  - Anchorage Areas
  - Disposal sites
  - Marine Aquaculture sites
  - Wind farm sites
  - Aggregate extraction areas
  - Military firing areas
- **Commercial Navigation:**
  - Shipping traffic regulation areas
  - Ferry routes
  - Motorways of the sea
- **Wrecks:**
  - 0.5 km buffer
- **Ordnance Disposal sites:**
  - 0.5km buffer

- **Designated Conservation Areas:**
  - Natura 2000
  - MPAs
- **Commercial Navigation:**
  - 1km buffer
- **Distance from shore:**
  - 0-16km
- **Bathymetry:**
  - Depth over 60m

- **Commercial Navigation:**
  - 3km buffer
- **Existing infrastructure:**
  - Cables and pipelines (1 km buffer)
- **Distance from shore:**
  - 16 - 29km buffer
- **Bathymetry:**
  - Depth between 50-60m

- **Bathymetry:**
  - Depth between 30-50m
- **Distance from shore:**
  - 29 - 40km buffer

- **Bathymetry:**
  - Depth between 0-30m
- **Distance from shore:**
  - Over 40km

**GEODETTIC INFORMATION**  
 PROJECTION: UTM 31 NORTH  
 SPHEROID: WGS 1984  
 DATUM: WGS 1984

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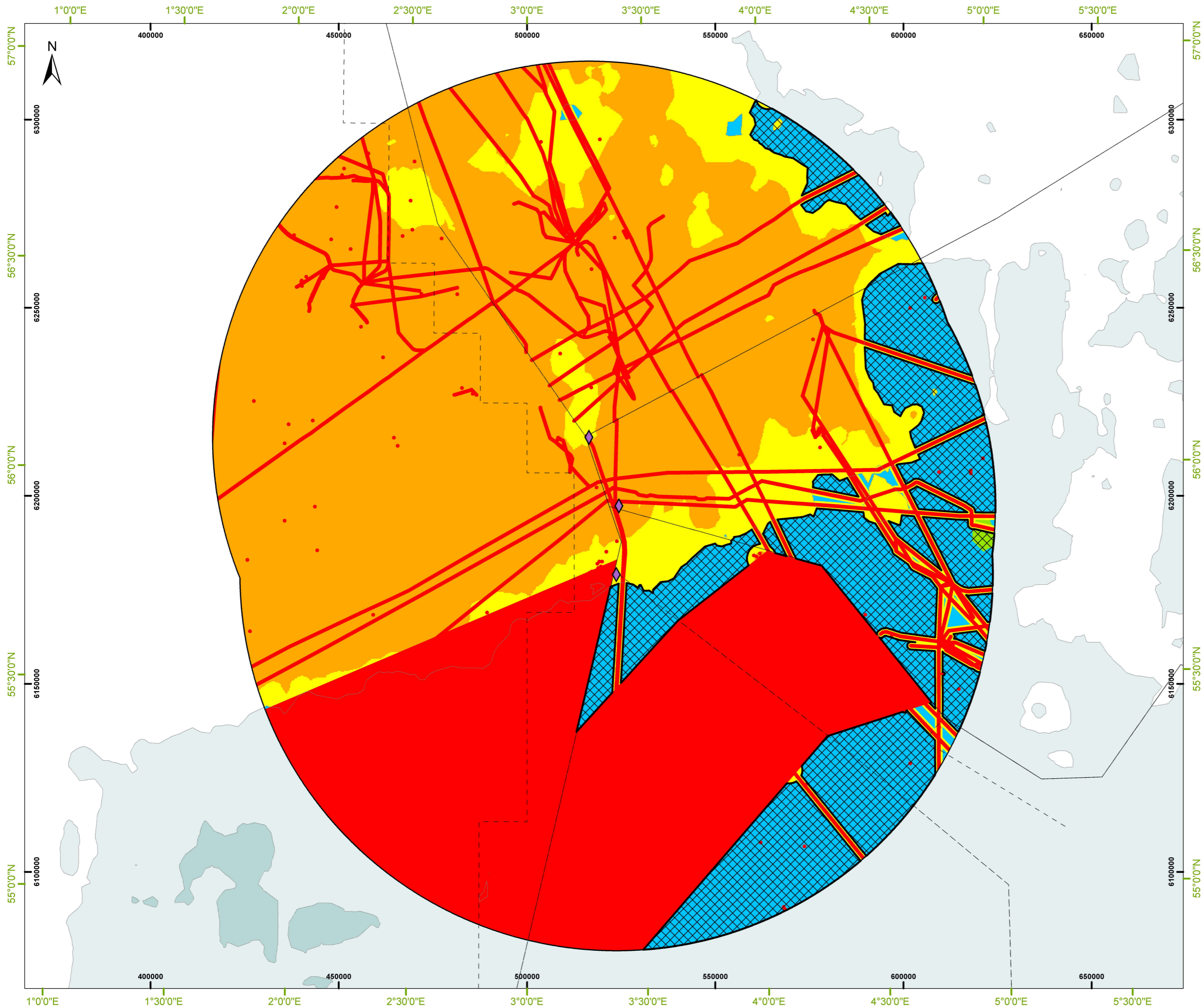


Figure 2b: Study Area B Site Suitability Scoring Assessment



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 PROJECT REF: DLS0342  
 DRAWING: DLS0342-002-B-01-DDE





**Legend**

- Study Area Location
- Study Area 100km Buffer
- EEA Maritime Boundaries
- Possible Wind Farm Site (Greater than 20km Sq)

**Bathymetry (m)**

- 2 - 0
- 20 - -2
- 50 - -20
- Less than -50

**Site Suitability Scoring Index**

Level	Grade
Very High	5
High	4
Medium	3
Low	2
Very Low	1

- Existing Infrastructure:** Pipelines, submarine cables, Anchorage Areas, Disposal sites, Marine Aquaculture sites, Wind farm sites, Aggregate extraction areas, Military firing areas
- Ordnance Disposal sites:** 0.5km buffer
- Commercial Navigation:** Shipping traffic regulation areas, Ferry routes, Motorways of the sea
- Wrecks:** 0.5 km buffer

- Designated Conservation Areas:** Natura 2000, MPAs
- Commercial Navigation:** 1km buffer
- Bathymetry:** Depth over 60m

- Commercial Navigation:** 3km buffer
- Existing infrastructure:** Cables and pipelines (1 km buffer)
- Bathymetry:** Depth between 50-60m

- Bathymetry:** Depth between 30-50m

- Bathymetry:** Depth between 0-30m

**GEODEIC INFORMATION**

PROJECTION: UTM 31 NORTH  
 SPHEROID: WGS 1984  
 DATUM: WGS 1984

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KILOMETERS

SCALE: 1:950,000  
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**Figure 3a: Study Area A Site Suitability Scoring Assessment Results Showing Potential Wind Farm Areas**

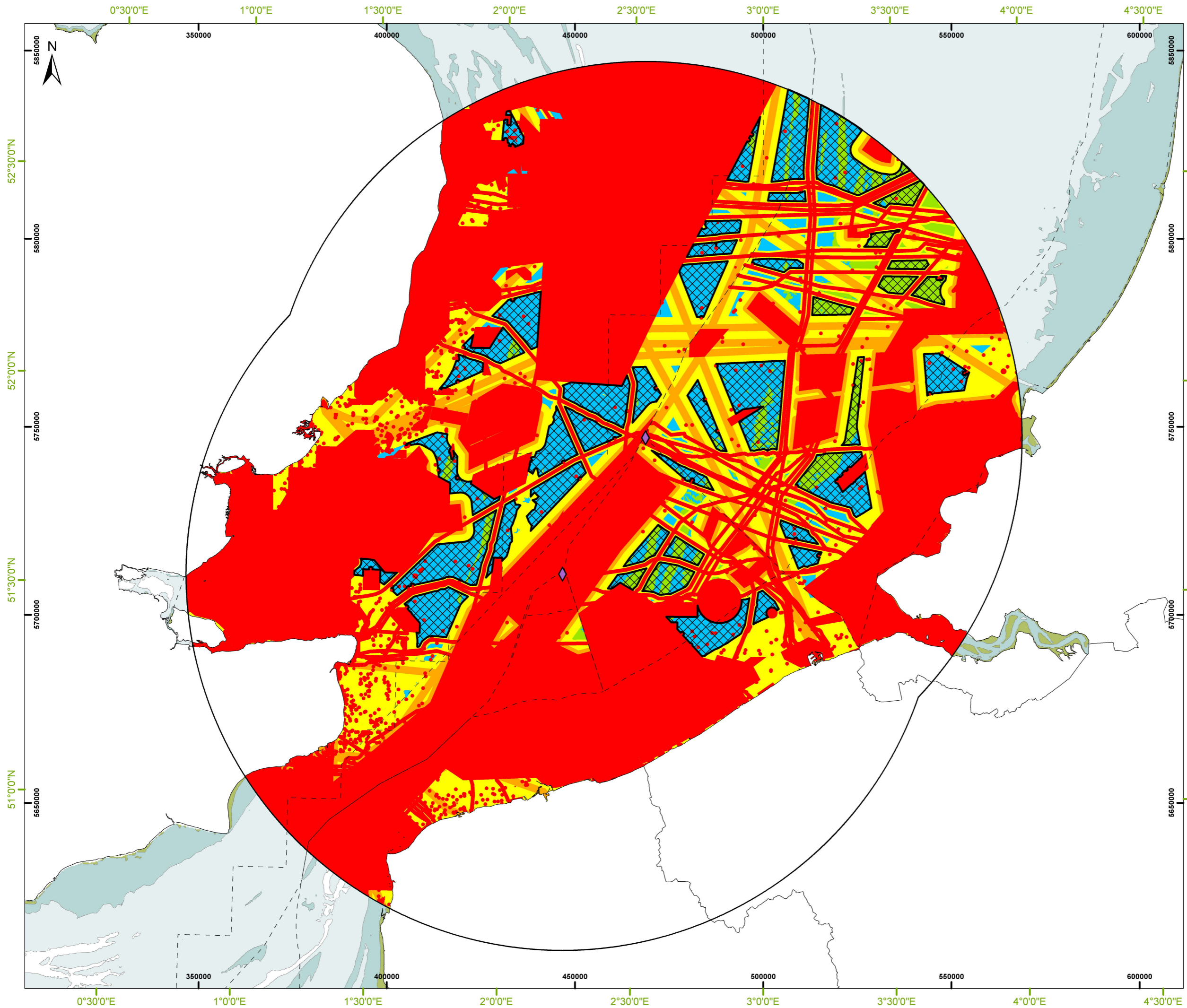
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PROJECT REF: DLS0342

DRAWING: DLS0342-003-A-01-DDE

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**Legend**

- Study Area Location
- Study Area 100km Buffer
- EEA Maritime Boundaries
- Possible Wind Farm Site (Greater than 20km Sq)

**Bathymetry (m)**

- 2 - 0
- 20 - -2
- 50 - -20
- Less than -50

**Site Suitability Scoring Index**

Level	Grade
Very High	5
High	4
Medium	3
Low	2
Very Low	1

- Existing Infrastructure:** Pipelines, submarine cables, Anchorage Areas, Disposal sites, Marine Aquaculture sites, Wind farm sites, Aggregate extraction areas, Military firing areas
- Ordnance Disposal sites:** 0.5km buffer
- Commercial Navigation:** Shipping traffic regulation areas, Ferry routes, Motorways of the sea
- Wrecks:** 0.5 km buffer

- Designated Conservation Areas:** Natura 2000, MPAs
- Commercial Navigation:** 1km buffer
- Distance from shore:** 0-16km
- Bathymetry:** Depth over 60m

- Commercial Navigation:** 3km buffer
- Existing infrastructure:** Cables and pipelines (1 km buffer)
- Distance from shore:** 16 - 29km buffer
- Bathymetry:** Depth between 50-60m

- Bathymetry:** Depth between 30-50m
- Distance from shore:** 29 - 40km buffer

- Bathymetry:** Depth between 0-30m
- Distance from shore:** Over 40km

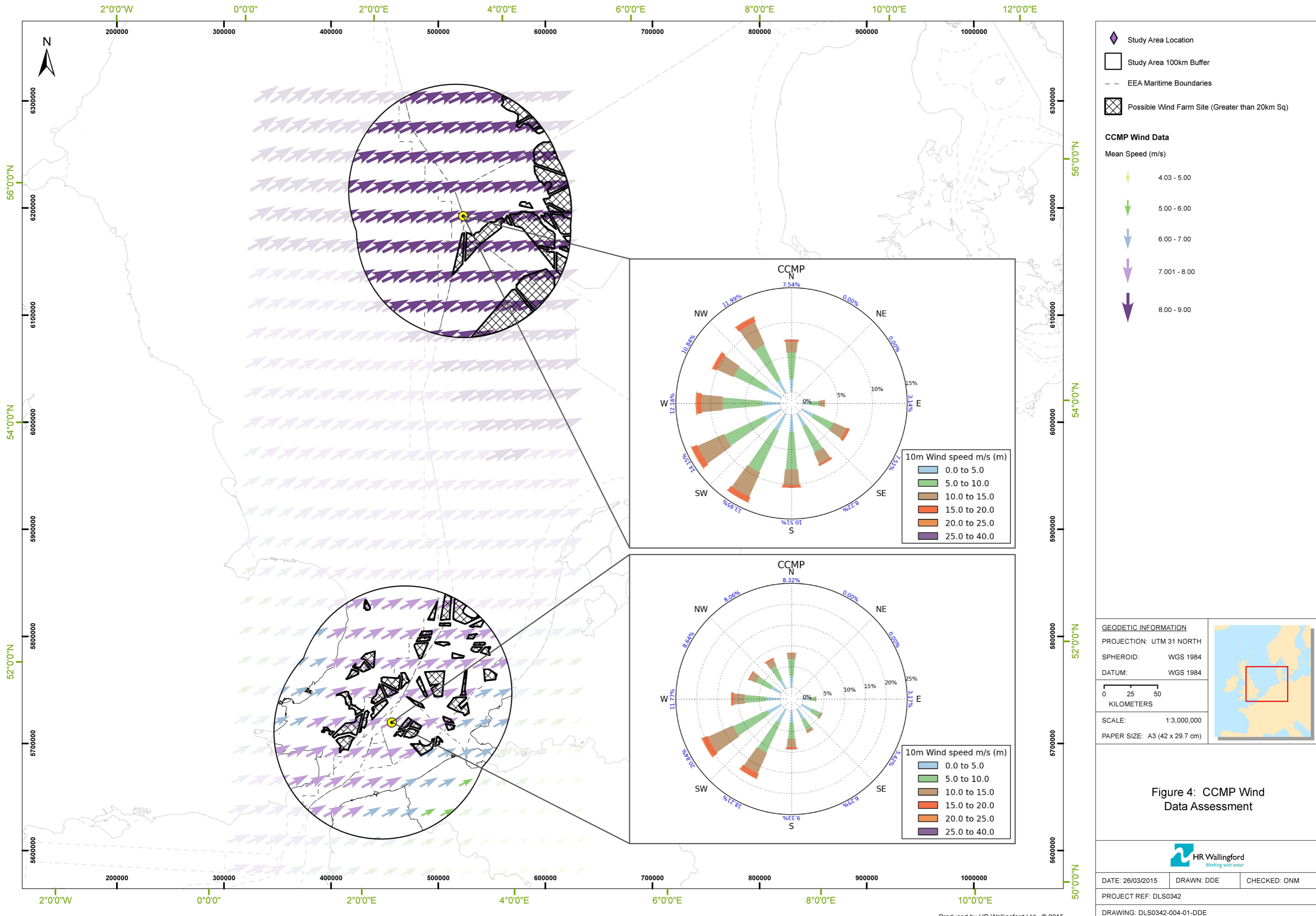
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 PROJECTION: UTM 31 NORTH  
 SPHEROID: WGS 1984  
 DATUM: WGS 1984

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 SCALE: 1:950,000  
 PAPER SIZE: A3 (42 x 29.7 cm)



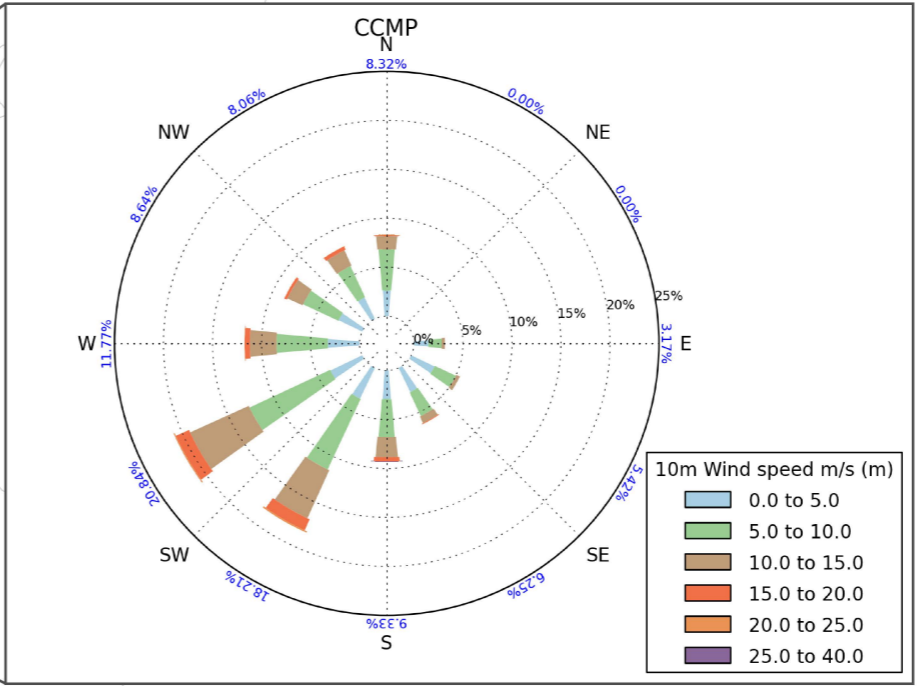
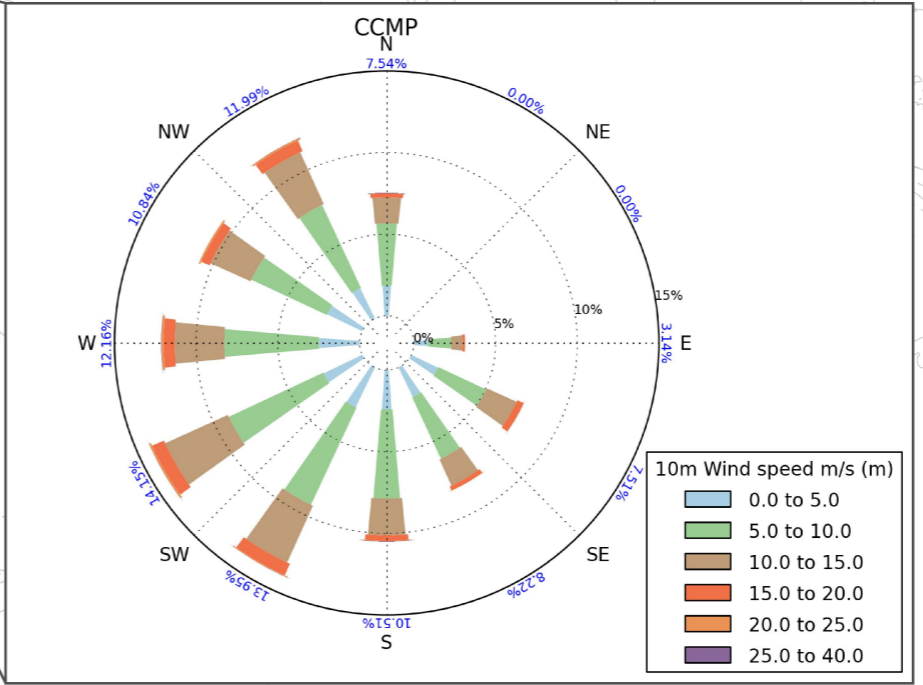
**Figure 3b: Study Area B  
 Site Suitability Scoring Assessment  
 Results Showing Potential  
 Wind Farm Areas**





- Study Area Location
- Study Area 100km Buffer
- EEA Maritime Boundaries
- Possible Wind Farm Site (Greater than 20km Sq)

- CCMP Wind Data**
- Mean Speed (m/s)
- 4.03 - 5.00
  - 5.00 - 6.00
  - 6.00 - 7.00
  - 7.001 - 8.00
  - 8.00 - 9.00



**GEODETTIC INFORMATION**

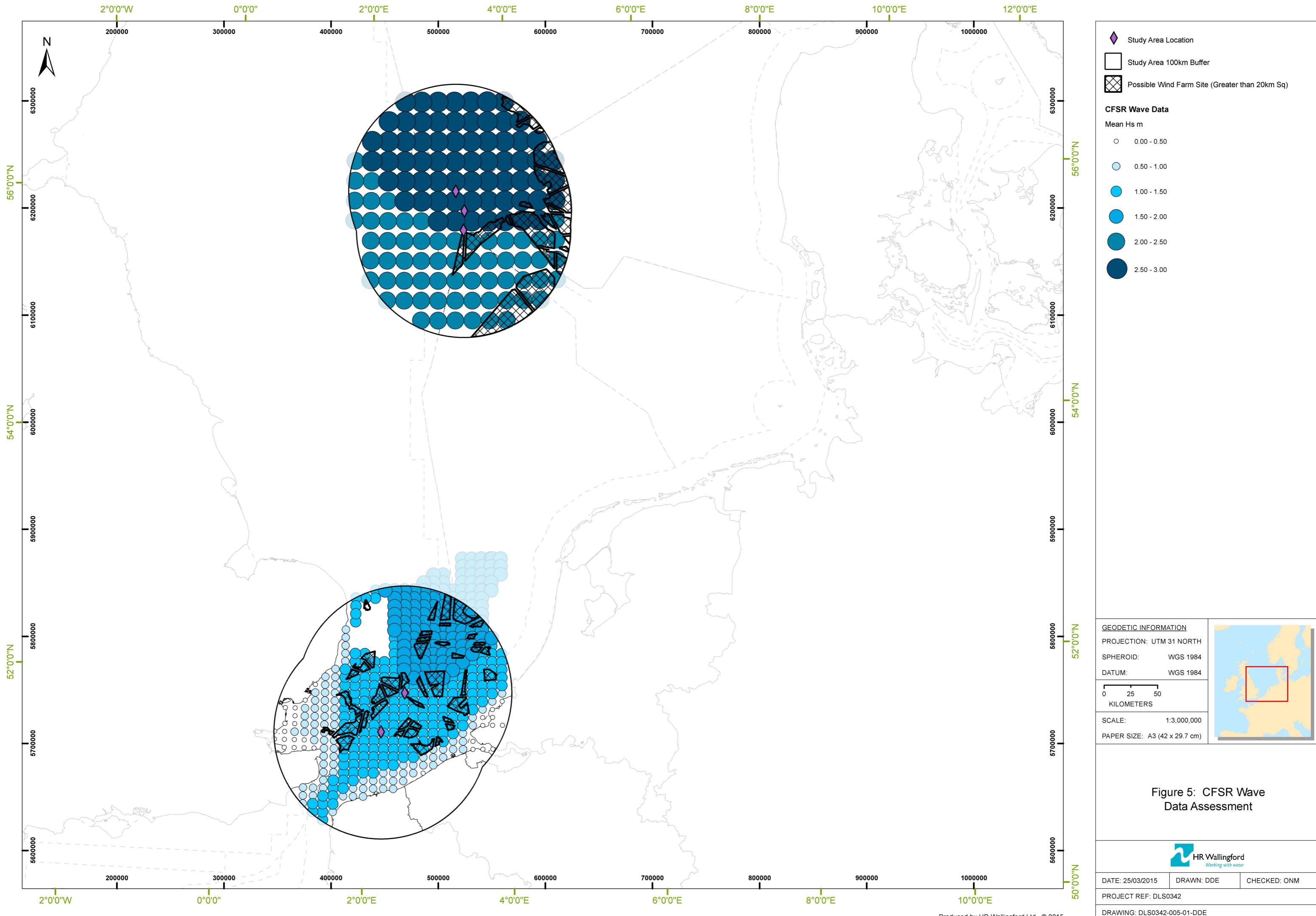
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 DATUM: WGS 1984

0 25 50  
KILOMETERS

SCALE: 1:3,000,000  
 PAPER SIZE: A3 (42 x 29.7 cm)



**Figure 4: CCMP Wind Data Assessment**



Study Area Location  
 Study Area 100km Buffer  
 Possible Wind Farm Site (Greater than 20km Sq)

**CFSR Wave Data**

Mean Hs m

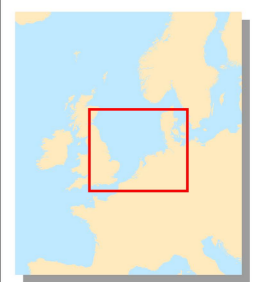
- 0.00 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00

**GEODETTIC INFORMATION**


PROJECTION: UTM 31 NORTH  
 SPHEROID: WGS 1984  
 DATUM: WGS 1984

0 25 50  
 KILOMETERS

SCALE: 1:3,000,000  
 PAPER SIZE: A3 (42 x 29.7 cm)

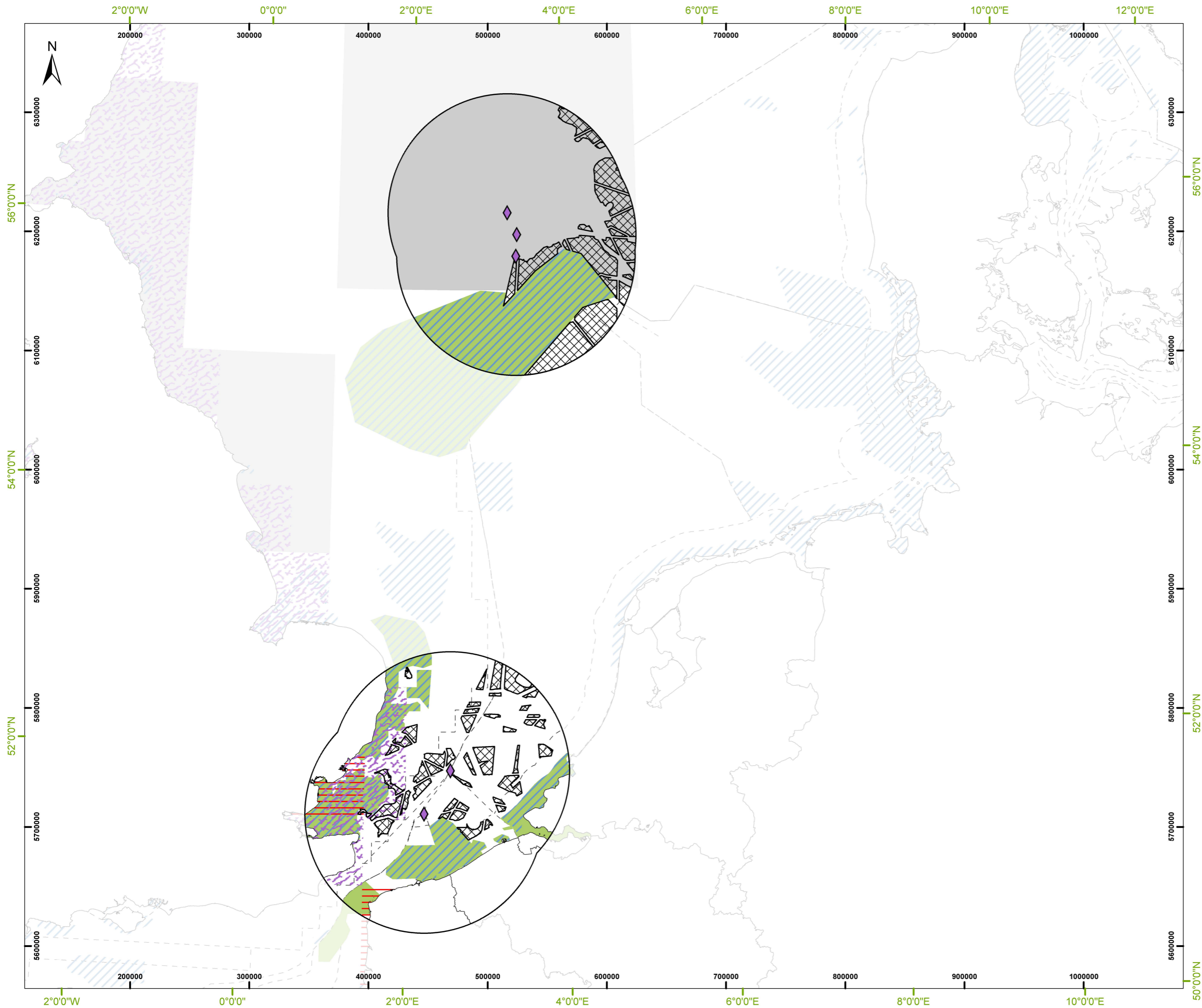


**Figure 5: CFSR Wave Data Assessment**

 **HR Wallingford**  
*Working with water*

DATE: 25/03/2015	DRAWN: DDE	CHECKED: ONM
PROJECT REF: DLS0342		
DRAWING: DLS0342-005-01-DDE		



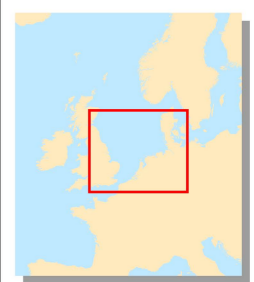


-  Study Area Location
-  Study Area 100km Buffer
-  Possible Wind Farm Site (Greater than 20km Sq)
-  Herring Nursery: High Intensity (CEFAS)
-  Sole Nursery: High Intensity (CEFAS)
-  Cod Nursery: High Intensity (CEFAS)
-  Marine Protected Area
-  European Environment Agency: Natura 2000 Sites
-  European Environment Agency: Maritime Boundaries

**GEODETTIC INFORMATION**  
 PROJECTION: UTM 31 NORTH  
 SPHEROID: WGS 1984  
 DATUM: WGS 1984

0 25 50  
 KILOMETERS

SCALE: 1:3,000,000  
 PAPER SIZE: A3 (42 x 29.7 cm)



**Figure 6: Assessment Of Protected Areas And Fishing Data**



DATE: 25/03/2015	DRAWN: DDE	CHECKED: ONM
PROJECT REF: DLS0342		
DRAWING: DLS0342-006-01-DDE		

## B. Data Assessment

Valuation of the data to solving a challenge (a sheet per challenge)

NSC-001-Wind		Consideration	ValueCriteria	VCFlag	ValueCriteriaReason
DT.Wind.NS001-ENTSO-E electronic grid map	Used	Contribution	True	Map showing the locations of interconnected electrical network in Europe, including all sub-stations around the North sea	
NSC-001-Wind		Location	True	All of Europe	
		Commercial	True	Freely available - needed to be requested via an online form	
		Attributes	True	Data was provided as a static map including a legend, showing plants, stations, existing high-voltage overhead lines and those under construction	
		Delivery	True	Data was downloaded online via a link sent by email	
		Usability	True	The map had to be georeferenced and the features of interest digitised. A shapefile or spreadsheet with co-ordinates would have been better.	
DT.Wind.NS003-EMODNET Bathymetry Gridded Bathymetry	Considered	Contribution	True	Gridded bathymetry data need for windfarm siting	
NSC-001-Wind		Location	True	Data set covers north sea region	
		Commercial	True	Open government licence - no fee	
		Attributes	True	Spatial resolution sufficient for windfarm citing	
		Delivery	True	Data can be downloaded from website	
		Usability	True	XYZ files - bulky to use but ok	
DT.Wind.NS004-National Grid Sub-station sites	Suitable	Contribution	True	Shapefiles containing data on electrical grid for the UK.	
NSC-001-Wind		Location	False	UK only. Better coverage was found via the information on the ENTSO-E website.	
		Commercial	True	Freely available	
		Attributes	True	Data included sub-stations, cables, gas sites, gas pipes, overhead lines and towers	
		Delivery	True	Downloadable online	
		Usability	True	Easy to use though when compared with the Entso-E data for the UK seemed incomplete	
DT-NS007-23 Years of Wind Speed Observations	NotConsidered	Contribution	True	Wind speed data available via the 4C Offshore website	
NSChlge-001-Windfarm Siting		Location	True	global range unsure how many for the North Sea	
		Commercial	True	more detailed 6 monthly and 6 hourly data can be purchased.	
		Attributes	True	Spatial resolution sufficient for windfarm citing	
		Delivery	False	Data accessed via enquiries to individual ports	
		Usability	False	Access difficulties meant that other wind data sources were easier to use	
DT.Wind.NS006-Crown Estate Marine Data Exchange wind data	Considered	Contribution	True	Crown Estate Marine Data Exchange wind data. The Marine Data Exchange contains a wealth of raw, cleaned and modelled wind data from various meteorological masts, LIDAR systems and meteorological buoys around the UK. The data is good for general checks, may be useful where windfarm siting is taking place in close proximity to an existing wind farm licence area.	
NSChlge-001-Windfarm Siting		Location	True	UK	
		Commercial	True	Login required. Once logged in data is freely available for download.	
		Attributes	True	The database contains data, reports and surveys from a number of offshore windfarm developments and government funded initiatives such as Aggregate Levy Sustainability Fund data around the UK.	
		Delivery	True	Data is requested via the website and an email containing download details can take up to 5 days to come through.	
		Usability	True	Data is especially useful when working in proximity to an existing windfarm licence site though other data is also available.	
DT-NS008-20 Months of Wind Data from the FINO3 (including FINO1 and 2 as well) Powerpoint	NotConsidered	Contribution	True	FINO1 & 3 masts are in the North sea hence directly relevant, they are also positioned in the middle of the sea not on the extremities - general info and examples	
NSChlge-001-Windfarm Siting		Location	True	North Sea (2) Baltic Sea (1)	
		Commercial	True	Data held in downloadable powerpoint presentation	
		Attributes	True	some graphical representations of data	
		Delivery	True	online - can be saved as a pdf	
		Usability	False	Extraction of trends in data from a pdf meant other sources of wind data were more helpful	
DT-NS009-NorseWind - Northern Seas Wind Index Database	NotConsidered	Contribution	True	wind data for the North Sea	
NSChlge-001-Windfarm Siting		Location	False	The North Sea, Baltic and Irish Sea though data downloaded only seems to cover the Eastern edge of the North Sea	
		Commercial	True	Free access to user (you have to register and log in to get data)	
		Attributes	True	10-year adjusted wind speed and direction value, annual and monthly long term corrected mean wind speed, standard deviation of annual values, weibull parameters (K&A), wind direction distribution, wind shear - $\alpha$ exponent, temperature, static stability, uncertainty in wind speed.	
		Delivery	True	Once login was received, data could be downloaded online	
		Usability	False	Data is designed for use by energy developers for preliminary siting calculations. The coverage of data downloaded did not appear to cover the area of interest although the project website stated that the data was to be gathered for the Baltic, North sea and Irish Sea.	
DT-NS011-FINO Database	Considered	Contribution	True	FINO Database is accessible via the German Maritime and Hydrographic Agency (BSH).	
NSChlge-001-Windfarm Siting		Location	True	North Sea	
		Commercial	False	Access to the webpage for the database is in German only.	
		Attributes	Null	no data was accessed	
		Delivery	False	No registration page was found. It was therefore difficult to assess the contents of the database and access the data	
		Usability	Null		
DT-NS012-Energy Industry Met Ocean Data around UK	NotConsidered	Contribution	True	data up to and including 31st July 1993. More recent data available	
NSChlge-001-Windfarm Siting		Location	True	Around UK - some in North Sea (see maps in document)	
		Commercial	True	Free and accessible - there is a copy saved in literature review	
		Attributes	True	Wind, wave, current and water level data in appendices B-E	
		Delivery	True	saved as pdf	
		Usability	False	Not easy to use as data would have to be drawn out of a pdf	
DT.Wind.NS013-MMO fishing density grids 2008-2013	Suitable	Contribution	True	not useful in itself but for completeness this is for all hse OTI docs as mentioned in the energy Industry Metocean Data around Uk report.	
NSChlge-001-Windfarm Siting		Location	True	UK waters and the North Sea	
		Commercial	True	Freely available	
		Attributes	True	summaries of fishing activity for UK commercial fishing vessels of 15m and over in length that are deemed to have been fishing within a specified calendar year. The data is referenced to a grid equal to a 0.05 degree sub-rectangle to provide a higher resolution	
		Delivery	True	Downloadable as a shapefile from the Environment Agency webstore	
		Usability	False	Data easy to use although there are lots of attributes and no accompanying report to guide the best way to display the data.	
DT-NS014-European Directory of Marine Environmental Data (EDMED)	Null	Contribution	True	Useful data discovery resource for identifying data. Provides links to data providers	
NSChlge-001-Windfarm Siting		Location	True	Europe	
		Commercial	True	The search facility is free. The cost of data and access restrictions will be dependent on data providers	
		Attributes	True	Provides discovery metadata to help users identify data which will meet their needs.	
		Delivery	True	Data is accessible via links to data providers	
		Usability	Null		
DT.Wind.NS015-CEFAS spawning and nursery grounds	Used	Contribution	True	Data on spawning and nursery sites around UK waters and for the North Sea	
NSChlge-001-Windfarm Siting		Location	True	UK waters and North Sea	
		Commercial	True	Freely available to download from CEFAS website	
		Attributes	True	Shows species and intensity levels for spawning and nursery survey results conducted in 2010 and spawning sites from 1998. Accompanying reports also available	
		Delivery	True	Downloaded from the website	
		Usability	True	Though the data not high resolution and was published in 2010, it is easily accessible and user-friendly and is commonly used in planning applications alongside ecological survey data	
DT-NS017-Magic Map	NotConsidered	Contribution	False	Information on presence of protected areas or areas The website though still online has *NOT BEEN UPDATED SINCE 2004. Therefore it is not suitable for meeting the wind farm challenge.	
NSChlge-001-Windfarm Siting		Location	False	UK only. Does not provide enough coverage for the wind farm siting exercise	
		Commercial	True	freely downloadable	
		Attributes	False	Provides access to a broad range of data including designated areas, species and habitat data, but have not recently been updates.	
		Delivery	True	Downloadable via the website.	
		Usability	True	Datadownloaded is easy to use. There may be useful data, but will need comparing with more recent data to assess the usefulness of individual datasets. A useful alternative may be the data provided on the Environment Agency webstore T&Cs: <a href="http://magic.defra.gov.uk/Copyright_Information_Data_Download.htm">http://magic.defra.gov.uk/Copyright_Information_Data_Download.htm</a> Raw data download: <a href="http://magic.defra.gov.uk/Dataset_Download_Summary.htm">http://magic.defra.gov.uk/Dataset_Download_Summary.htm</a>	
DT.Wind.NS019-Marine Life	NotConsidered	Contribution	False	collection of publications and reports on cetacean siting project results.	
NSChlge-001-Windfarm Siting		Location	True	UK waters and North Sea	
		Commercial	True	Free	
		Attributes	True	cetacean and seabird data	
		Delivery	True	No spatial data available to download beyond downloadable pdfs	
		Usability	False	Data would need to be extracted from pdfs. This was not considered worthwhile for the wind farm siting exercise	
DT-NS021-OSPAR map of protected areas	Suitable	Contribution	True	Very useful online map resource for viewing and downloading MPAs	
NSChlge-001-Windfarm Siting		Location	True	North East Atlantic	

		Commercial	True	Free
		Attributes	True	various protected site locations. Attributes are very useful and include hyperlinks to area descriptions on the website for the responsible organisation
		Delivery	True	download process was straightforward, only requiring an email address. Downloadable as a shapefile, TAB, KML, MIF/MID
		Usability	True	easily loaded into a project GIS
DT.Wind.NS025-MESH - mapping European Seabed Habitats NSChlge-001-Windfarm Siting	Considered	Contribution	True	Several MESH datasets are available via the EMODnet Marine Habitat portal. These were downloaded but not used for the wind farm siting
		Location	True	North Sea, Irish Sea and North Atlantic
		Commercial	True	Freely available
		Attributes	True	Habitat classifications
		Delivery	True	Downloadable via EMODnet Marine Habitat portal
		Usability	True	Data was downloadable in an accessible format as shapefiles
DT.Wind.NS026-EUSeaMap - predicted seabed habitat for Celtic, North, Baltic and western Med NSChlge-001-Windfarm Siting	Suitable	Contribution	True	SeaMap website is active but data download is directed to the EMODnet portal. Seabed habitat mapping was used only for reference in the windfarm challenge.
		Location	True	Covers North Sea and parts of the North Atlantic. Excludes Baltic, Southern Atlantic and Mediterranean
		Commercial	True	Freely available
		Attributes	True	Extensive attribution of habitat classifications including EUNIS
		Delivery	True	Downloaded via the EMODnet portal
		Usability	True	Useful in characterising both seabed habitats and comparison with seabed sediment information (in the absence of other sediment data)
DT.Wind.NS027-One Geology - geology for European seabeds NSChlge-001-Windfarm Siting	Used	Contribution	True	Offshore sediment mapping viewable via the mapviewer through the EMODnet geology tab
		Location	True	Europe
		Commercial	True	Freely downloadable
		Attributes	True	Attribute information had to be extracted from reports
		Delivery	True	Data downloadable as kml for terrestrial and marine geology and sediment data
		Usability	True	kml data could be converted for use in GIS but only as an image, therefore losing all attribute information. Data was used as no other freely available data could be found.
DT.Wind.NS029-EEA elevation map 1000m cell size NSChlge-001-Windfarm Siting	Suitable	Contribution	True	Raster map of elevation for EU land areas. Provided at several scales along with a hilighted dataset
		Location	True	Europe
		Commercial	True	data was freely available
		Attributes	True	Raster data provides gridded height values
		Delivery	True	Data downloaded as an Tiff with associated projection file and metadata
		Usability	True	Usable format. For the wind farm siting challenge, potential wind farm locations are too far from land areas for elevation data to be significant
DT.Wind.NS031-EMODNET Physics portal for waves and wind NSChlge-001-Windfarm Siting	Null	Contribution	Null	The EMODnet Physics provides access to physical data and metadata, and contributes to developing of the Global Monitoring for Environment and Security (GMES) marine core service. Wind and wave data is available as time series from the portal.
		Location	True	Europe
		Commercial	True	data from the past 60 days is freely available for download while access to older data (monthly archives) can be made after registration.
		Attributes	Null	
		Delivery	False	Difficult as a non-expert to filter the portal for potentially useful information. No data was downloaded.
		Usability	Null	
DT.Wind.NS040-EMODNET Human Activities portal for main ports NSChlge-001-Windfarm Siting	Suitable	Contribution	True	Dataset showing the locations of coastal and inland ports provided as point and polygon data. Very useful for background mapping.
		Location	True	Data available for all of the North Sea and beyond.
		Commercial	True	Freely available
		Attributes	True	Data includes both point and polygon data for both coastal and inland ports.
		Delivery	True	Downloaded from portal as shapefiles
		Usability	True	Data could be used for the wind farm siting, although was not really required as other data was used for background mapping
DT.Wind.NS041-EMODNET Human Activities portal for hydrocarbon extraction NSChlge-001-Windfarm Siting	Considered	Contribution	True	Useful providing extensive data on hydrocarbon extraction infrastructure. Useful in identifying areas with high levels of industrial activity
		Location	True	Extensive data was available for the North Sea Basin.
		Commercial	True	Freely available
		Attributes	True	Data is provided as point data with information on operators, distance from coast and water depth.
		Delivery	True	Downloaded as an ArcGIS geodatabase
		Usability	False	The data could be used in combination with hydrocarbon license areas in Hydrospatial Base. For the wind farm siting data would have been more useful provided as polygons showing licence area extents. Therefore Hydrospatial Base was used.
DT.Wind.NS042-EMODNET Human Activities portal for dredging NSChlge-001-Windfarm Siting	Considered	Contribution	True	All existing licence areas required for the wind farm siting. Data was therefore downloaded and reviewed.
		Location	False	Plenty of records in the Baltic, and the Channel, but the data looks incomplete for the North Sea Basin. No records were available off the Dutch and German coasts. Therefore the data was not used for the wind farm challenge.
		Commercial	True	Freely available
		Attributes	True	Data provided as centroids for licence areas. The license area polygons would provide much more useful information.
		Delivery	True	Downloaded as an ArcGIS shapefile
		Usability	False	Data was displayed as point data. Therefore the extents of licence areas were not provided. Polygons showing the extent would be more useful for marine planning projects
DT.Wind.NS043-EMODNET Human Activities portal for fisheries zones NSChlge-001-Windfarm Siting	Considered	Contribution	False	Statistical fisheries data from ICES and FAO available for viewing and download via the portal.
		Location	True	Europe
		Commercial	True	Freely available
		Attributes	True	Could not connect to geodatabase
		Delivery	True	Two of the datasets could not be downloaded using the download button but could be accessed via the source link in the metadata.
		Usability	True	Data was used for reference when looking at fisheries data
DT.Wind.NS044-EMODNET Human Activities portal for protected areas NSChlge-001-Windfarm Siting	Considered	Contribution	False	Although protected areas are required for the wind farm challenge, it was not downloaded as it could be sourced from elsewhere as shapefile rather than a csv
		Location	Null	
		Commercial	True	Freely available
		Attributes	Null	
		Delivery	True	Data is available for download as a CSV file
		Usability	Null	
DT.Wind.NS045-EMODNET Human Activities portal for waste disposal NSChlge-001-Windfarm Siting	Considered	Contribution	True	The dataset provided separate shapefiles for dredged spoil disposal and munitions dumping. Both datasets are of high importance when undertaking a wind farm siting exercise.
		Location	False	Coverage is not complete. No data was provided for the UK, Belgium, Holland or Germany apparent for spoil dumping or for ordnance disposal.
		Commercial	True	Freely available
		Attributes	True	Polygons provided for both munitions and spoil. Point data also provided for spoil dumping
		Delivery	True	Downloaded via EMODnet portal as shapefiles
		Usability	True	Usable format, the data was compared with Hydrospatial Base and found to be less complete.
DT.Wind.NS047-EMODNET Human Activities portal for wind farms NSChlge-001-Windfarm Siting	Considered	Contribution	True	Downloaded as important to know where existing license areas are
		Location	False	windfarm locations only available for the Baltic area
		Commercial	True	Freely available
		Attributes	True	--
		Delivery	True	Downloaded via EMODnet portal as ArcGIS shapefile
		Usability	Null	
DT.Wind.NS051-Marine Spatial Planning for the Baltic Sea NSChlge-001-Windfarm Siting	NotConsidered	Contribution	False	null - more just fyi
		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	--
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	-
DT.Wind.NS052-Marine Spatial Planning for the Baltic Sea - Borders NSChlge-001-Windfarm Siting	NotConsidered	Contribution	False	null - more just fyi
		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	--
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	-
DT.Wind.NS053-Marine Spatial Planning for the Baltic Sea - ecology Pollution NSChlge-001-Windfarm Siting	NotConsidered	Contribution	False	null - more just fyi
		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	--
		Attributes	Null	--

		Delivery	Null	-
		Usability	Null	
DT.Wind.NS054-Marine Spatial Planning for the Baltic Sea- ecology salmon rivers	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS055-Marine Spatial Planning for the Baltic Sea - people	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS056-Marine Spatial Planning for the Baltic Sea maritime traffic Shipping	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS057-Marine Spatial Planning for the Baltic Sea - maritime traffic Risks for large spills	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS058-Marine Spatial Planning for the Baltic Sea - maritime traffic Risks for small medium spills	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS059-Marine Spatial Planning for the Baltic Sea - maritime traffic fairways	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS060-Marine Spatial Planning for the Baltic Sea - fishing fish spawning grounds	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS061-Marine Spatial Planning for the Baltic Sea - fishing hydroacoustics	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS062-Marine Spatial Planning for the Baltic Sea - fishing quarterly catches	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS063-Marine Spatial Planning for the Baltic Sea - fishing quarterly catches - herring 2007-2009	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS064-Marine Spatial Planning for the Baltic Sea - energy wind	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS065-Marine Spatial Planning for the Baltic Sea - Energy cables and pipelines	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS066-Marine Spatial Planning for the Baltic Sea - nature protection areas	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS067-Marine Spatial Planning for the Baltic Sea - defence and scientific research - monitoring - coastal fish	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS068-Marine Spatial Planning for the Baltic Sea - defence and scientific research - monitoring - MORS station	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS069-Marine Spatial Planning for the Baltic Sea - defence and scientific research - monitoring - Gillnet surveyes	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	
DT.Wind.NS070-Marine Spatial Planning for the Baltic Sea - defence and scientific research - monitoring - Military	NotConsidered	Contribution	False	null - more just fyi
NSChlge-001-Windfarm Siting		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	



DT.Wind.NS071-Marine Spatial Planning for the Baltic Sea - sand and gravel extraction - dredging NSChlge-001-Windfarm Siting	NotConsidered	Contribution	False	null - more just fyi
		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	-
DT.Wind.NS072-Marine Spatial Planning for the Baltic Sea - tourism and recreation - fairways and harbours NSChlge-001-Windfarm Siting	NotConsidered	Contribution	False	null - more just fyi
		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	-
DT.Wind.NS073-Marine Spatial Planning for the Baltic Sea - cultural heritage - archeology NSChlge-001-Windfarm Siting	NotConsidered	Contribution	False	null - more just fyi
		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	-
DT.Wind.NS074-Marine Spatial Planning for the Baltic Sea - cultural heritage -cultural areas (Fin) NSChlge-001-Windfarm Siting	NotConsidered	Contribution	False	null - more just fyi
		Location	False	Did not cover windfarm siting study areas
		Commercial	Null	-
		Attributes	Null	--
		Delivery	Null	-
		Usability	Null	-
DT.Wind.NS075-European Atlas of the Seas - Under sea relief names NSChlge-001-Windfarm Siting	Considered	Contribution	True	Reviewed as part of the European Atlas of the Seas website, could be relevant to windfarm siting for referring to sea area locations
		Location	True	Covers European waters
		Commercial	True	Freely available
		Attributes	True	Point data providing location names
		Delivery	True	Downloaded as shapefile. Also available as txt
		Usability	True	Usable format, could be useful for making reference to sea areas, although the data was not used for the challenge.
DT.Wind.NS076-European Atlas of the Seas - Natura 2000 sites NSChlge-001-Windfarm Siting	Suitable	Contribution	True	Location and extents of Natura 2000 site. Required for wind farm siting - The data source was The European Environment Agency (EEA)
		Location	True	Covers European waters
		Commercial	True	Freely available
		Attributes	True	Layer file - Shows Habitat Directive Sites (SCIs) and Bird directive Sites (SPAs). Some metadata was provided on the link webpage
		Delivery	True	Layer file could be downloaded via an EEA page though the dataset was an older version of the one available through EMODnet. There was an alert letting users know that a more up-to-date version of the data existed.
		Usability	True	Useful, as a link was provided to the EEA website. The link to the source webpage was more useful than the link to the data download map server page which was not easy to use providing access to data is several formats including ArcGIS viewer, kmz. The dataset downloaded via EMODnet was used for the challenge.
DT.Wind.NS077-European Atlas of the Seas - Marine Protected Areas NSChlge-001-Windfarm Siting	Considered	Contribution	True	Location of Marine protected Areas. Required for windfarm siting. Source was WDPA
		Location	True	Covers European waters
		Commercial	True	Freely available
		Attributes	True	Shapefile containing extents of MPAs
		Delivery	False	It was not possible to download the shapefile as the link to EC website was broken. The data was also available as KMZ or CSV but these were less useful and therefore other sources of MPA data were identified.
		Usability	Null	Data was not downloaded therefore usability was not assessed.
DT.Wind.NS078-European Atlas of the Seas - Coastal geology NSChlge-001-Windfarm Siting	Considered	Contribution	False	Characterisation of coastal geology - Provided by Euroision. The data contains polylines showing coastal geomorphology. This was not expected to be useful in meeting the requirements of the challenge.
		Location	True	Covers European Coastlines. No offshore data
		Commercial	True	Freely available
		Attributes	True	The dataset contains polylines showing coastal geomorphology.
		Delivery	True	Downloaded as shapefile
		Usability	True	polygons showing marine sediment types would be more useful.
DT.Wind.NS080-European Atlas of the Seas -tidal amplitude NSChlge-001-Windfarm Siting	Considered	Contribution	True	Tidal amplitude measured in meters along the coast - Provided by Euroision
		Location	True	Covers European waters
		Commercial	True	Freely available
		Attributes	True	point data providing a single value of tidal amplitude from 2005.
		Delivery	True	Downloaded as part of a hydrodynamics and sea level rise dataset from the EEA website. Lots of supporting documents provided
		Usability	False	The data was considered to be too out of data for use on the challenge though it was provided in a useful format.
DT.Wind.NS081-European Atlas of the Seas - Sea level change per year (mm) NSChlge-001-Windfarm Siting	Considered	Contribution	True	Sea level change measured in millimeters per year - Provided via Euroision
		Location	True	Covers European waters
		Commercial	True	Freely available
		Attributes	True	Point data providing a single value of sea level change measured in 2005. Lots of supporting documents are provided
		Delivery	True	The data was downloaded as part of a hydrodynamics and sea level rise dataset from the EEA website.
		Usability	False	The data was considered to be too out of data for use on the challenge though it was provided in a useful format.
DT.Wind.NS083-European Atlas of the Seas - Average coastal wave height and direction NSChlge-001-Windfarm Siting	Considered	Contribution	False	Shows significant wave height in all directions along the coast - provided by Euroision. The data only provides measurements along the coast. As other wind and wave data was available and could be processed for use in meeting the challenge, this dataset was considered but not used.
		Location	True	Covers European Coastlines
		Commercial	True	Freely available
		Attributes	True	Point data providing measurements for cardinal and intercardinal compass directions measured in 2005
		Delivery	True	Downloaded as part of a hydrodynamics and sea level rise dataset from the EEA website. Lots of supporting documents provided
		Usability	True	Higher resolution data is available from other sources, though they require interpretation of raw data, while this is a derived dataset which can be loaded straight into GIS.
DT.Wind.NS084-European Atlas of the Seas - Ferry routes NSChlge-001-Windfarm Siting	Used	Contribution	True	The dataset shows all important regular international and national ferry routes. This dataset was recognised as being useful for the challenge as it provides an important indicator of shipping traffic - Source: EuroGlobalMap 5.1
		Location	True	Covers European waters
		Commercial	True	Freely available
		Attributes	True	Provided as shapefiles showing ferry ports as point data and routes as polylines
		Delivery	True	Delivered as shapefiles via Eurographics website. Requires registration
		Usability	True	useful and usable
DT.Wind.NS085-European Atlas of the Seas - Motorways of the sea NSChlge-001-Windfarm Siting	Used	Contribution	True	The dataset shows motorways of the sea, designed by the EC to improve cohesion in freight traffic. It shows areas likely to experience high levels of shipping traffic
		Location	True	Covers European waters
		Commercial	True	Freely available
		Attributes	True	Shows main trans-European shipping routes. The data is accompanied by supporting documentation on the Europa.eu website
		Delivery	True	Downloaded as a shapefile showing polylines
		Usability	True	useful and usable
DT.Wind.NS086-European Atlas of the Seas - Offshore wind farms (existing and consented) NSChlge-001-Windfarm Siting	NotConsidered	Contribution	True	Data on the location of offshore windfarms, very relevant to windfarm siting as there is a minimum distance requirement from existing license areas.
		Location	False	The data did not cover windfarm siting study areas. The shapefiles downloaded only contained data from Denmark and Sweden
		Commercial	True	freely available
		Attributes	True	Information on windfarm name, country, distance from coast and link to project website
		Delivery	True	Downloaded from EMODnet portal as shapefile
		Usability	False	The data does not cover the study area, otherwise, it would have been useful
DT.Wind.NS086-European Atlas of the Seas - Offshore wind farms (existing and consented) NSChlge-001-Windfarm Siting	Considered	Contribution	True	Provides the location of windfarms, relevant to windfarm siting as part of existing infrastructure - Source is UWEA via the Europa.eu website
		Location	True	Covers the southern North Sea
		Commercial	True	Freely available



		Attributes	False	The data was provided as point data which can be displayed by number of turbines. Spatial extents would be more useful for marine planning projects.
		Delivery	False	Data delivered as shapefile but with no co-ordinate reference system (CRS) or metadata containing recommended CRS so data does not map in the right place
		Usability	False	The data lacks CRS information and doesn't show license area extents, making it unuseable for the wind farm challenge
DT.Wind.NS087-European Atlas of the Seas - Marine energy production facilities	Considered	Contribution	True	shows the marine energy production facilities in Europe (existing, under construction and projects). It includes tidal power (barrage and stream), current power, wave power, osmotic power, thermal conversion power. Source - Ocean Energy Association, EMEC
NSChlge-001-Windfarm Siting		Location	False	Covers mostly the English Channel and Irish Sea. Not much data was available in the North Sea. As there was little coverage for the wind farm challenge study area, the data was not used.
		Commercial	True	Freely available
		Attributes	True	Data provided as point data recording the type of energy production and power output
		Delivery	True	Downloaded via Europa.eu as a shapefile
		Usability	False	Data was displayed as point data. Therefore the extents of licence areas were not provided. Polygons showing the extent would be more useful in meeting the requirements for marine planning projects.
DT.Wind.NS088-European Atlas of the Seas - Seabed sediments	Considered	Contribution	True	Point data showing seabed sediments. Very relevant but very few records were provided for the North Sea
NSChlge-001-Windfarm Siting		Location	False	Although the coverage was expected to be the EU, there were not many records outside of the Irish Sea. Therefore the data was not used to meet the requirements of the wind farm challenge.
		Commercial	True	Freely available
		Attributes	True	Downloadable as layer file or KMZ via a webservice. Not very clear to use. Provides information on sediment type, depth, sampling device and source
		Delivery	True	Downloadable as layer file or KMZ via a webservice. Not very clear how it could be used.
		Usability	False	Looked to identify better sediment data with greater coverage and displayed as polygons as it was not possible to map offshore seabed sediments from the data
DT.Wind.NS089-European Environment Agency - Maritime boundaries	Used	Contribution	True	Data showing International maritime limits. Useful in defining search areas for windfarm siting
NSChlge-001-Windfarm Siting		Location	True	Europe
		Commercial	True	Freely available
		Attributes	True	Attributes only contain codes. Need to use supporting resources and pre-symbolised layer to identify boundary types.
		Delivery	True	Delivered as a shapefile accompanied by supporting documents and a range of mxds and a layer file.
		Usability	True	Very helpful, though much of the data within the mxd have broken source paths. This had to be resolved in order to use the data.
DT.Wind.NS090-European Environment Agency - Natura 2000 - spatial data	Used	Contribution	True	Extents of Natura 2000 sites. Very relevant
NSChlge-001-Windfarm Siting		Location	True	Europe
		Commercial	True	Freely available
		Attributes	True	Downloadable as a shapefile. Includes site names, country and classification. The data covers designations on land and sea.
		Delivery	True	Downloadable as a shapefile. There were however two datasets, an online search for Natura 2000 data led to a dataset published in 2010 on the EEA website while access via EMODnet led to a more up-to-date dataset published in 2013.
		Usability	True	Relevant and useful format once the data had been found.
DT.Wind.NS091-EMODnet - Seabed habitats - OSPAR habitats 2013	Considered	Contribution	False	OSPAR habitat map, available via EMODnet marine habitats portal, alongside MESH, EUSeaMap, EUNIS data. It was decided that habitat mapping would not be interpreted for the purpose of the challenge.
NSChlge-001-Windfarm Siting		Location	True	Mostly Northern Europe (France, UK, Germany, Ireland, Sweden, Norway). No data apparent for Belgium, Denmark or Netherlands
		Commercial	True	Freely available
		Attributes	True	Data included point and polygon shapefiles and associate layer files. Attributes included habitat types, status and data owners.
		Delivery	True	Downloadable as shapefile after filling in personal details and data use
		Usability	True	Usable for reference in combination with other habitat maps.
DT.Wind.NS092-EMODnet - Seabed habitats - National Maritime Landscapes	Considered	Contribution	False	Series of national habitat maps. UK data is a simplified gridded vector version of UKSeaMap data, with less attribute information. It was decided that habitat mapping would not be interpreted for the purpose of the challenge.
NSChlge-001-Windfarm Siting		Location	True	UK, Netherlands, Belgium, France
		Commercial	True	Freely available
		Attributes	True	Variation in attribute field names and categories making data difficult compare or to bring together
		Delivery	True	Delivered as a zip file containing a shapefile for each country and supporting documentation
		Usability	True	Data would be useful and was provided in an accessible and well documented format, but was not required for the challenge.
DT.Wind.NS093-Windspeed database	Considered	Contribution	True	Resource which calculate suitable windfarm locations using a series of parameters. Very useful
NSChlge-001-Windfarm Siting		Location	True	Belgium, Denmark, Germany, Netherlands, Norway, UK
		Commercial	True	Freely available, required to create login
		Attributes	True	Takes account of a broad range of parameters such as distance to shore, depth, windfarm size, human activities to produce maps showing site suitability
		Delivery	True	Produces maps as output grading areas by their exclusion count
		Usability	False	Have not managed to get the web resource to produce any results
DT.Wind.NS094-EMODNET Human Activities portal for mariculture	Considered	Contribution	True	The data was provided as a database containing mariculture species data. This would have been useful in meeting the requirements of the challenge if the coverage had been greater.
NSChlge-001-Windfarm Siting		Location	False	Data provided only provided coverage for a proportion of the wind farm study area, including data for the UK and Italy only, with no data available for the other North Sea countries
		Commercial	True	Freely available
		Attributes	True	Attributes describe species and provide a location reference such as a region or town. Table structures vary between providers
		Delivery	True	Downloadable as Access database via EMODnet portal. No way of displaying the data spatially.
		Usability	False	With no way of spatial display, the data was of limited value to the windfarm siting challenge
DT.Wind.NS095-EMODNET Human Activities portal for aggregate extraction	Considered	Contribution	True	Data on the locations of aggregate license areas.
NSChlge-001-Windfarm Siting		Location	True	Mostly Channel and Baltic (France, UK, Denmark, Belgium)
		Commercial	True	Freely available
		Attributes	True	Point data provides information on source, type of extraction and purpose. Also provides a year
		Delivery	True	Downloadable as zip file containing a shapefile
		Usability	False	Data was displayed as point data. Therefore the extents of licence areas were not provided. Polygons showing the extent would be more useful
DT.Wind.NS096-EMODNET Human Activities portal for ocean energy facilities	Considered	Contribution	True	Wave and tidal energy facilities, would be useful where license areas or infrastructure are present
NSChlge-001-Windfarm Siting		Location	False	Provided no coverage for the wind farm study area. Data provided for Italy Spain Portugal and France
		Commercial	True	Freely available
		Attributes	True	Contained no data relevant to the study areas
		Delivery	True	database, opens in Access but not as a geodatabase in ArcMap.
		Usability	False	No data found for the study area, the data did not open as it should have in ArcGIS
DT.Wind.NS097-ERA Interim	NotConsidered	Contribution	True	ERA-Interim represents a third generation re-analysis of atmospheric data from 1979 to 2013.
NSChlge-001-Windfarm Siting		Location	True	Global dataset
		Commercial	True	Free to download
		Attributes	False	75km resolution, too coarse to be useful in this challenge. Data is delivered either in a netCDF or GRIB format
		Delivery	True	Data can be downloaded directly from the website after sign in via account
		Usability	False	Although the data is available in self describing netCDF with accompanying documentation and papers, it was too coarse to meet the requirements of the wind farm challenge
DT.Wind.NS098-NOAA Climate Forcast System	Used	Contribution	True	CFS Re-analysis data is a fully coupled model representing the interaction between the Earth's atmosphere, oceans, land and sea ice. The resource is particularly good for wave data
NSChlge-001-Windfarm Siting		Location	True	Global and regional sub models
		Commercial	True	Freely available
		Attributes	True	50km and 5-15km cell size for data
		Delivery	True	Partially available at time of challenge due to NOAA server crash. Full data set archived at HR Wallingford.
		Usability	True	Grid format with idiosyncratic longitude convention that needs confirming with documentation authors but the data did meet the requirements of the wind farm challenge. Ref: Saha, Suranjana, and Co-authors, 2010: The NCEP Climate Forecast System Reanalysis. Bull. Amer. Meteor. Soc., 91, 1015-1057. doi: 10.1175/2010BAMS3001.1
DT.Wind.NS099-GlobWave satellite data	Considered	Contribution	True	Wind and wave satellite data which would be suitable in meeting the wind farm challenge. The data was however used as coverage is patchy.
NSChlge-001-Windfarm Siting		Location	False	Has global decadal coverage though is patchy in places.
		Commercial	True	Freely available to download

		Attributes	True	Resolution is sparse and irregular but can be used for the challenge
		Delivery	True	Downloadable from the website
		Usability	False	The data is useful using a program written in-house to extract the data and use it
DT.Wind.NS100-NEXT from OceanWeather	Considered	Contribution	True	Wind and wave data time series providing multi-decadal and regional for the North Sea
NSChlge-001-Windfarm Siting		Location	True	Multi-decadal and regional for the North Sea. Worldwide coverage, depending on data products. Extents available via the website
		Commercial	False	Expensive to access and download, £25,000 per point. Data sold by points and T&Cs preclude comparison with any other data set therefore not able to validate externally.
		Attributes	False	Data would be expected to be sufficient as it uses standard meteorological variables. However, comparison against other datasets or observations is prohibited in the terms and conditions.
		Delivery	True	Data can be purchased through email exchange with OceanWeather
		Usability	True	Well documented, simple format.
DT.Wind.NS101-Met Office	Suitable	Contribution	True	Virtual Met mast and Wind data time series providing 34 year re-analysis model covering the North Sea. Would be useful in solving the wind farm challenge
NSChlge-001-Windfarm Siting		Location	True	35 year re-analysis model covering North Sea. Global, European and UK models running at 25km, 4km and 1.5km respectively are available
		Commercial	False	Charge £5000 per data point for wind and wave data
		Attributes	True	approximately 10km resolution and have Virtual Met Mast data available at additional cost with Global, European and UK models running at 25km, 4km and 1.5km respectively
		Delivery	True	Data access through correspondence, not as fast as downloading directly from website
		Usability	True	Data is provided as self-describing time series, making it easy to use for wind data modelling
DT.Wind.NS102-NORA10	Considered	Contribution	True	Wind data time series providing 10km re-analysis of data, from 1957 to present. Would be useful in solving the wind farm challenge
NSChlge-001-Windfarm Siting		Location	True	Covers whole North Sea and 6 hour temporal resolution
		Commercial	False	The data was too expensive to be used in solving the wind farm challenge, costing approximately £1000 per data point
		Attributes	True	10km re-analysis of wind data, from 1957 to present
		Delivery	True	Not easy to find on internet, once located available through correspondence with authors
		Usability	True	Self-explanatory time series once downloaded
DT.Wind.NS103-CCMP wind data	Used	Contribution	True	easily accessible and suitable for the challenge
		Location	True	Global six hourly data set
		Commercial	True	Free to access
		Attributes	True	25km resolution, publicly validated
		Delivery	True	access via website and OpenDAP server
		Usability	True	Publicly available and well documented
DT.Wind.NS104-SeaZone Hydrospatial One - Bathymetry	Suitable	Contribution	True	Vector data containing depth areas
		Location	True	Extracted for project search area. Full coverage of North Sea. Coverage shown on webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC)
		Delivery	True	delivered via online download link
		Usability	True	Provided as a data package with an mxd, making the data easy to use for planning. Depth areas are based on resolution of chart bathymetry and depth area ranges do vary in resolution
DT.Wind.NS105-SeaZone Hydrospatial One - Wrecks	Used	Contribution	True	Vector data containing wreck and obstruction data
		Location	True	Extracted for project search area. Full coverage of North Sea. Coverage shown on webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as points and polygons
		Delivery	True	delivered via online download link
		Usability	True	Comprehensive database of wreck and obstruction sites in an accessible format
DT.Wind.NS106-SeaZone Hydrospatial One - Navigational channels	Used	Contribution	True	Vector data showing charted navigational channels
		Location	True	Extracted for project search area. Full coverage of North Sea. Coverage shown on webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Comprehensive data on navigational channels in an accessible format
DT.Wind.NS107-SeaZone Hydrospatial One - Aquaculture and Fisheries	Suitable	Contribution	True	Vector data showing licenced and charted aquaculture and fishery sites
		Location	True	Extracted for project search area. Full coverage of North Sea. Coverage shown on webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Charted data on fisheries available in an accessible format
DT.Wind.NS109-SeaZone Hydrospatial One - Cable and Pipeline installations	Used	Contribution	True	Vector data showing charted cables and pipelines
		Location	True	Extracted for project search area. Full coverage of North Sea. Coverage shown on webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Charted data on cables and pipelines available in an accessible format. Appeared to be comprehensive
DT.Wind.NS110-SeaZone Hydrospatial One - Traffic Regulation	Used	Contribution	True	Vector data showing charted shipping traffic regulation areas such as traffic separation zones. Useful in mapping shipping routes
		Location	True	Extracted for project search area. Full coverage of North Sea. Coverage shown on webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Charted traffic regulation areas available in an accessible format. Appeared to be comprehensive
DT.Wind.NS111-SeaZone Hydrospatial One - Dredged Areas	Suitable	Contribution	True	Vector data showing maintenance dredging areas. Useful in combination with depth areas.
		Location	True	Extracted for project search area. Full coverage of North Sea. Coverage shown on webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Charted dredged areas in an accessible format.
DT.Wind.NS112-SeaZone Hydrospatial One - Licenced Areas	Used	Contribution	True	Contains all licence areas for aggregate extraction and oil and gas licence areas
		Location	True	Extracted for project search area. The product provided full coverage of North Sea. The available coverage of data for Hydrospatial Base is shown on the SeaZone product webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Charted licence areas in an accessible format.
DT.Wind.NS113-SeaZone Hydrospatial One - Oil and Gas Activity	Suitable	Contribution	True	Contains all oil and gas licence installations as charted to S57 standard
		Location	True	Extracted for project search area. The product provided full coverage of North Sea. The available coverage of data for Hydrospatial Base is shown on the SeaZone product webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Charted oil and gas installations in an accessible format.
DT.Wind.NS114-SeaZone Hydrospatial One - Renewable energy activity	Suitable	Contribution	True	Contains all licence areas for renewable energy activity
		Location	True	Extracted for project search area. The product provided full coverage of North Sea. The available coverage of data for Hydrospatial Base is shown on the SeaZone product webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Charted renewable energy licence areas in an accessible format.
DT.Wind.NS115-SeaZone Hydrospatial One - Military activity	Used	Contribution	True	Contains all licence areas for military practice areas
		Location	True	Extracted for project search area. The product provided full coverage of North Sea. The available coverage of data for Hydrospatial Base is shown on the SeaZone product webpage
		Commercial	True	chargeable commercial product
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	delivered via online download link
		Usability	True	Charted military practice areas in an accessible format.

DT.Wind.NS117-EEA Europe Coastline for analysis	Used	Contribution	True	The EEA coastline for analysis is created for highly detailed analysis, e.g. 1:100 000, for geographical Europe. The criteria for defining the coastline is the line separating water from land. The EEA coastline is a product derived from two sources: EU-Hydro and GSHHG. This was a suitable resolution for analysis and background mapping
		Location	True	Datasets covered the EU coastline
		Commercial	True	Data is freely downloadable from the EEA website
		Attributes	True	broad range of attributes using S57 standard for Electronic Navigational Charts (ENC). Data provided as polygons
		Delivery	True	Downloadable as a zip file containing a polygon shapefile and a polyline shapefile
		Usability	True	High resolution land area data in an accessible format.
DT.Wind.NS118-The Crown Estate Windfarm Licence Areas	Used	Contribution	True	The Crown Estate supply maps and GIS data for all offshore activities within their remit. Data is very useful for planning and is kept up-to-date
		Location	True	UK only
		Commercial	True	Data is freely downloadable from the Crown Estate website
		Attributes	True	Broad range of data provided as a shapefiles including all licence and licence application areas, cables, meteorological equipment, and pipelines
		Delivery	True	Downloadable as a zip file containing a series of shapefiles
		Usability	True	Useful data and had been regularly updated.
DT.Wind.NS121-UK Tidal Gauge Network Tidal predictions	Used	Contribution	True	Uk National Tidal Gauge Network data real time data, site information, highest recorded measurements and tidal range predictions are provided in tables on the National oceanography Centre website.
		Location	True	UK only
		Commercial	True	Data is viewable on the NOCS website and downloadable from the BODC website
		Attributes	True	Provide useful predictions of mean maximum and minimum tidal ranges for spring and neap tide at 44 coastal locations
		Delivery	False	Data can be viewed but not downloaded from the NOCS website
		Usability	True	Useful data afor documentary research
DT.Wind.NS120-BODC Tidal Gauge Network data	Used	Contribution	True	Uk National Tidal Gauge Network data providing values and residuals, extremes, surges and mean data monthly and annually for 44 locations around the UK coast.
		Location	True	UK only
		Commercial	True	Data is downloadable from the BODC website free of charge for raw data while a charge will be made for processed data.
		Attributes	True	Provide useful predictions of mean maximum and minimum tidal ranges for spring and neap tide at 44 coastal locations
		Delivery	True	Data downloadable from BODC website following registration. Data is delivered as a zip file containing a series of .txt files accompanied by a licence agreement and supporting information
		Usability	True	Useful data afor documentary research



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FS 516431  
EMS 558310  
OHS 595357

HR Wallingford, Howbery Park, Wallingford, Oxfordshire OX10 8BA, United Kingdom  
tel +44 (0)1491 835381 fax +44 (0)1491 832233 email [info@hrwallingford.com](mailto:info@hrwallingford.com)  
[www.hrwallingford.com](http://www.hrwallingford.com)