Before applying for a permit under Chapter 9 of the Swedish Environmental Code

Before applying for a permit under the Swedish Exclusive Economic Zone Act and the Continental Shelf Act.

Consultation document

BALTIC OFFSHORE DELTA WIND POWER FARM

and the associated internal cable network in Sweden's Exclusive Economic Zone, Baltic Sea

2021 12 03

Operators

Njordr Offshore Wind AB

Lantvärnsgatan 8
652 21 Karlstad
www.njordroffshorewind.com

Corporate ID Number: 559308 – 6019

Niklas Sondell,
project manager
niklas.sondell@modernenergy
070 - 218 50 64

Consultant

Ecogain AB
Headquarters:

Västra Norrlandsgatan 10 D
903 27 Umeå
www.ecogain.se

Corporate ID Number: 556761-6668

Isabel Enström,
assignment manager
isabel.engstrom@ecogain.se
010-405 91 35

Project information

Baltic Offshore Delta

Project owner: Njordr Offshore Wind AB – a joint venture between Vindkraft Värmland and Njordr

Report: Before applying for a permit under Swedish Exclusive Economic Zone Act and Continental Shelf Act – Consultation Document – Baltic Offshore Delta wind power farm and the associated internal cable network

Prepared by: Isabel Enström, Charlotte Nauclér, Anna Singh, Johanna Birgander and Malin Blohm, Ecogain as well as Niklas Sondell, Rolf-Erik Keck and Niclas Erkenstål, Njordr Offshore Wind.

Reviewed by: Karolina Adolphson, Ecogain
Approved by: Niklas Sondell, project manager Njordr Offshore Wind

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Other photos, Ecogain.
Illustrations, Susan Enet iron, Ecogain

ABOUT THE CONSULTATION DOCUMENT

According to the provisions of Sec. 6 of Environmental Assessment Regulation (2017:966), the planned activities are assumed to have a significant impact on the environment, which means that a so-called scope consultation will be performed. This consultation document has been prepared as a basis for the Baltic Offshore Delta scope consultation, a project developed by Njordr Offshore Wind AB.

A scope consultation follows the provisions of Chapter 6, Sec. 30 of the Environmental Code, and consultations will be held with the County Administrative Board, regulatory officials, and private individuals who are expected to be particularly affected by the operation, as well as other governmental authorities, municipalities, and the public that may be expected to be impacted by the project.

A consultation document is not to be confused with an environmental impact assessment, which is prepared at a later stage of the permit application process. The purpose of the consultation is to inform regulatory authorities, individuals, and the public about the planned project and to provide a comprehensive report on the environmental effects that the planned activities are expected to produce, while future environmental impact assessments will further investigate these effects.

This consultation document outlines what future environmental impact assessments will include and which environmental effects will be further investigated. A complete environmental impact assessment is expected to be completed in 2023, and a permit application under the Swedish Exclusive Economic Zone Act and the Continental Shelf Act is planned to be submitted in 2023.

Since the project is located in the Swedish Exclusive Economic Zone (EEZ) and in an area that may affect the interests of other nations, consultations will also be held on the basis of the Espoo Convention, the Convention on Environmental Impact Assessments in a cross-border context.

Actors identified as part of the consultation circuit are listed in Appendix 2.

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Contributors

Isabel Enström, assignment leader, Ecogain

Ecologist focused on environmental engineering. She has worked on strategic planning, climate and environmental issues within municipalities and on education for sustainable development. Many years of experience in the energy sector, in particular with renewable energy and wind power development.

Charlotte Nauclér, deputy assignment lead and investigator, Ecochain

Certified forest officer with a focus on nature and the environment, and who has extensive experience with EIAs and environmental assessments, especially with regard to the wind power permit process.

Anna Singh, investigator, Ecochain

Environmental scientist with a master's degree in natural geography and ecosystem analysis. Specialized in climate effects on different types of ecosystems, environmental engineering, and in public management of protected natural areas from both scientific and social perspectives.

Johanna Birgander, Investigator, Ecogain

A PhD in ecology with deep knowledge of climate related issues. She has worked on strategic environmental work at the County Administrative Board. Many years of experience with the permit process and environmental assessments, primarily for wind power.

Malin Blohm, Investigator, Ecogain

Environmental lawyer with many years of experience in environmental permit issues and civil engineering issues both from working at the Swedish Land and Environmental Court of Appeal and as a consultant.

Karolina Adolphson, Quality Review, Ecogain

Biologist and experienced project manager with solid experience working on environmental assessments and EIA and broad knowledge of the permit process as well as the requirements and legislation associated with environmental assessments.

Susan Enetjärn, graphic artist, Ecogain

Susan has more than 30 years of experience as an illustrator and graphic artist.

YOUR OPINIONS ARE IMPORTANT

The consultation procedure allows authorities, individuals, and the public to provide information and to submit comments on the activities planned. Njordr Offshore Wind AB would like to receive feedback and opinions on the content and design of the environmental impact assessment, as well as on the location, scope, design, and the environmental effects that planned activities may entail directly or indirectly.

Please provide your remarks in writing so that we can compile them in a consultation report as objectively and correctly as possible and to incorporate them into future environmental impact assessments.

Consultation remarks can be sent via e-mail to ***njordr.samrad@ecogain.se***

Alternatively by letter to:

Ecogain AB
Baltic Offshore Delta
Attention: Administrator
Östra Hamngatan 17
411 10 Gothenburg
Consultation remarks may be submitted until 12 February 2022.
Be sure to label the e-mail or letter with "Baltic Offshore Delta."

CONTENTS

SUMMARY

Njodr Offshore Wind AB (Njodr) intends to apply for a permit under the Swedish Exclusive Economic Zone Act (1992:1140) and the Continental Shelf Act (1966:314) to construct the Baltic Offshore Delta wind power farm within Sweden's exclusive economic zone. At most, 300 turbines with a maximum total height of 330 meters are planned.

The project is expected to contribute with a number of positive environmental effects. The main one is that the wind power farm will produce a large amount of renewable electricity that contributes to mitigating climate change. In addition, the artificial reef structures created by the foundation of wind turbines can benefit bottom-dwelling organisms and fish who feed on them. Disruptions to animal life from trawling and shipping in the project area are also reduced.

The planned activities are assumed to have significant environmental impacts and therefore scope consultations must be held. This consultation document forms the basis for the consultation process and will be followed by an environmental impact assessment (EIA). The consultation document contains an example of the layout of the wind power farm, i.e., the potential location of the wind turbines within the project area.

The project area for Baltic Offshore Delta is almost 55 kilometres from land (Sandhamn, the municipality of Värmdö) and almost seven kilometres south-east of Sweden's territorial border.

The project area is located in a marine area with few identified and protected opposing interests. It involves a maritime route of national interest for shipping and coincides with three registered historic cultural sites. Except for shipping and commercial fishing, other important areas of national interest, such as defence, the natural and cultural environment, and recreation, are located west of the project area.

In-depth investigations, mainly regarding the conditions on the sea bottom, natural values, bird life and marine archeology will be carried out as part of the environmental impact assessment. The investigations, together with opinions from the consultation process, will form the basis for the final design of the wind power farm and the basis for the environmental impact assessment to support the permit application.

Based on the information now available, our assessment is that the project's most significant adverse environmental effects include a possible impact on marine wildlife, flying birds and shipping. The assessment may change in light of the results of planned investigations.

1. INTRODUCTION

This chapter introduces the project and the planned activities. In addition, the current legislation, the various stages of the authorisation process and the consultation process for the project are presented.

1.1 Background

Sweden has developed energy policy targets which, among other things, state that Swedish electricity production in 2040 should be 100 percent renewable and that no net greenhouse gas emissions should be released into the atmosphere by 2045. Wind power is an important part of the transition to a more ecologically sustainable society, through more efficient use of electricity and a shift to renewable forms of energy using environmentally acceptable technologies. In 2020, wind power accounted for 17 per cent of the country's electricity production, which corresponds to 27.6 TWh (Swedish Energy Agency, 2021a). The demand for electricity is expected to increase significantly in the coming years. For example, the main scenario from the Swedish Energy Agency means that 80–120 TWh of new renewable energy production is needed by 2045, and the conversion of transport and industry is of great importance toward that end (Swedish Energy Agency, 2018).

The Swedish Energy Agency has stated that around 50 TWh of offshore wind power should be part of the plan to reach the government's target of 100% renewable energy by 2040 (Swedish Agency for Marine and Water Management, 2019a). According to the National Strategy for Sustainable Wind (Swedish Energy Agency, 2021b), offshore wind power is expected to be increased by 20 TWh. In 2018, approximately 0.67 TWh of offshore wind power was produced according to the Swedish Energy Agency (Swedish Energy Agency, 2019). Today there are three offshore wind farms: Lillgrund, Bockstigen and Kårehamn.

Njordr Offshore Wind AB is now investigating the possibility of establishing wind power in the Swedish Exclusive Economic Zone in the Baltic Sea in an area that is situated about 55 kilometres east of Sandhamn, 65 kilometres south of Åland and 100 kilometres north of Fårö on Gotland. With its location outside the Stockholm region, the project provides good opportunities for helping to meet the ever-increasing need for renewable energy in a region that already has difficulties producing its own electricity, and where the possibilities for land-based wind power are limited.

1.2 Applicable legislation and consultation

Planned activities require the government's authorisation in accordance with the Swedish Exclusive Economic Zone Act (1992:1140). According to the permit application procedure, Chapters 2–4 and Chapter 5, Sections 3–5 and 18 of the Swedish Environmental Code applies. A specific environmental assessment will be carried out, and an EIA will be prepared by the operator, Table 1.

Government permission is also required for the wind power farm's internal cable network, in accordance with the Continental Shelf Act (1966:314), and for investigations before and during the laying of underwater cables and pipelines on the continental shelf , Table 1.

According to Sec. 6 of Environmental Assessment Regulation (2017:966), the planned activities are assumed to have a significant impact on the environment, which means that a so-called scope consultation must be carried out. Therefore, no investigatory consultations have been carried out.

This document provides background information for the scope consultation, which according to Chapter 6, Sec. 30 of the Swedish Environmental Code, must be held with the County Administrative Board, regulatory agencies, and private individuals who are expected to be particularly affected by the operations, as well as the other governmental authorities, municipalities and the public that may be expected to be impacted by the project.

The Swedish Exclusive Economic Zone Act (1992:1140) states that it is the County Administrative Board of the county where Sweden's marine territory is closest to the planned activity that is responsible for the processing the application. For the Baltic Offshore Delta project, this means the County Administrative Board in Stockholm County.

According to Chapter 6, Sec. 28 of the Swedish Environmental Code, a specific environmental assessment means that the operator consults on the scope of the EIA, identifies, assesses, and documents the environmental effects of the planned activities in the EIA, and that the authority providing the approval permit then completes the EIA.

The different steps of the permit process are shown schematically in Figure 1.

The consultation procedure allows regulatory authorities, individuals, and the public to provide information and to submit comments (consultation remarks) on the activities planned.

Njordr now intends to obtain information and opinions on the content and design of the EIA, as well as on the location, scope, design, and environmental effects that the project may entail directly or indirectly. The environmental effects may be positive or negative, temporary or permanent and may arise in the short, medium or long term with regard to:

- population and human health
- animal or plant species protected under chapter 8 of the Swedish Environmental Code and other biological diversity
- ground, soil, water, air, climate, landscapes, and cultural values
- the management of land and water and the physical environment in general
- other management of materials, raw materials, and energy
- other parts of the environment.

We ask you to submit consultation remarks in writing so that we can compile them in a consultation report as objectively and correctly as possible and to incorporate them into future environmental impact assessments.

Chapter 2 presents the planned activities in more detail.

1.2.1 Scope of the consultation

The establishment of the Baltic Offshore Delta wind power farm also requires permits other than those specified in Section *1.2 Applicable Legislation and Consultation.* These will be applied for and reviewed separately and are not covered in this consultation document, Table 1.

TABLE 1 Summary of the application of permits identified so far, which are intended to be applied for in terms of the project and the legislation by which this is regulated.

Activity	Permits as required by law	When
The wind power farm	The Swedish Exclusive Economic Zone Act (1992:1140). During the permit application process, Chapters 2–4 and Chapter 5, Sec. 3–5 and 18 of the Swedish Environmental Code are applied, and a specific environmental assessment is to be carried out, and an EIA is to be produced by the operator.	This consultation and the subsequent permit application
The associated internal cable networks for the wind farm	The Continental Shelf Act (1966:314) for investigations before and when laying underwater cables and pipelines on the continental shelf.	This consultation and the subsequent permit application
Seabed surveys	Permit application under the Continental Shelf Act (1966:314) or notification to the Geological Survey of Sweden (SGU).	Separate application/ registration
Connection of the wind farm to land outside Sweden's territory	The Continental Shelf Act (1966:314) for shutting down and operation of connecting cables on the continental shelf from the wind farm (from the substation) to the connection to overhead powerlines on land, within Sweden's Exclusive Economic Zone and territorial waters.	Separate application
Connection of the wind farm to land in Sweden's territory	Swedish Electricity Act (1997:857) (concession) for the decommissioning and operation of connecting cables and/or air lines in Sweden's territory.	Separate application
Decommissioning and operating connection cables and/or overhead lines in Sweden's territory	Swedish Environmental Code (1998:808)	Separate application
Network connection to Swedish National Grid	Authorisation and ability to connect to the main electrical grid.	Separate application

THE PERMIT PROCESS

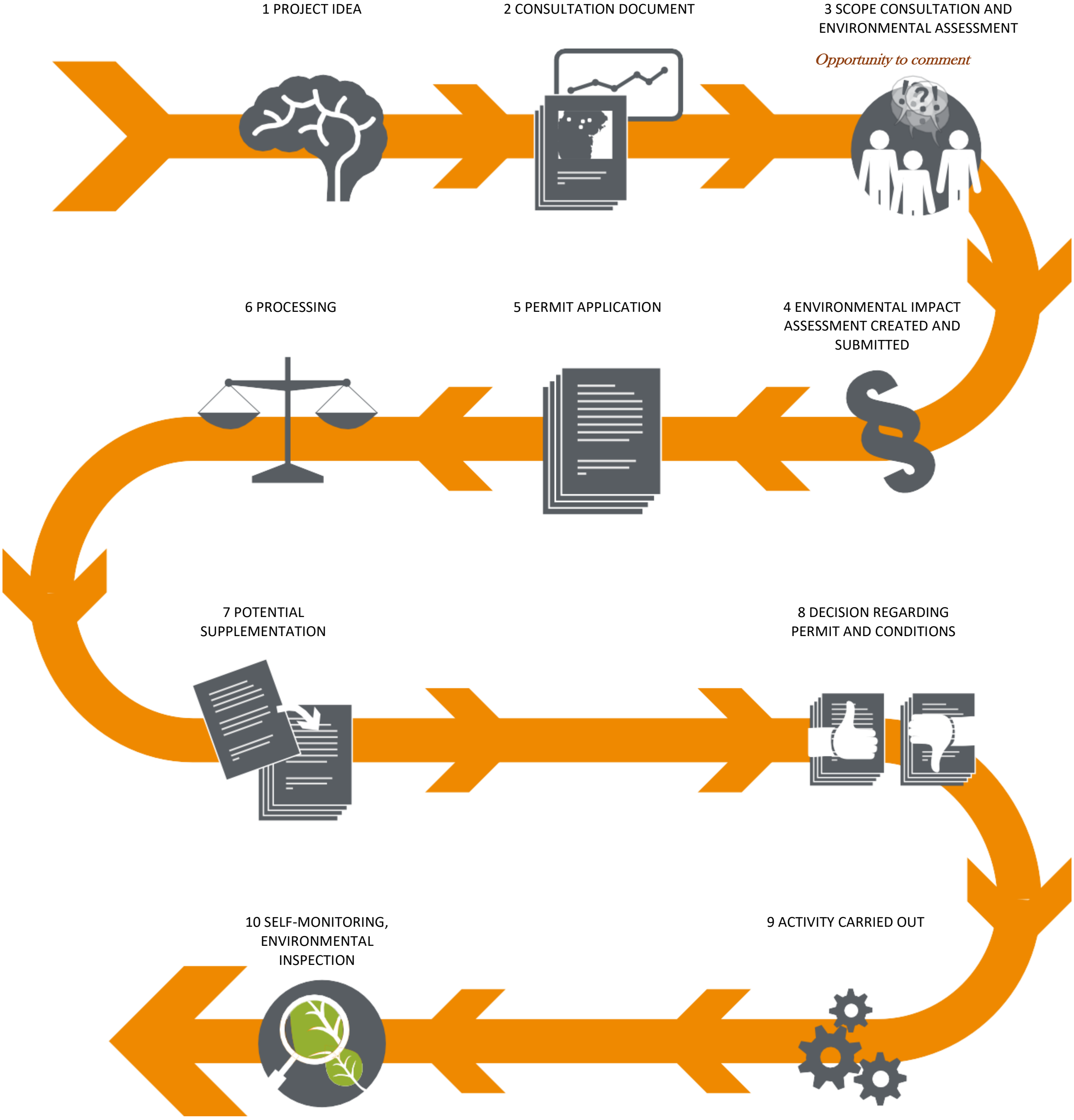


FIGURE 1 Visual diagram of the permit application process

1.3 Administrative information

Table 2 sets out the administrative information on which this consultation document is based.

TABLE 2. Administrative information, technical data, and wind farm dimensions

Operators	Njordr Offshore Wind AB
Corporate ID Number	559308 – 6019
Postal address (head office)	Lantvärnsgatan 8 652 21 Karlstad SWEDEN
Contact person	Niklas Sondell, project manager Njordr Offshore Wind AB
Telephone	070 - 218 50 64
The name of the wind farm	Baltic Offshore Delta
Location	Marine area east of Stockholm (Ö204), Marine area North Baltic Sea and Southern Kvarken Strait, Sweden's Exclusive Economic Zone

2. LOCATION STUDY AND PROJECT DESCRIPTION

This chapter describes how the location for the planned activities was selected. The scope, dimensions and technical conditions for the planned wind farm are also presented.

2.1 Location process

Since planned activities are automatically assumed to have a significant environmental impact, future EIAs should list alternative locations, if possible, as well as different design options that are investigated within the framework of the project. In addition, a zero alternative should also be presented. In the present case, no specific alternative locations have been developed, but based on a selection process, as described in Section *2.1.1 Choice of location* below, the most suitable site for the wind turbine farm has been selected. The method for selecting the location will be described in more detail in the EIA.

The Swedish Environmental Code states in its portal section that land, water, and the physical environment should be used in such a way as to ensure good long-term management from an ecological, social, cultural, and socioeconomic point of view. In addition, Swedish energy policy targets state that wind power will be expanded to a large extent, and that the expansion must take place in several locations at the same time.

A suitable area to expand wind turbine operations requires good wind conditions, few opposing interests, and also good opportunities for large-scale operations in order to share common costs, for example connection to the electrical network.

2.1.1 Selection of location

The proposed location for Baltic Offshore Delta is based on a comprehensive feasibility study of the Swedish part of the Baltic Sea in relation to future energy needs, technical and commercial feasibility, environmental conditions, and impact on the environment, as well as other potential opposing interests. The aim has been to identify the places that maximise the climate and environmental benefits while minimising the impact on nature and the environment, and any negative consequences for human health and the environment.

The study is based on a basic mapping of the potential wind resources (see Section 3.4), technical and commercial feasibility, and opposing interests. Distance to land, depth to the seabed, and economic conditions were also important aspects in the choice of location.

In addition, a variety of parameters have been taken into account in the process of selecting a location. The following can be mentioned among these:

- Maritime traffic – focus on adaptation to actual maritime traffic
- Defence – known stopping areas, practice areas and national interests have been avoided
- Fishing – avoids conflicts with national interests
- Net fishing – areas with high intensity have been avoided
- Porpoises - areas that are less important for porpoises
- Long-tailed duck and black guillemot – estimated presence used as an indicator of important seabird areas
- Nature restrictions (Natura2000, conservation areas, etc.) – outside and with buffer zones
- Aviation - outside areas in conflict with aviation
- Swedish Agency for Marine and Water Management – marine plans are used to avoid conflict areas
- Sea depth – deeper water with floating foundations or those anchored to the sea bottom
- Oxygen deficiency – areas that sometimes or consistently lack oxygen at the bottom are encouraged
- Wind resources – detailed surveys of wind
- Risk areas for mines – the known areas have been avoided
- Main electrical grid - strategic location in relation to needs and interconnection with other countries
- Energy needs – focus on regions with a high production deficit
- Visibility – turbines that are hidden beneath the horizon as much as possible
- Disturbances for the public – being far out at sea also results in reduced disturbance beyond being visible
- Commercially feasible – being far out at sea in deep water requires large wind farms
- In general, all known national interests have been avoided. The exception is for maritime traffic where the focus has been more on actual shipping.

2.2 Main options

The Baltic Offshore Delta project area is located in the area of the sea that is east of Stockholm (Ö204) in the North Baltic Sea and Southern Kvarken Strait in Sweden's Exclusive Economic Zone, see Figure 2. The distance to the surrounding land is far, where the closest is Sandhamn, 53 kilometres west of the project area. The project area consists of open sea with no islands, see Figure 3.

The project area is 1064 square kilometres. The depth of the sea varies between roughly 30 and 180 metres, with the shallowest areas located in the north. The average depth of the entire project area is approximately 100 metres (SGU, 2021). The bottom of the area is low in oxygen, and the bottom sediment is dominated by post-glacial fine sand and glacial clay (SGU, 2021), see further description in Section 3.8.

The project is estimated to have potential for approximately 5000 MW of installed power with an annual production of approximately 20 TWh.

The factors on which the scope of the project area is based are described in more detail in Section 2.1.1.

A separate application to connect to the main electrical grid has been submitted to the Swedish National Grid, see Section 5.2 regarding electricity connection.

In order to improve the options for offshore wind power in the Baltic Sea, surrounding countries have jointly started the Baltic Offshore Grid Initiative, which will pursue joint plans for electrical grids in the Baltic Sea and between the different countries on the Baltic Sea. The Baltic Offshore Delta project area is strategically well-positioned with potential future links to most countries (Baltic IntelGrid 2019), see Figure 4.

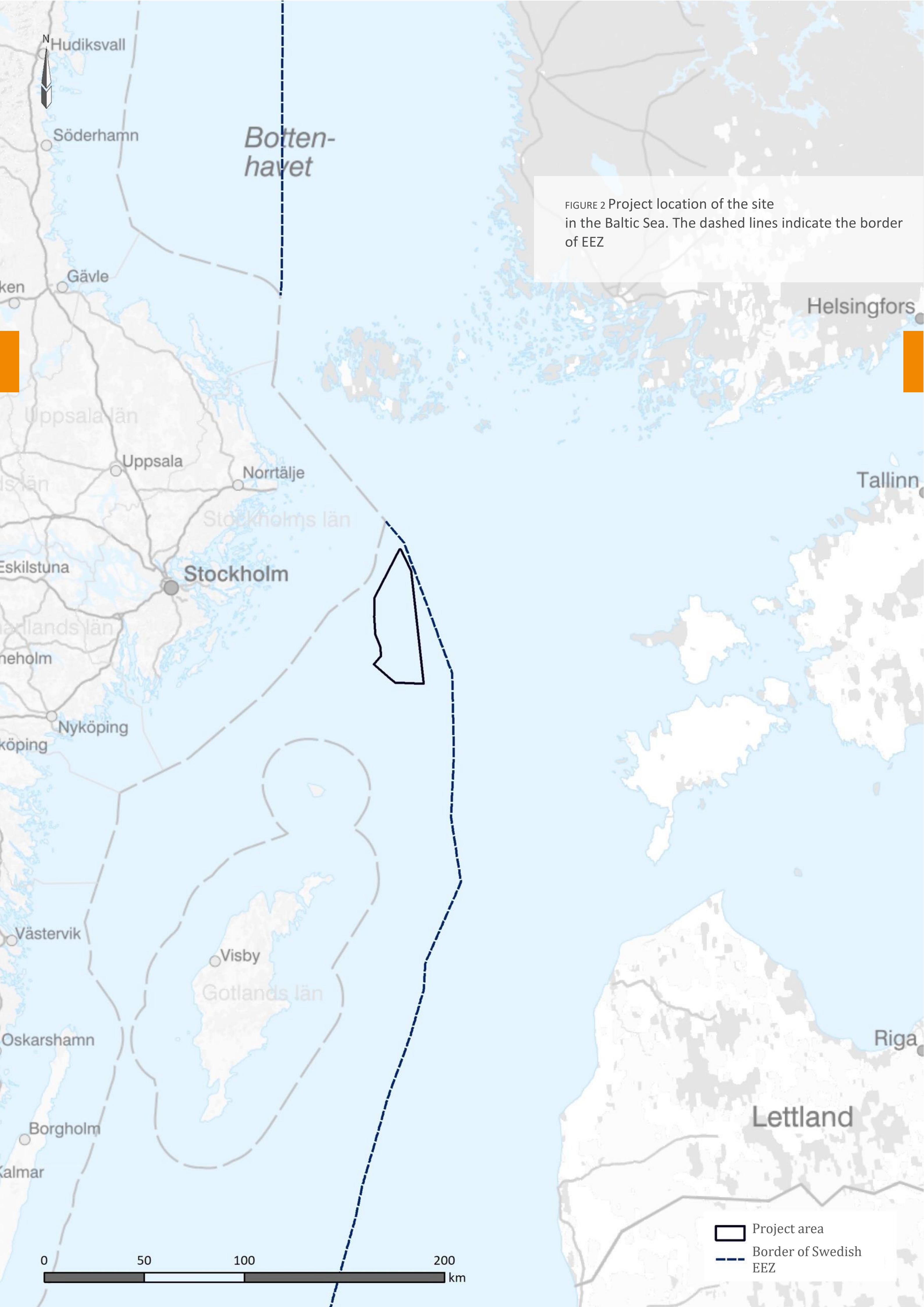


FIGURE 2 Project location of the site in the Baltic Sea. The dashed lines indicate the border of EEZ

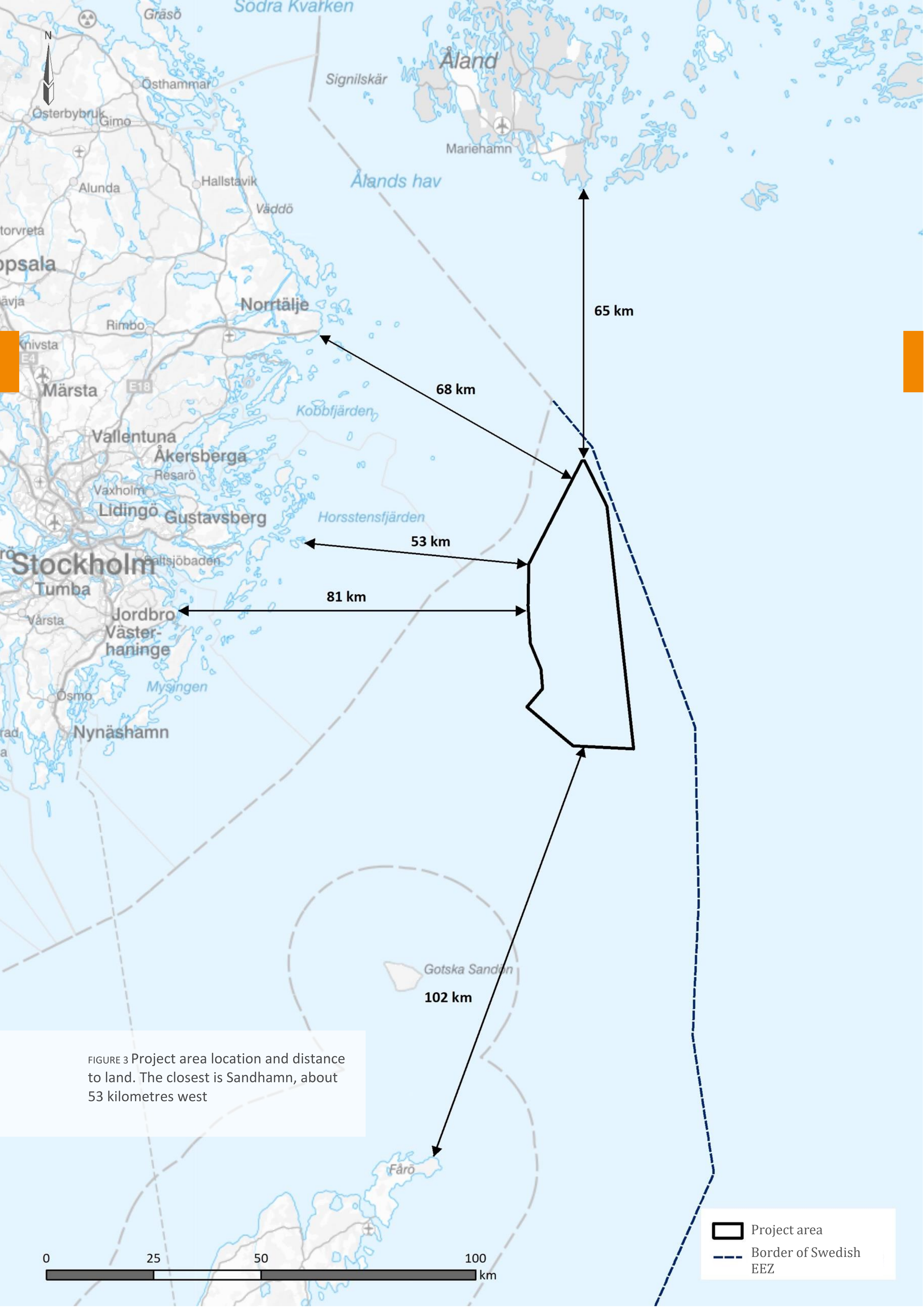


FIGURE 3 Project area location and distance to land. The closest is Sandhamn, about 53 kilometres west

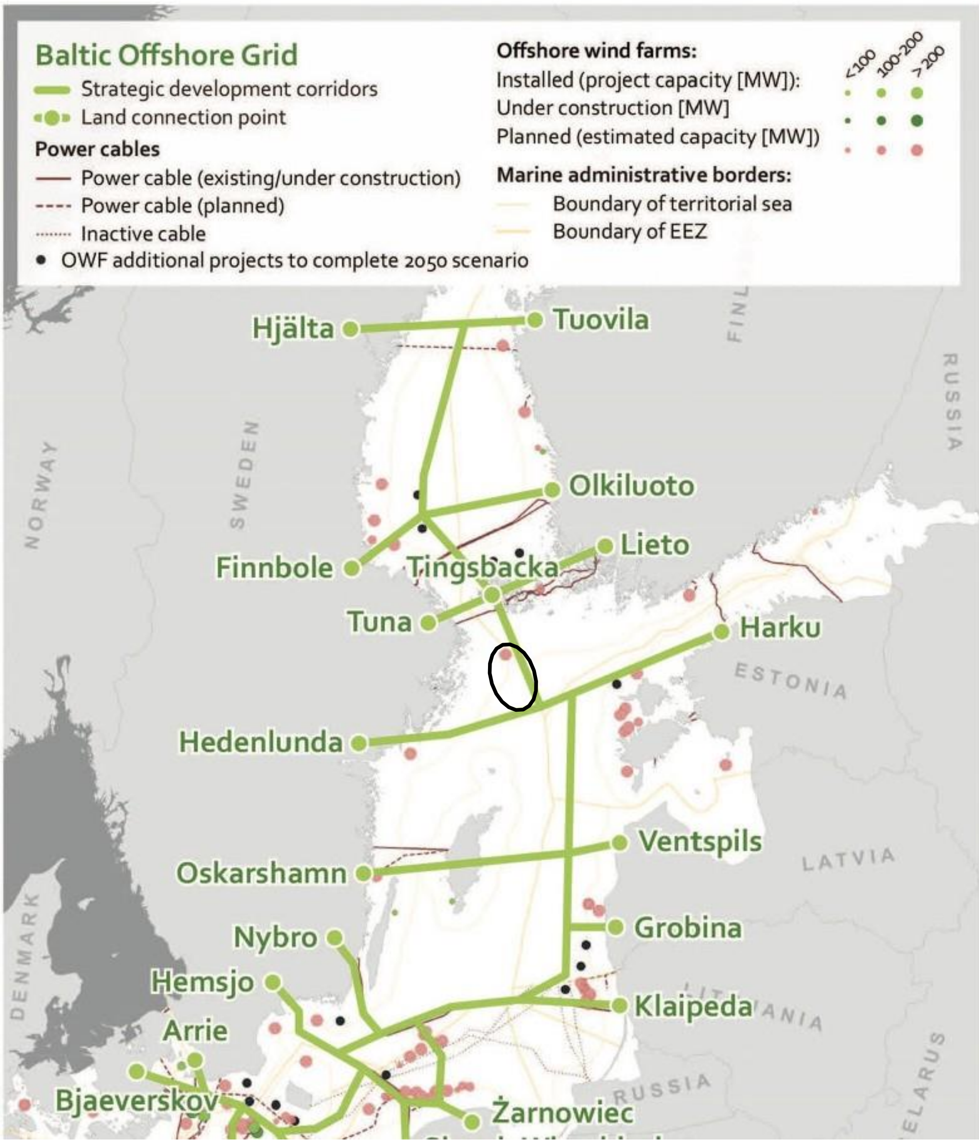


FIGURE 4 Baltic Offshore Grid (BOG 2050) concept. Source: Baltic IntegrGrid (n.d.), page 25. The black ring marks the approximate location of the project area in relation to the planning proposal's investigation corridors and has been added to the map afterwards.

2.2.1 Design options

The work on developing the most optimal layout for the wind farm, i.e., the placement of wind turbines and associated infrastructure with the least possible environmental impact, takes place on an ongoing basis throughout the project. Design options can include, for example, different locations for the turbines, different dimensions of the turbines or different foundation choices. The layout presented during the consultation phase, see Section 2.4, should therefore only be seen as an example of how the planned wind power farm might look. However, the number of turbines will not exceed 300 in the final layout.

A summary of the different design options examined will be presented in the next EIA.

2.3 Zero alternative

A zero alternative is a comparison option that describes the situation if planned activities are not carried out. A report on the zero alternative is prepared in the upcoming EIA and the estimated environmental effects, as a result of planned activities, will then be compared with the zero alternative.

2.4 Design of wind power farm

The Baltic Offshore Delta wind farm is planned to consist of a maximum of 300 wind turbines with a total installed power of about 5000 MW and an expected annual production of about 20 TWh.

The turbines within the wind farm will be connected via an internal cable network connected to one or more offshore substations to transfer electricity to the land via one or more connection cables. Refer to Section 2.4.5 for a more detailed description of electrical and communication systems.

There are two main techniques for anchoring foundations to offshore wind turbines; directly to the bottom (bottom-anchored foundations) or via cables (floating foundations). See Section 2.4.2 for a detailed description of the various foundations. Both of these technologies are expected to be relevant for Baltic Offshore Delta. Due to the depth of the sea, bottom-anchored foundations can only be considered in the northern part of the project area where the depth is shallower than in the southern part, see Figure 6 below.

Scope and design

At most, 300 turbines with a maximum overall height of 330 metres are planned within the 1130 square kilometre project area. The scope and dimensions of the wind power farm are summarized in Table 3. The number of turbines, and thus their relative locations, will be planned on the basis of available technology in order to make decisions about construction. Different options are presented in Table 4. An example layout is described in Section 2.4.1.

TABLE 3 The dimensions of the planned Baltic Offshore Delta wind farm.

Number of turbines	Up to 300
Power per turbine	Approx. 20 MW, production approx. 80 GWh/year (sample turbine)
Total height	Up to 330 metres

TABLE 4. Parameters for power, size of turbine and distance between them depending on the number of turbines used. For sample layouts, as well as for calculating production and power profiles, 253 turbines of 20 MW each have been used (see Section 2.4.1).

No. of turbines	Power (MW)	Rotor diameter (m)	Total power (MW)	Average distance (m)
300	15	230	4500	1800
250	20	263	5000	2000
220	25	295	5500	2150

2.4.1 Wind turbines and layout

Due to the relatively long processes for realizing offshore wind power, combined with the rapid technological development in the wind power industry, it is not possible at this time to describe in detail the wind turbines that may eventually be constructed. The current schedule indicates that Baltic Offshore Delta is likely to be completed at the earliest around 2030–2032, see Section 5.4.

There are currently offshore wind turbines with an installed power of 15 MW and according to industry forecasts, 20 MW turbines are likely to be in existence around year 2025. The production analysis for the project is based on a sample turbine with an installed power of 20 MW. This involves a somewhat conservative expectation of future technology development up to 2030–2032. The example turbine has a rotor diameter of 263 metres and a total height of 300 metres, see Figure 5. Note, however, that the application includes a maximum total turbine height of 330 metres.

The locations for the wind turbines in the project area are governed by local conditions, such as geotechnical engineering, depth conditions, shipping, natural and cultural values, and wind conditions. For example, in the project area there is a five kilometre wide corridor for maritime traffic to access the area, see Figure 6. Wind turbines also need to be located about two kilometres apart in order to avoid affecting each other's production and to maintain proper safety.

Associated activities

During the construction and decommissioning phase of the wind farm, temporary disturbances may occur, including in the form of increased vessel traffic and pile driving for anchoring foundations. For a description of how marine wildlife, recreation and shipping may be affected, see the respective sections in Chapter 3.

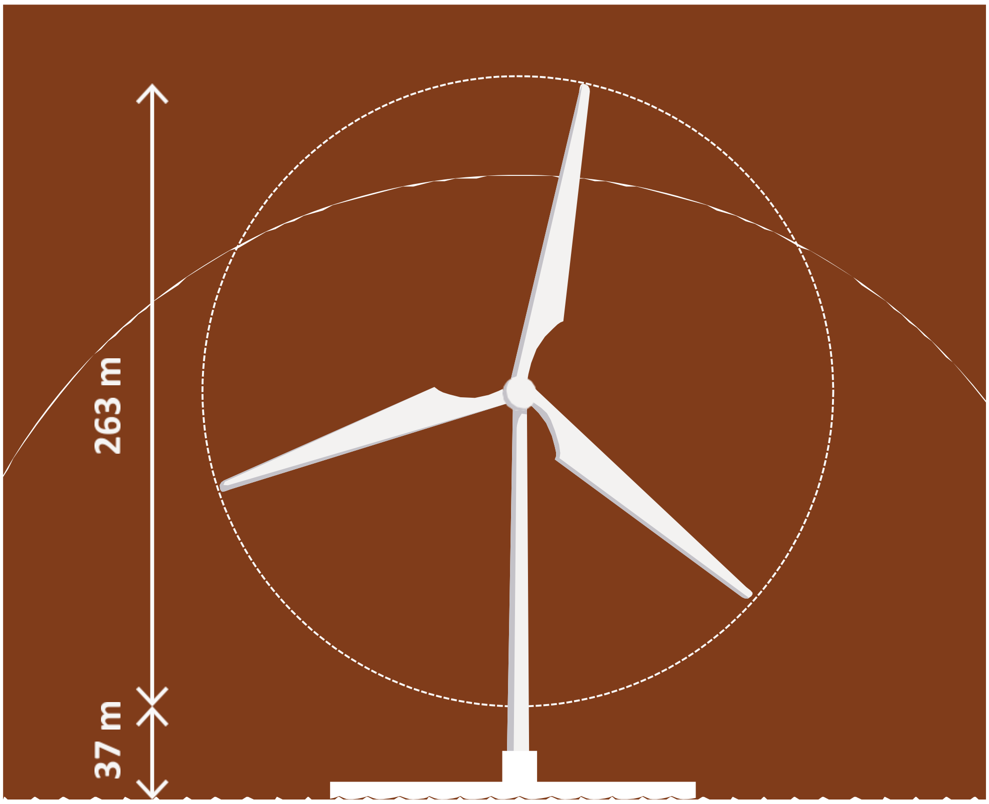


FIGURE 5 Sample turbine size above the water surface in the preliminary production analysis for Baltic Offshore Delta.

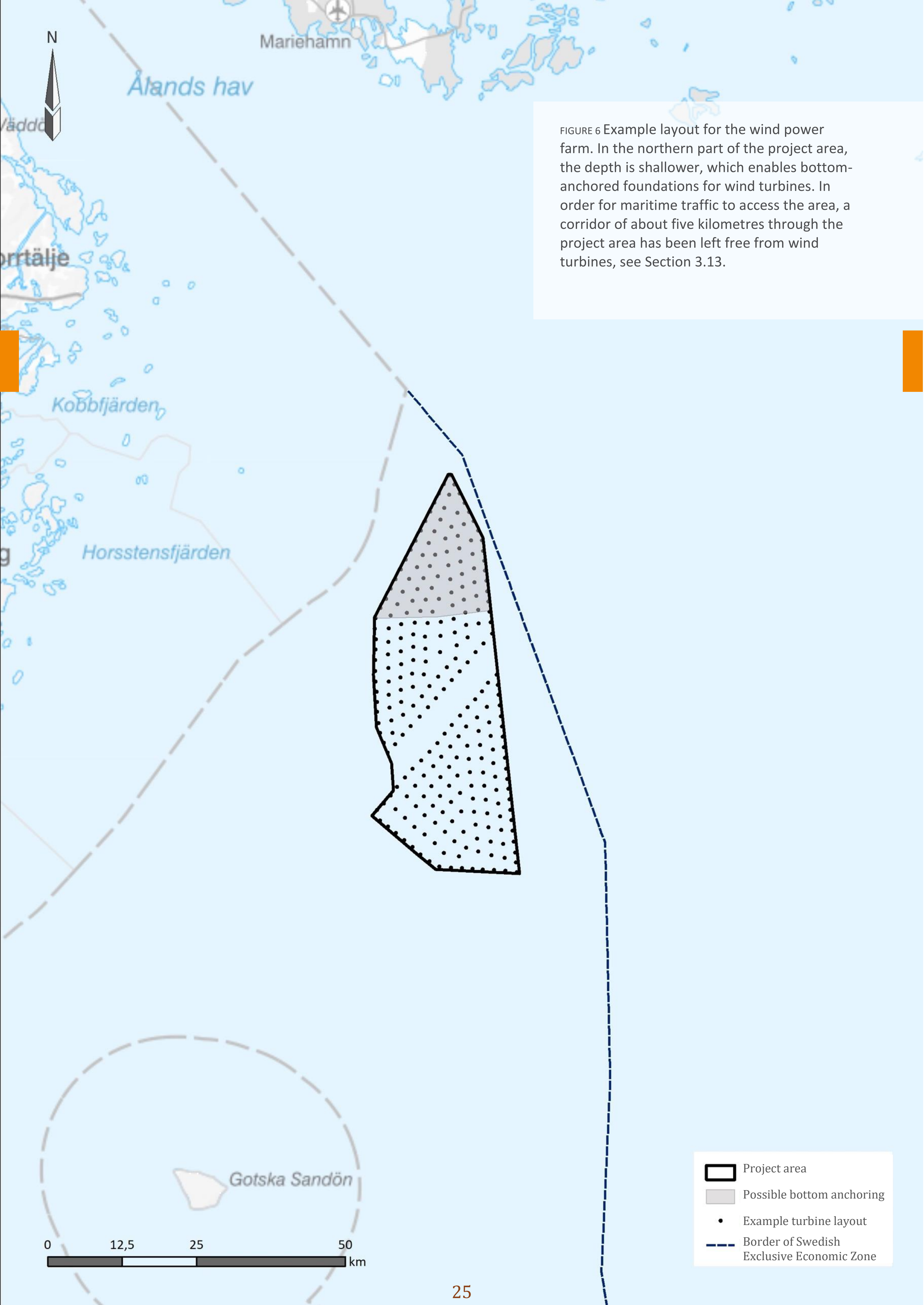


FIGURE 6 Example layout for the wind power farm. In the northern part of the project area, the depth is shallower, which enables bottom-anchored foundations for wind turbines. In order for maritime traffic to access the area, a corridor of about five kilometres through the project area has been left free from wind turbines, see Section 3.13.

2.4.2 Foundations and anchoring

Offshore wind turbines can be placed on foundations that are either floating or anchored to the seabed, see Figure 7. With today's technology, bottom-anchored foundations can be used down to about 60 metres depth. At larger depths, floating foundations are a more suitable solution. Floating foundations are a newer technology that is relatively expensive at the moment, and in the short-term, it is competitive only at large depths of water. However, future development and significantly higher volumes are expected to drive down the costs for floating foundations. The anchoring method that is best for Baltic Offshore Delta will be investigated and determined when the turbine model has been selected.

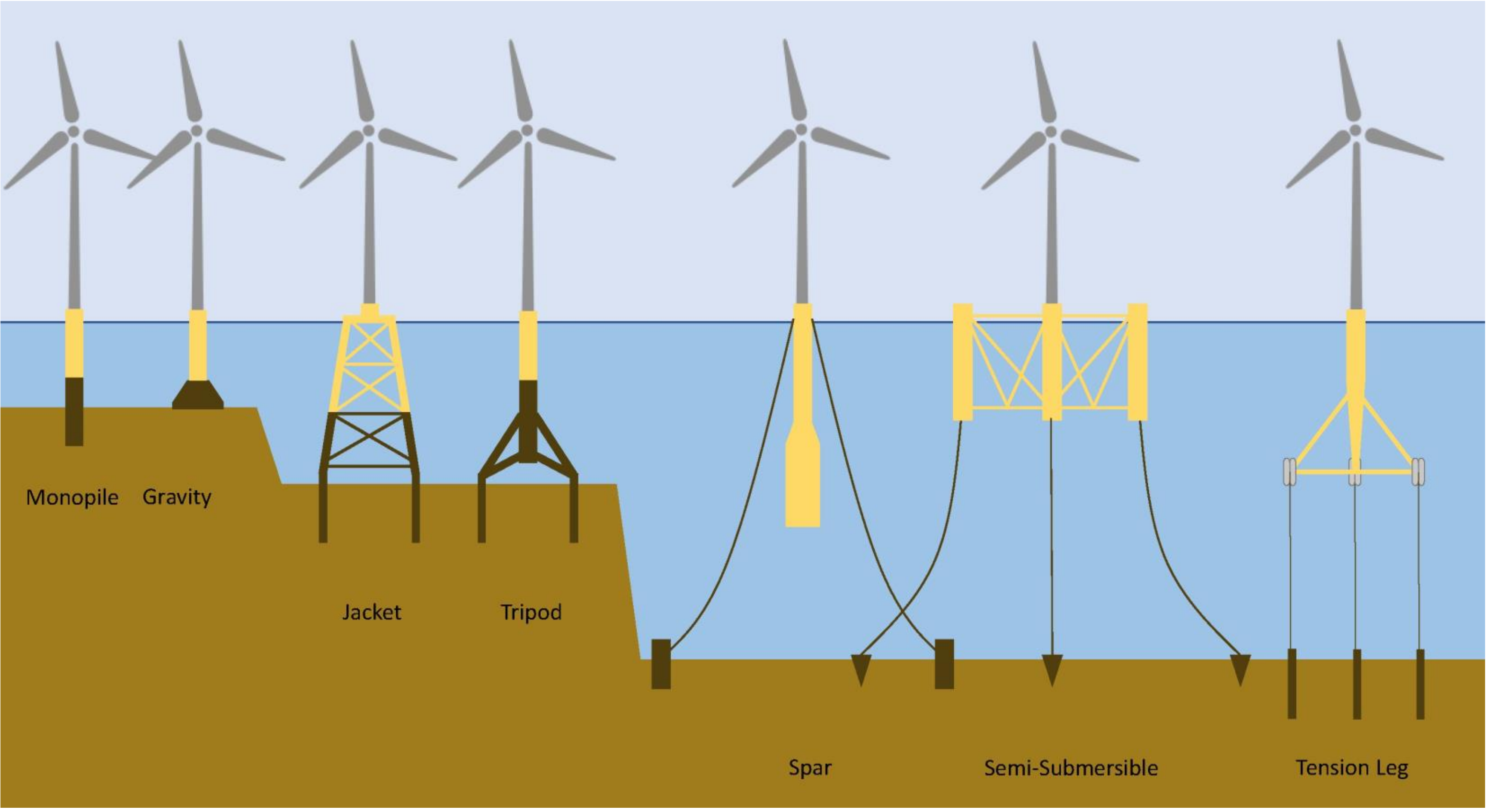


FIGURE 7 Overview of types of foundations for offshore wind turbines. Source: Dornhelm et al. (2019).

2.4.3 Bottom-anchored foundations

Bottom-anchored foundations consist of four main technologies:

Monopile

Monopile foundations consist of a steel cylinder driven down into the sea bottom by piling. It is currently the most common technology for offshore wind. It is fast and relatively inexpensive to install. The technology is well-suited for relatively shallow water, up to 30–40 metres using current technology, and seabeds consisting mainly of sand or gravel. There is ongoing research aimed at changing the design to produce monopile solutions that work down to 70 metres. A disadvantage of the conventional piling method for installing of monopiles is that it creates vibrations and sounds that can disturb underwater organisms and animals. In sensitive areas, an alternative to monopiles can therefore be using a suction pipe/anchor where the pipe itself is driven down by creating a vacuum in the pipe. This option is suitable for soft bottoms.

Gravity foundation

A gravity foundation consists of a circular concrete structure filled with ballast that rests on the seabed. The tower is fixed to the foundation and the turbine is kept upright by gravity. Gravity foundations are a simple and cost-effective method suitable for most types of sea bottom. The disadvantage is that their area of use is limited to relatively shallow depths of water, 30 metres is a general maximum depth of the bottom.

Jacket (truss foundation)

The jacket foundation consists of a truss structure that is anchored to the sea bottom. It is a stable design that can handle high loads and far greater depth than the above solutions. The foundation is also relatively insensitive to the type of sea bottom, since the method of fastening to the seabed can be adapted to the conditions.

Tripod

A tripod foundation consists of an upper cylindrical part joined to the tower and a lower three-legged structure that distributes the force to the bottom. The tripod technology is stable and capable of handling relatively large sea depths. It also fits most fixed bottom types. The disadvantage is the cost and the fact that it requires more effort during transportation.

2.4.4 Floating foundations

For floating foundations, there are three main techniques today. However, this technology is developing quickly, and more potential solutions are likely to be developed before Baltic Offshore Delta is realized.

All floating foundations described below are based on fastening the foundation to the sea bottom with cables. The choice of anchoring depends on the type of seabed that is present and can therefore vary within the project area, see Figure 8.

Under normal production conditions, the floating foundation, semi-submersible and SPAR, can move horizontally with the movements of the water in a radius of about 10–25 metres from the centre. The fastening in the sea bottom does not move and the fastening lines are never so slack that they reach the bottom.

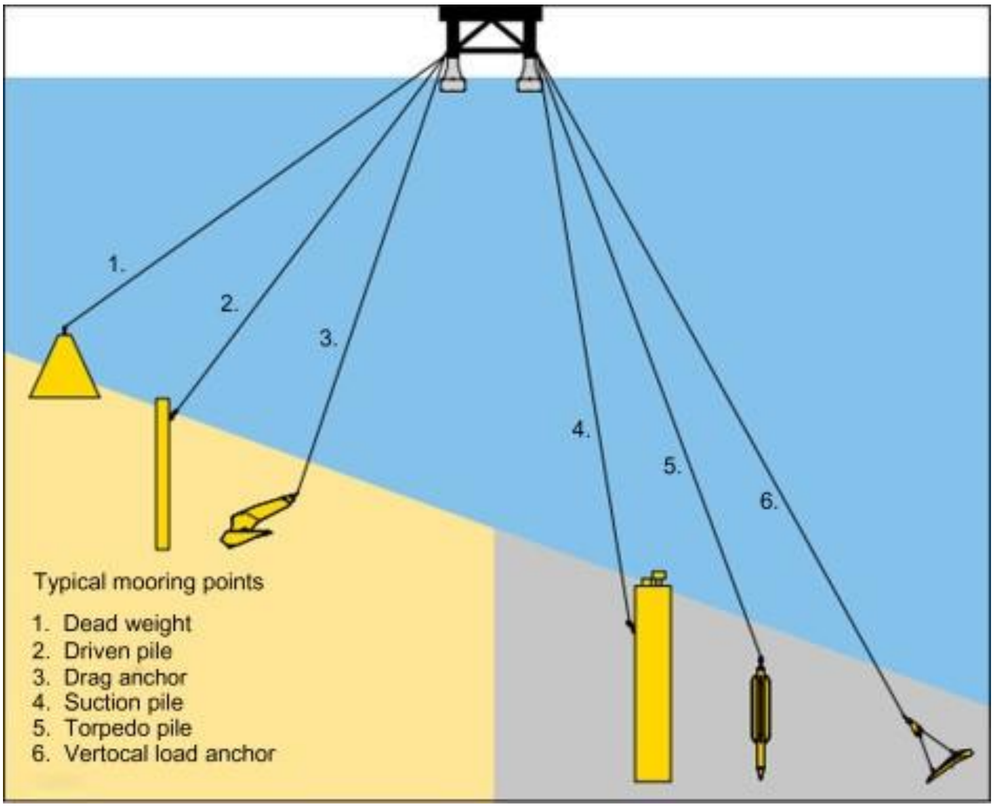


FIGURE 8 A view of the most common methods of fastening to the bottom. Source: Vryhof anchors, 2010.

Spar

The Spar technology is based on a counterweight placed directly under the floating wind turbine and thus stabilising the lateral movement of the turbine from both aerodynamic loads and forces from waves and ocean currents. The stabilising counterweight typically consists of a cylinder filled with ballast. A practical limitation is that the cylinder body is generally the same length as the turbine tower, which means that very deep ports, or other solutions, are required to perform the assembly off-site.

Semi-submersible

The turbine is placed on a floating platform that is anchored to the bottom with slack anchor lines. The floating platform can consist of both a single large floating element or many floating elements (pontoons) assembled with outriggers to distribute the lifting force over a larger area, thereby increasing stability.

Tension Leg

The tension leg technology is based on a floating platform that is stabilised by tensioned anchor lines to the bottom. Compared to the techniques above, which are based on slack lines to keep the turbines in place, the tension leg technology means that the platform needs more buoyancy, and the line fastening needs to handle a greater load.

2.4.5 Electrical and communication systems

The turbines are connected to an internal cable network for communication and transmission of the produced energy. The voltage level in today's internal cable systems is usually 66 kV, but it is likely that higher voltage levels may also be relevant for Baltic Offshore Delta. Communication between the wind turbines is important for operational monitoring and load control at both the turbine and system levels.

The internal cable network is connected at one or more offshore substations, so-called OSS’s (Offshore Sub-Stations). The substations transform the electricity produced by the wind turbines into high voltage and probably also into high voltage direct current (HVDC) to reduce electrical losses when transferring to the mainland via one or more connecting cables.

No dumping of material is planned, but a trench will be created when laying the cable at the right depth in the sea bottom. Moving sediment is also not planned.

Potential impacts on plant and animal life from internal cable networks and substations, as well as the risk of leaking current in the water, both during the installation phase and operation, will be analysed and clarified in the EIA and form part of the risk and vulnerability analysis in the event of an accident or sabotage.

A separate application to connect to the main electrical grid has been submitted to Swedish National Grid, see Section 5.2 regarding electricity connection.

3. ASSUMPTIONS ABOUT THE AREA AND ANTICIPATED ENVIRONMENTAL EFFECTS

This chapter briefly describes the surrounding conditions and the expected environmental effects that the wind power facility is expected to cause. In future work on the EIA, these environmental effects will be investigated and reported in more detail.

3.1 Planning conditions

The oceans are largely unexplored at the same time as they are important from many different aspects, e.g. in terms of shipping routes, combating climate change, habitat for biodiversity, importance for food production and recreation, and more. In order to ensure that we use the seas in a long-term and sustainable way without harming them, it is important to carefully investigate the impact of the planned activities prior to their possible installation.

The current project area lies within Sweden's Exclusive Economic Zone, and thus it is the state that has planning responsibility for the area in terms of marine planning and marine environmental management. The distance from the project area to the Finnish Exclusive Economic Zone is approximately 1.5 kilometres, equivalent to just under one nautical mile.

3.1.1 Marine planning

The Swedish Agency for Marine and Water Management has been given a government mandate to prepare proposals for official marine plans for the Gulf of Bothnia, the Baltic Sea, and the North Sea, with the aim of contributing to the long-term sustainable development of marine areas that bring economic policy objectives, social objectives, and environmental objectives together. The Swedish Agency for Marine and Water Management submitted a proposal for an official governmental marine plan at the end of 2019. The government is now reviewing the proposal that was submitted. The marine plan is a guiding document for the permit application process.

The Swedish Energy Agency has identified national interests for energy production, but the marine plan states that the national interests identified are not sufficient to achieve the objectives for energy production, and the marine plan has therefore developed new areas for energy production together with the Swedish Energy Agency (Swedish Agency for Marine and Water Management, 2019b). The assessment has been based on depth, average wind, bottom conditions, and proximity to electricity connections on land and areas with high electricity consumption. For areas designated for energy production in the marine plan, this interest should be given priority in terms of the permit authorisation process. This does not mean that areas that are not designated are not suitable or should not be authorised. The marine plan also describes the need to identify more areas for offshore wind power. The main conflict of interest identified involves the national defence interests.

The project area is located in the Baltic Sea area. The Baltic Sea area is divided into five areas, where the project area is located in the northernmost region, called the North Baltic Sea and the South Kvarken Strait. Each area is in turn divided into twelve sub-areas with a different focus. The entire project area is located in sub-area *Ö204, General use Ö204*, with particular regard to cultural values, see Table 5. Sub-areas *Ö214, Ö203, Ö206* and *Ö207* are adjacent to the project, see Figure 9. Sub-area *Ö214* is located north of the project area and special consideration should be given to the special natural values found in the form of reef environments, bird and mammal habitats, and climate refuge for blue mussels. West of *Ö214* is the area *Ö203,* which is used for natural conservation, shipping, and maritime traffic research. The area also includes special cultural values. Both *Ö206* and *Ö207* are located west of *Ö204, and they are used primarily for national defence, but shipping and maritime traffic research,* while *Ö206* is also used for nature conservation.

The northern Baltic Sea area is well suited for energy production due to good wind conditions. There is a suitable depth in several places and the electricity demand is great in the Mälardal region around Stockholm. A region of *national interest for energy production* is located in sub-areas Ö203 and Ö214, north of the project area, see Figure 9. Both north and south of the project area are highlighted areas in the marine plan designated as Energy: *Other claims for wind turbines*, see Figure 9. The smaller area north of the project area that is designated for *Energy: Other claims for wind turbines* overlaps the project area by 1.77 square kilometres. Otherwise, it is mainly the interests of shipping that affect parts of the project area, see Sections 3.6 and 3.13.

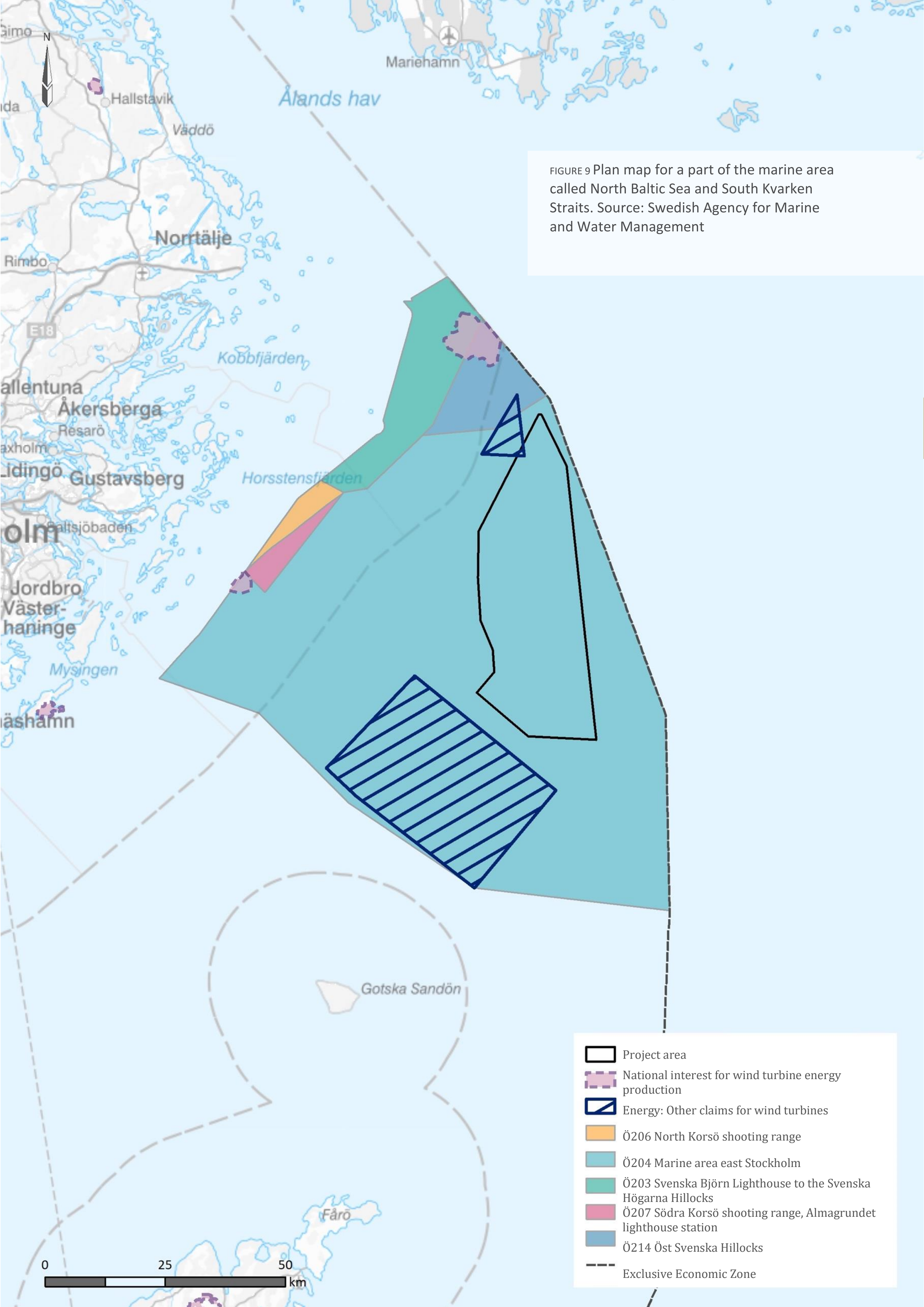


FIGURE 9 Plan map for a part of the marine area called North Baltic Sea and South Kvarken Straits. Source: Swedish Agency for Marine and Water Management

TABLE 5 Extract from description of the marine area Ö204 North Baltic Sea and South Kvarken Strait. Special consideration should be given to these aspects if they occur. Defence interests should be given priority if coexistence cannot be achieved. Source: Swedish Agency for Marine and Water Management, 2019b.

Area	Usage	Special consider-ation	Priority or specific adaptation for co-existence	Justification for precedence
Ö204	General use Shipping	High cultural values	Defence takes precedence over energy production.	The national interests in terms of overall national defence are given priority in accordance with Chapter 3, Sec. 10 of the Swedish Environmental Code over the national interest claims for wind farms and the general interests of vital importance for wind farms. The uses are not considered to be able to co-exist.

3.1.2 Marine environmental management

The Marine Strategy Framework Directive, which extends from the shoreline to the outermost boundary of the Exclusive Economic Zone, is an EU directive aimed at achieving or maintaining good environmental status in Europe's seas by 2020. The Marine Strategy Framework Directive is implemented in Sweden in accordance with the marine environment regulation (Swedish Agency for Marine and Water Management, 2021). Marine environmental management under the Marine Strategy Framework Directive is done on the basis of assessing the environmental status, monitoring environmental status and, if necessary, creating measures to achieve or maintain good environmental status, see Section 3.2 on environmental quality standards.

3.1.3 HELCOM Baltic Sea Action Plan

HELCOM, the Baltic Marine Environment Protection Commission, is a partnership between all of the countries around the Baltic Sea that aims to protect the marine environment of the Baltic Sea from all types of pollution. In 2007, HELCOM developed an action plan, the Baltic Sea Action Plan, (HELCOM, 2007). The Action Plan lists several threats to the Baltic Sea and measures that the Baltic Sea countries are committed to implementing. It describes how to reduce pollution from hazardous substances, preserve the unique brackish water ecosystems of the Baltic Sea, ensure long-term fishing, and promote safe and environmentally responsible shipping. The plan does not directly affect wind power and the planned wind power operation does not conflict with any of the parts of HELCOM's action plan if the project is implemented in such a way as to ensure, for example, that no hazardous substances are dispersed during construction or operation.

3.2 Environmental quality standards

Environmental quality standards are regulations regarding the quality of soil, water, air, or the environment in general. Environmental quality standards can specify pollution or disturbance levels which humans, the environment or nature can be safely exposed to. They may also consist of threshold values or guiding values, indicate the maximum or minimum presence of organisms in the surface water or groundwater, or be made up of the requirements otherwise imposed in terms of environmental quality due to Sweden's membership in the EU.

The Marine Strategy Framework Directive 2008/56/EC aims to maintain or achieve good environmental status in Europe's seas by 2020. In Sweden, the directive has been implemented by the Marine Environmental Regulation (2010:1341), which states that the management of the marine environment shall mean that a good environmental status is achieved or maintained in the North Sea and the Baltic Sea.

The Swedish Agency for Marine and Water Management is the regulatory authority responsible for implementing marine management plans. This includes the development of environmental quality standards with indicators to be used to assess whether a good environmental status has been achieved or maintained. Another part involves the development and implementation of programmes to monitor compliance with environmental quality standards and the measures to be taken to maintain or achieve good environmental status.

The aspects involved in maintaining or achieving good environmental status in the sea include physical and chemical conditions, habitats, and biological conditions. The environmental burden may consist of physical disturbances such as damage to the sea bottom, provision of nutrients, pollutants, and biological disturbances, such as the extinction of species from fishing.

The action programme developed by the Swedish Agency for Marine and Water Management sets out the measures needed to comply with environmental quality standards for the marine environment and to achieve the established objectives for good environmental status in the marine environment (Swedish Agency for Marine and Water Management, 2015). The actions are divided into different thematic areas. The two thematic areas that are considered to be affected by the planned wind energy facility are *the integrity of the seabed* and *the supply of energy, including underwater noise.*

Benthic marine environments are adversely affected by both the effects of eutrophication and the direct impacts on the seabed, such as from fish trawling. Oxygen content and currents are also important factors, see also Section 3.8.1. Even if the planned wind farm affects the integrity of the seabed through a direct intrusion, the total amount of substrate with the operation increases and benthic organisms can benefit. The bottom is also protected for a long time from the effects of trawling while the wind turbines are in operation.

The noise in the seas caused by human activity increase both in strength and frequency and may affect the animals living there, see Sections 3.9 and 3.14. Environmental quality standards for energy, including underwater noise, mean that good environmental status is characterized by *"activities that create noise levels that are sufficiently high to cause adverse effects on individual populations or ecosystems that are limited in time and space"* and *"underwater noise from ships should not give rise to long-term adverse impacts on biodiversity and ecosystems."* Since the state of knowledge about noise in the sea is poor, and there are no functional indications for assessing environmental quality standards, no action is proposed in the action programme, other than to raise awareness (Swedish Agency for Marine and Water Management, 2015).

3.3 Nearby wind turbine facilities

So-called cumulative effects can occur if there are wind turbines in the vicinity of the project area in question. Figure 10 and Table 6 show the wind turbines that are built, have been granted permits, or are planned within 50 kilometres of the project area. Within this distance, there is only one smaller wind turbine at the Swedish Högarna hillocks about 30 kilometres northwest of the project area. The next wind turbine farm is about 80 kilometres away, on the mainland. This turbine farm is not expected to be in operation at the time of the preparation for this consultation document. The cumulative effects are not likely to be relevant for the project, but on the basis of the final placement of wind turbines and associated ancillary activities, a more detailed description and assessment will be made in the EIA.

Note that the reporting of nearby wind power farms and planned areas is based on the current situation and may change over time. The information comes from Vindlov's mapping service called Vindbrukskollen (Vindlov 2021), which is updated by the operators themselves.

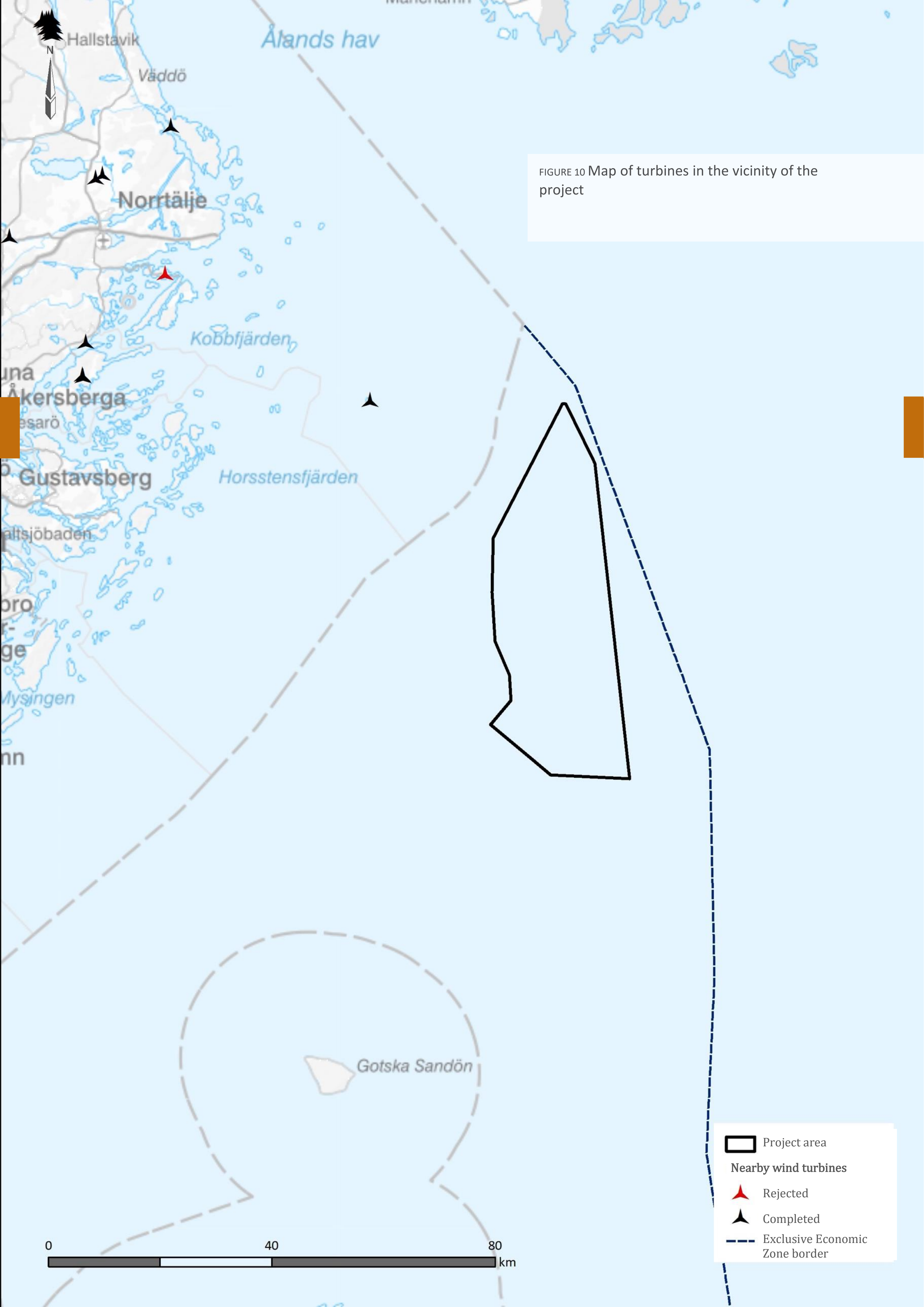


FIGURE 10 Map of turbines in the vicinity of the project

TABLE 6 Summary of wind power turbines within 50 kilometres and their distance from the project area.

Installation	Operators	Scope/total height	Status	Distance
Swedish Högarna Hillocks	Project engineer not registered	One turbine / 26 metres	Completed	30.5 kilometres

3.4 Wind resources

The wind resources in the project area are very good with a mean wind speed of 9.6 m/s at 160 meters above sea level. The prevailing wind directions in the area include westerly and southwesterly winds. These winds also have the highest average wind speed in the area and thus make up a large part of the potential wind resources in the area. Measurement data is based on long-term adjusted, high-resolution simulations of the local wind conditions, see Figure 11.

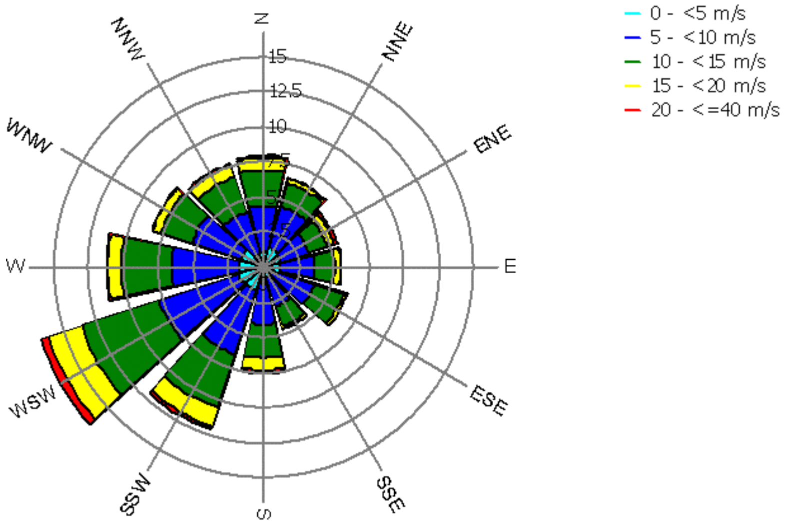


FIGURE 11 The prevailing wind directions in the Baltic Offshore Delta project area are westerly and southwesterly, based on long-term, adjusted high-resolution simulations of the local wind conditions with the ME-WAM model (Keck and Sondell 2020).

The good wind resources in the area, combined with the fact that periods of low wind speeds occur less frequently than onshore, results in smoother production over the year, see the estimated power profile for Baltic Offshore Delta in Figure 12. The calculations show that the power output in December and January, when there is the greatest need for energy, is over 1500 MW for 70–75 percent of the time (solid line in Figure 12), while in the middle of the summer, it is over 1500 MW only about 40–45 percent of the time (dashed line in Figure 12). In December and January, the output power is above 3500 MW more than 50 percent of the time. The power can be compared to the capacity of the Oskarshamn 3 nuclear reactor, which has a maximum power of 1450 MW.

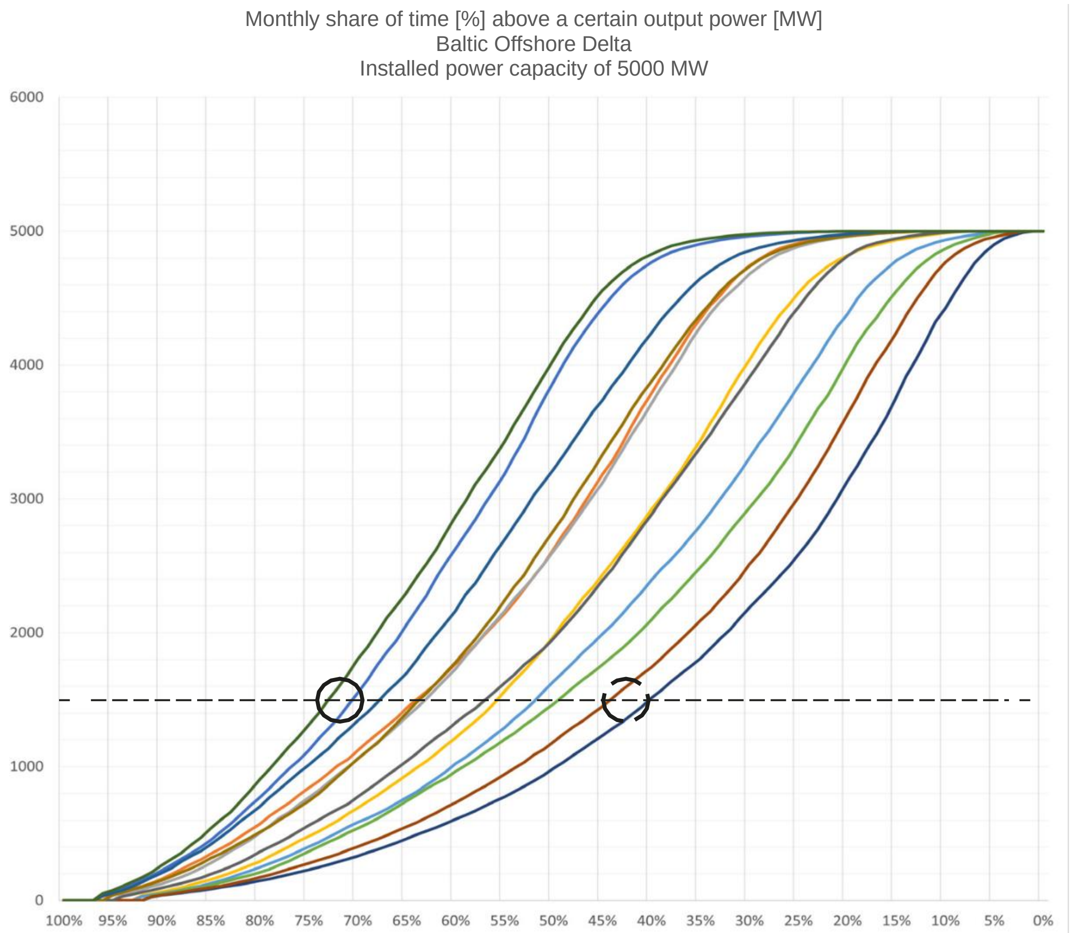


FIGURE 12 Cumulative distribution of total power from Baltic Offshore Delta wind farm for the various months of the year. To increase understanding of the figures, markers have been inserted after analysis. The dashed line shows the 1500 MW limit, the solid circle shows when the power in December and January exceeds 1500 MW, and the dashed circle shows when the power exceeds 1500 MW in summertime.

3.5 Cables and pipelines

In the Baltic Sea, there are a number of cables and lines, mainly for communications and transmission of electricity in the region. Most pipelines run in an east-west direction between Sweden, Finland, and Estonia. According to available data, there are no cables or lines in the project area or its immediate vicinity (HELCOM, 2018, EMODnet, 2014 and 2017 and the Swedish Agency for Marine and Water Management, 2019a).

The area that is closest to passing through the project area is in the south-east, where there are gas pipelines between Russia and Germany, but there are also cables about 8 kilometres away, see Figure 13. Updated information on existing and planned cables and pipelines connected to the project area will be collected during project planning and will be described in the EIA.

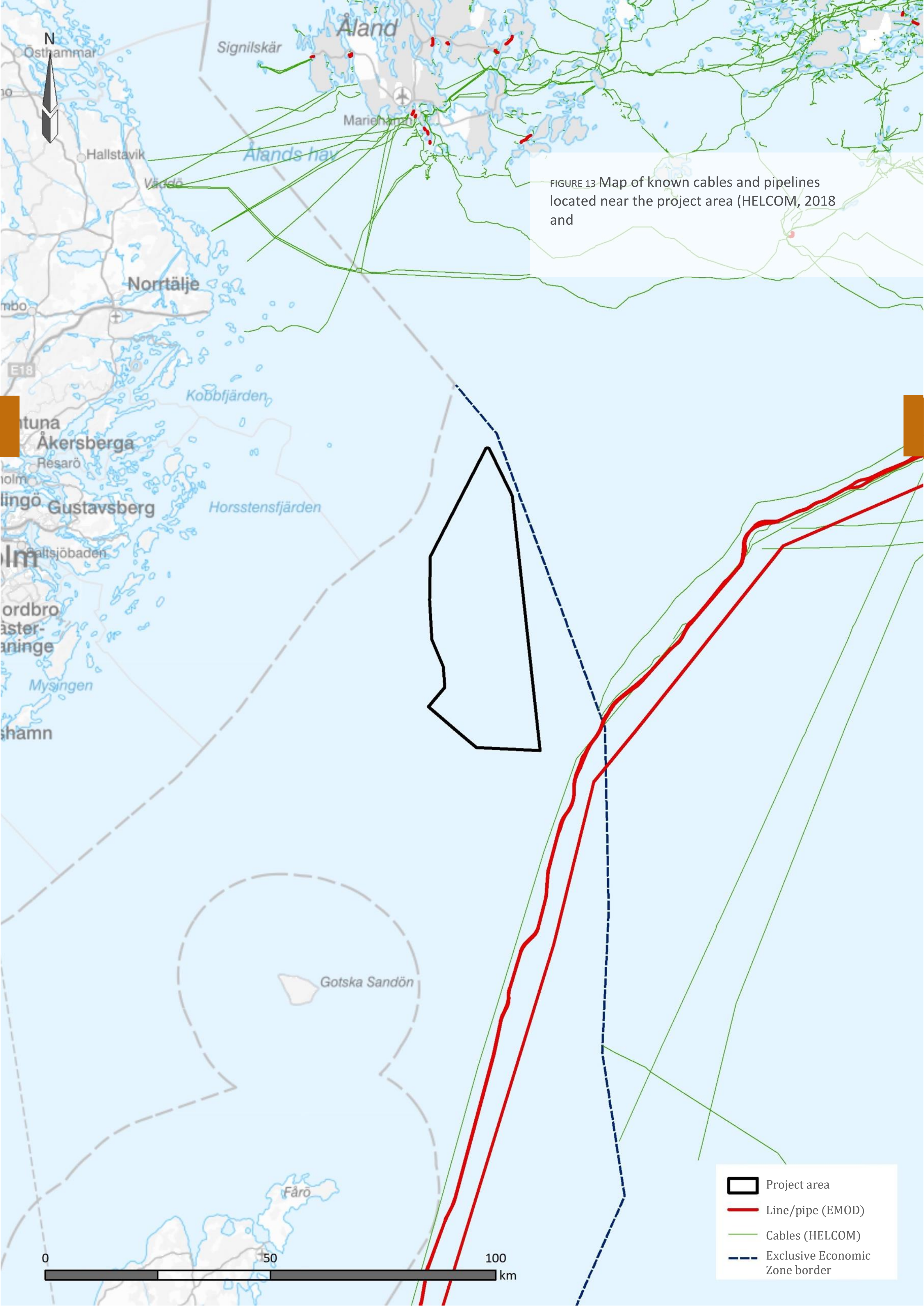


FIGURE 13 Map of known cables and pipelines located near the project area (HELCOM, 2018 and

3.6 Areas of national interest

National interests are geographical areas that are highlighted because they contain important values and qualities from a national perspective. Areas of national interest may aim to preserve values or prioritize the area for a certain type of exploitation, but may also be identified for a certain type of use, such as commercial fishing (Boverket, 2017).

Apart from a waterway of national interest for shipping, see Figure 14, no national interest is directly affected by the project area. The route runs along the eastern side of the project area and is covered in more detail in Section 3.13.

There is an area located 27 kilometres west of the project which has been defined by the Swedish Defence Forces as a national interest to keep free of obstacles, see Figure 15. There are also two naval training areas for the Armed Forces located 38 and 48 kilometres south of the project area.

An area of national interest in terms of recreation is located 6.5 kilometres northwest of the project area. Due to the distance it is not likely to be affected by the project, see Figure 16. There are two areas of national interest for energy production via wind farms in the vicinity of the project area. One is located at the Svenska Björn lighthouse, about 14 kilometres north of the project area, and the other at the Almagrundet lighthouse, roughly 47 kilometres west of the project area, see Figure 17. The closest area of national interest for commercial fishing is more than 60 kilometres away, see Figure 17.

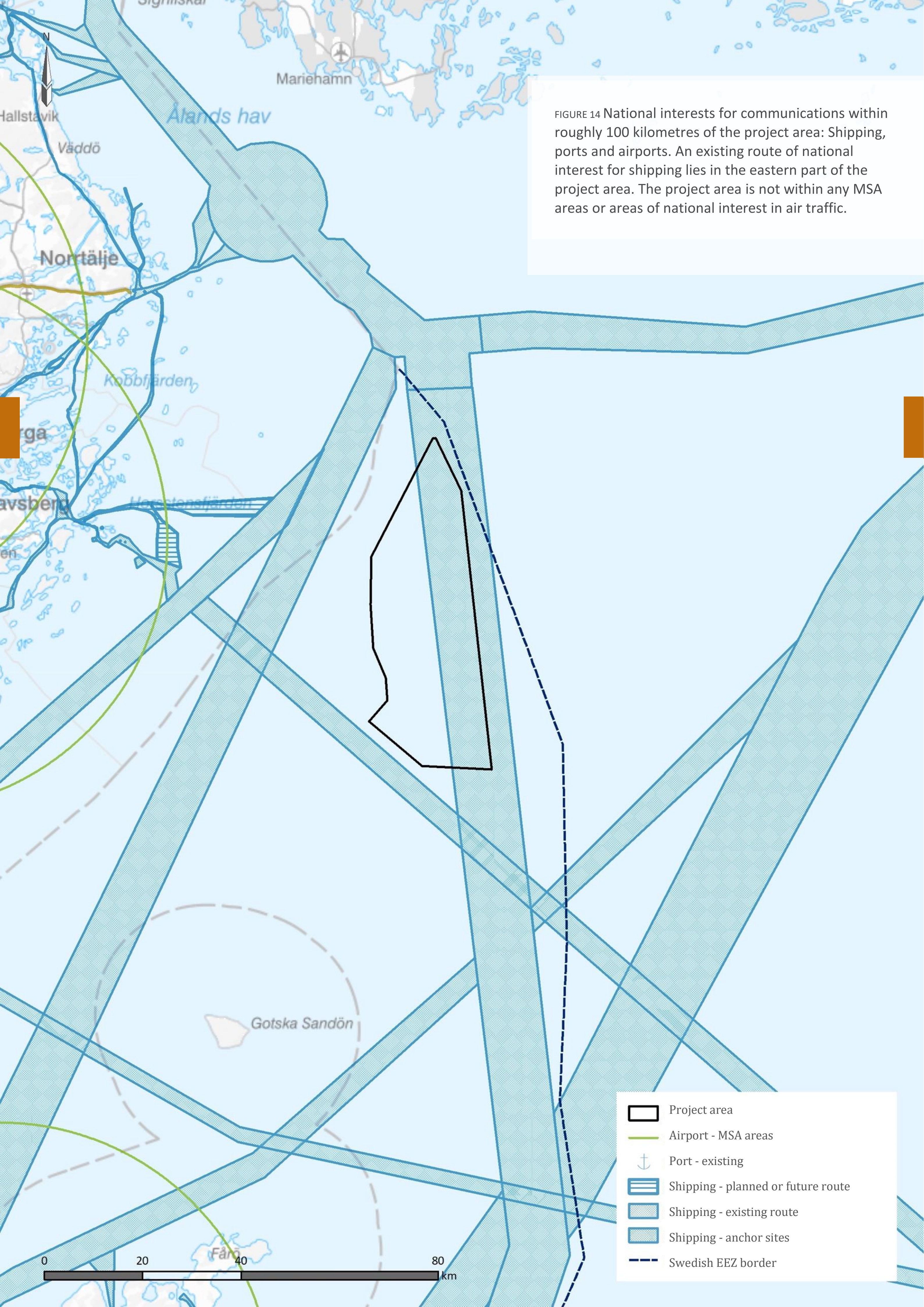


FIGURE 14 National interests for communications within roughly 100 kilometres of the project area: Shipping, ports and airports. An existing route of national interest for shipping lies in the eastern part of the project area. The project area is not within any MSA areas or areas of national interest in air traffic.

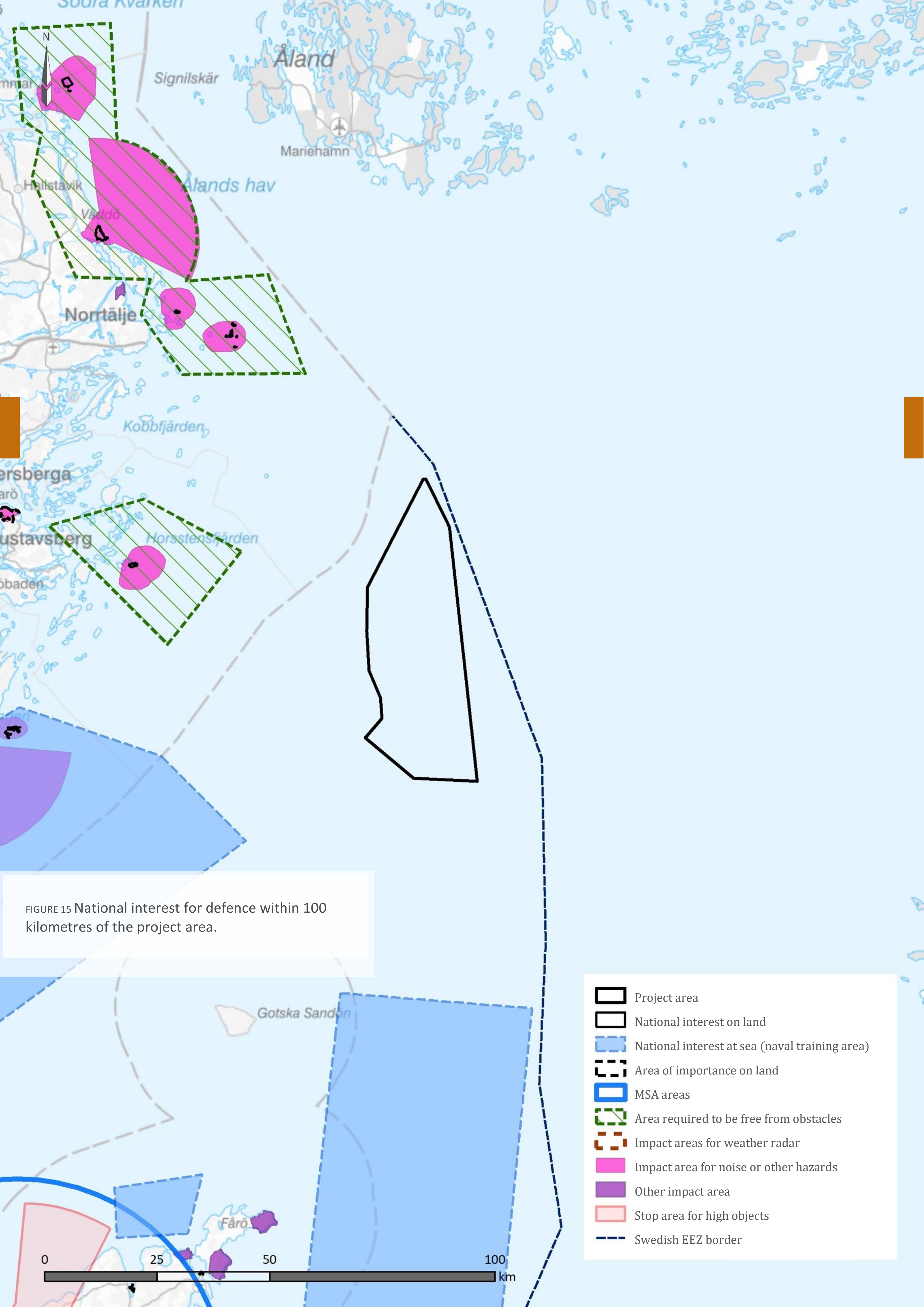


FIGURE 15 National interest for defence within 100 kilometres of the project area.

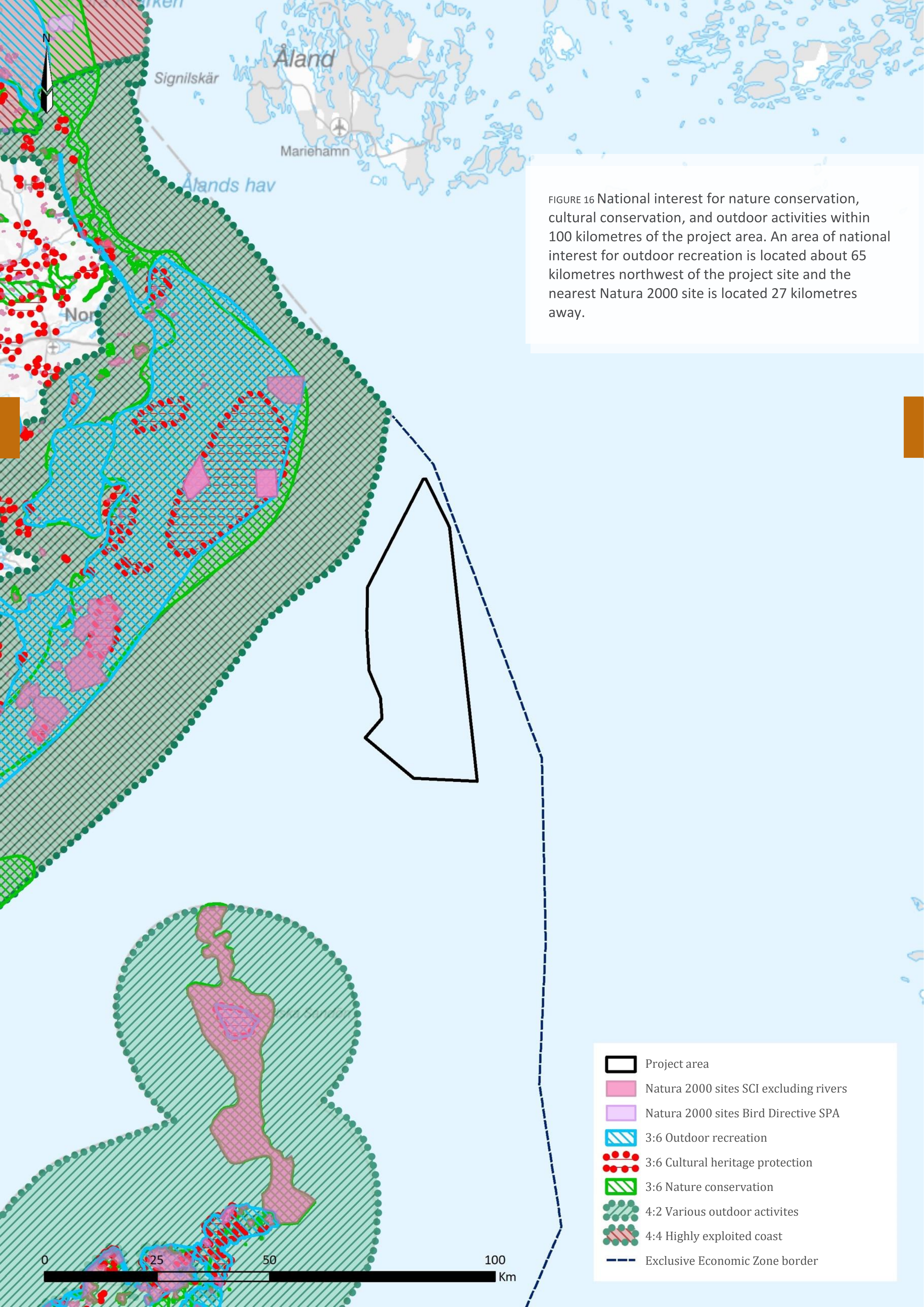
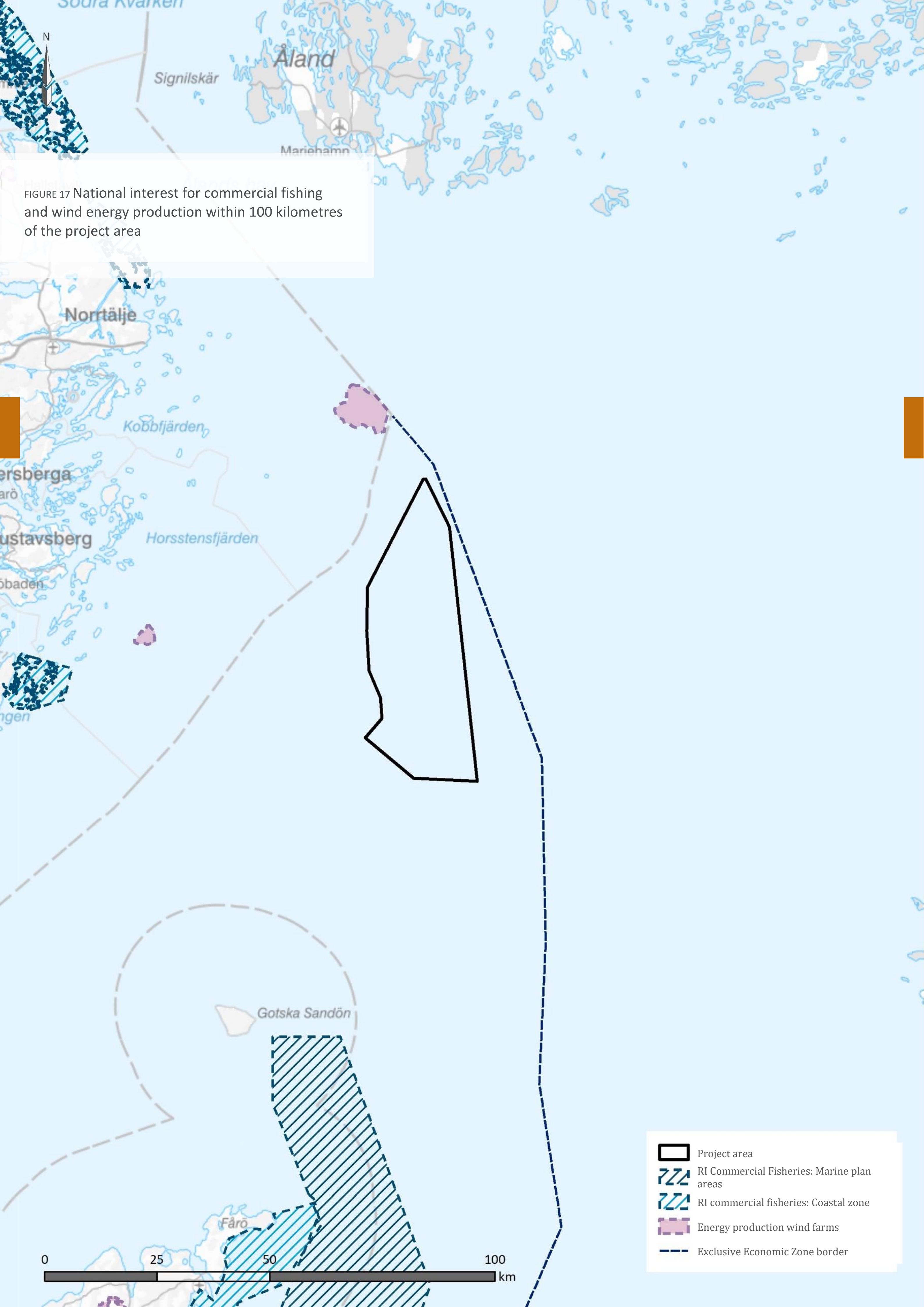


FIGURE 16 National interest for nature conservation, cultural conservation, and outdoor activities within 100 kilometres of the project area. An area of national interest for outdoor recreation is located about 65 kilometres northwest of the project site and the nearest Natura 2000 site is located 27 kilometres away.

FIGURE 17 National interest for commercial fishing and wind energy production within 100 kilometres of the project area



3.7 Landscape view

The view of the landscape and the consequences of a wind turbine farm are subjective and are based on the human experience of the landscape. In general, it is inevitable that a wind farm will affect the prevailing landscape, but how the changes are perceived varies with the viewer and is related to the viewer's expectations of the landscape and attitudes towards renewable energy.

The landscape view is defined as the character of the landscape, that is, the appearance of the landscape and the experience of the landscape. This section is therefore closely linked to other sections described in this consultation document, such as outdoor activities and recreation and cultural environment.

Topography and natural geographical conditions

The Baltic Offshore Delta project area is located in the open sea without islands and with long distances to the surrounding countries. The nearest land area is Sandhamn, which is about 55 kilometres west, Åland is 65 kilometres north of the project area and Fårö north of Gotland just over 100 kilometres south.

Due to the long distance to shore the visual impact on land (coastal zone or mainland) would be negligible. The visual effects of the Baltic Offshore Delta alone have been analysed preliminarily using line-of-sight analyses that show the theoretical possibility of seeing wind turbines with a completely open view and taking into account the curvature of the earth. Figure 18 shows the distance from which a light obstacle located 180 metres above sea level is visible above the horizon at sea level, the orange line. Purple line shows the same information for the top tip of the wind turbine at 330 metres above sea level.

In the EIA, further visibility analyses will be presented to show where the wind turbines will be visible. In addition, photomontage and obstacle animations will be created to illustrate how the planned wind power farm may look from some representative locations in the surrounding areas. The visibility analyses available to date can be found in Appendix 5 and via www.njordroffshorewind.eu/pagaende-projekt/Delta/.

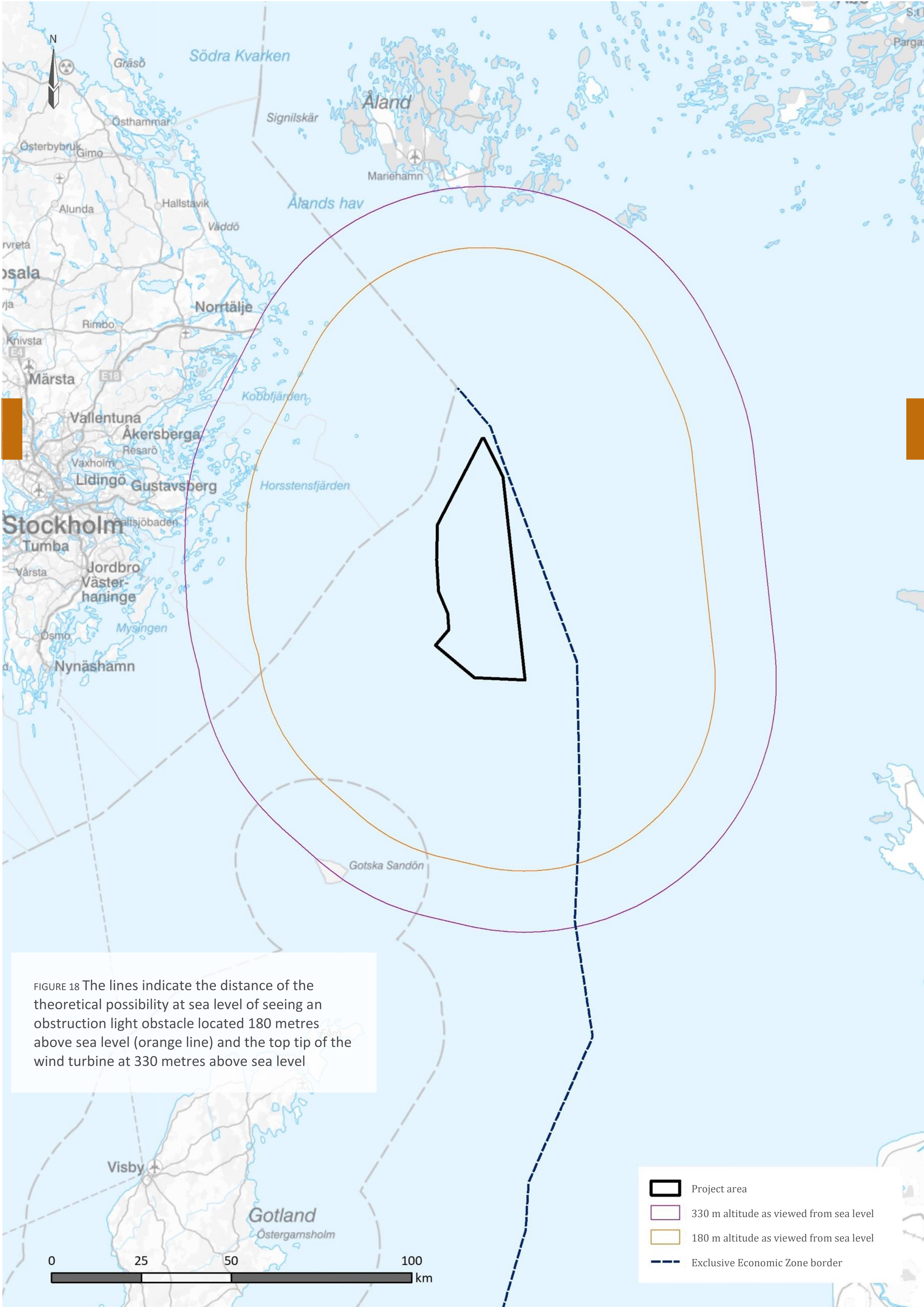


FIGURE 18 The lines indicate the distance of the theoretical possibility at sea level of seeing an obstruction light obstacle located 180 metres above sea level (orange line) and the top tip of the wind turbine at 330 metres above sea level

3.8 Oceanography and marine geology

The Baltic Sea is an inland sea of brackish water. The northern parts have a large supply of fresh water and therefore a very low salt content. In the south, there is a greater exchange of sea water from the North Sea and the water therefore has a higher salt content. The sea around the project area has a salinity of around six per mille, which can be compared to the oceans with a salinity of around 35 per mille. The salt content increases slightly at greater depths and is just under ten per mille at 80 metres depth (measured at Huvudskär eastern buoy, measurements at different depths during the period May 2001 to September 2021, SMHI, 2021).

The depth within the project area varies from 30–45 metres in a few locations down to 165–180 metres in the deepest locations. The depth is mainly around 100 metres, shallower in the north and deeper in the south. The seabed where the project area is located consists mainly of post-glacial fine sand and glacial clay (SGU, 2021). Oxygen measurement data from the last 12 years (2009-2021) at various times, within and in the vicinity of the project area, shows very low oxygen levels (<0.5 ml/l) near the bottom (sharkweb.smhi.se). At depths over 70 metres there are no major fluctuations in the oxygen level. Parts are at high risk for oxygen deficiency. Data from the Swedish Agency for Marine and Water Management (2018) shows less than two milligrams of oxygen per litre in the sediment in the surroundings of the project. See planned investigations in Chapter 5.

Significant wave height is on average just below one metre high and peaks around 5.5 metres (measurement at the Huvudskär eastern buoy, average from May 2001 to September 2021), while the maximum wave height for 30 minutes on average is just over one and a half metres high for the same location and period, and the highest waves measured is just over nine metres high (SMHI, 2021). However, storms, and hence wave intensity, are expected to increase in number and strength due to climate change (IPCC, 2021), (see also Section 3.17, Wear and Extreme Weather).

The sea water level varies, for example, due to winds, air pressure, and land uplift. The sea water level in the project area varied between half a metre below to one metre above the mean water level (measurement at North Province/Landsort Norra between October 2004 and September 2021, RH2000). On average, during the entire period, the sea water level was 13 cm above the mean water level (SMHI, 2021). The current direction is usually, and on average, around 180° (measured at Huvudskär eastern buoy for the period May 2021 to September 2021), which means a southerly current. The speed of the current is approximately ten centimetres per second at a depth of both two metres and 90 metres, while the current is twice as fast at a depth of 40 metres. However, most of the time the speed of the current is slower than the average speed. (SMHI, 2021).

3.8.1 Effect on sea currents and mixing

The oxygenation of the bottom of the Baltic Sea is linked to the supply of oxygen-enriched salt water from the North Sea. The oxygen-rich water is distributed east and north via the bottom currents of the Baltic Sea, see Figure 19. This dynamic is very important for the ecosystem in the brackish water of the Baltic Sea.

Bottom-anchored offshore wind turbines, see Figure 20, which are mounted on towers down to the seabed, can potentially affect the mixing of the layered water masses, which in turn, can theoretically have consequences for the salt and oxygen content (see also Section 2.4.2 Foundations and fastening). Based on the current state of knowledge, the effects of bottom-anchored wind turbines are expected to be very limited.

Studies on the mixing induced by bottom-anchored foundations, both individual cylinders and entire wind parks, located in the current into the western Baltic Sea have been carried out (Rennau et al., 2012). In addition, the fluctuations in salinity in the Bornholm channel have been simulated in various scenarios for wind power expansion in the western Baltic Sea (Rennau et al., 2012). The analysis shows that the changes in salinity at the bottom of the Bornholm Canal, due to wind-induced water mixing, are very low compared to the natural variations over the year. These are levels of between 0.002 and 0.006 psu, which corresponds to about 0.1-0.3% of the salinity at the bottom of the Bornholm Canal. The study concludes that the impact on the Baltic Sea ecosystem is expected to be small.

A similar study for bottom-anchored turbines in the German part of the North Sea (Carpenter et al., 2016) is in line with the study above:

- The turbulence induced by the towers can contribute to vertical mixing.
- In large-scale development this is judged to have a detectable impact on temperature layers in the sea. (Note, however, that stratification as a result of salinity is less sensitive).
- The possible environmental impact of remixing will be small. The effect can be both positive and negative for the ecosystem.

Carpenter et al. (2016) also describes that the impact from floating wind turbines, see Figure 20, is expected to be negligible in terms of mixing and the effect on sea currents. This means that at the deepest sites, where the salty, oxygen-rich currents are the most important, offshore wind will not affect the mixing locally as bottom-anchored turbines are unlikely to be present at depths below 50–80 metres. Project Delta, whose southern part is located in the area where the northbound current at the bottom splits, is therefore unlikely to affect the sea currents.

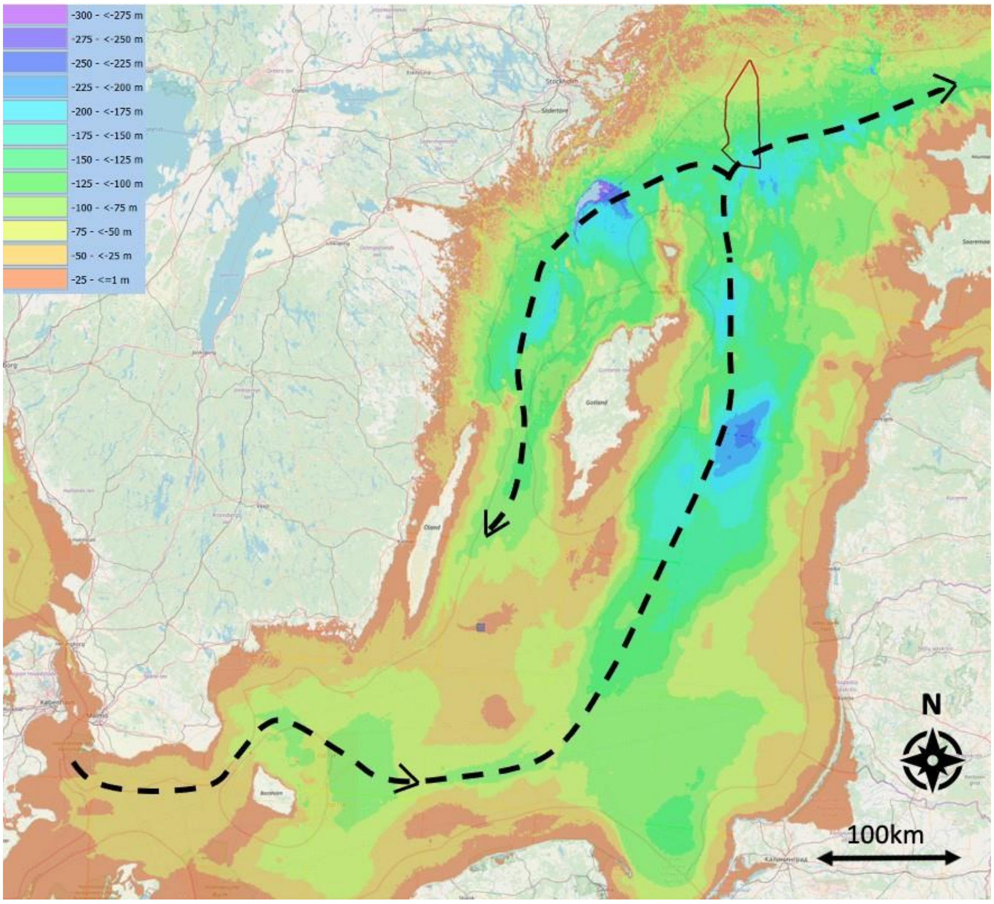


FIGURE 19 North Sea water route into the Baltic Sea. The project Delta area is marked as a polygon. Source: Njordr, adaptation of data from SMHI and Baltic Sea Bathymetry Database, http://data.bshc.pro/about/.

FIGURE 20 Overview of types of foundations for offshore wind turbines. Source: Illustration Joshua Bauer, NREL 49055.

3.9 Natural environment

Marine ecosystems are affected by such things as salinity, temperature, currents, winds, waves, depth ratios and bottom substrates. The planned operations may affect currents and waves locally by posing physical obstacles to the movement of water, as well as creating new substrates for organisms to establish themselves on. The operations can also affect the natural environment by generating noise.

Using the planning tool Symphony, the cumulative loads on the marine environment has been evaluated (Swedish Agency for Marine and Water Management, 2018). According to the report, the cumulative impact on the area around the project area is relatively low, with slightly greater environmental impact in the southern parts of the project area. In addition to the load, a large-scale picture of the natural values of the sea can also be generated. Based on the analysis, high natural values are mainly linked to shallower areas, which could probably be partly explained by the fact that in several parts of the deeper bottoms of the Baltic Sea there is a lack of oxygen. The combined natural values, according to the green map produced in the Symphony project, are probably relatively low in the project area. However, knowledge of the natural values in the area is low (Agency for Marine and Water Management, 2018) and will be further investigated within the EIA.

Plants and animals can be affected by the establishment of wind power facilities at sea mainly by the effects of acoustic disturbances, the effect on benthic habitats, and the fact that flying animals can collide with the wind turbines (Vindval, 2017). The main negative effect on the life below the sea level occurs during the construction phase, as the amount of activity is greater in the area and there are more disturbances. However, during the operating phase, the effects of the wind farm may be positive for life in the sea, for example, through artificial reef formations, see Sections 3.9.2 and 3.9.3. The degree of positive impact depends, among other things, on whether water circulation is affected by the project and to what extent organisms settle on the structures that are created. In the case of flying animals, it is mainly the operating phase that can adversely affect them by, for example, collision risk or habitat loss, see Sections 3.9.5 and 3.9.6.

3.9.1 Protected areas

No areas that are protected with regard to the natural environment are directly affected by the project area, see Figure 21. The nature reserve *Swedish Högarna hillocks* is located about 18 kilometres west of the project area. The values of the nature reserve are mainly tied to the outer archipelago, the islands' vegetation and fauna, and the marine environments adjacent to the islands and the thriving mussel banks far out at sea, even at greater depths down to about 30 metres on hard substrates.

There are also bird colonies, and the area is an important stretch for migratory birds. The birds involved include the black guillemot, common guillemot, razorbill, and the silver tern. The nature reserve overlaps the two Natura 2000 areas *of Svenska Högarna hillocks and Svenska Björn lighthouse*, which are situated at a distance of about 27 and 33 kilometres from the project area respectively.

The Natura 2000 area Svenska Högarna hillocks is a protected area based on both the Species and Habitat Directive (SCI) and the Bird Directive (SPA). The protected natural environments are sandbanks, lagoons, reefs, skerries and small islands in the Baltic Sea, and the identified species are grey seals, silver tern and large salamanders. The area also has two important colonies with nesting razorbills and common guillemots. The area is a protected bird and seal area, and there are periodically bans on accessing the area.

The Natura 2000 site *Svenska Björn* is a designated protected area according to the Species and Habitat Directive (SCI). The protected natural environments include reefs, skerries, and small islands in the Baltic Sea and the identified species are grey seals. The area is almost entirely made up of the open sea with reefs, and it is also an important location for grey seals, which can be found in large numbers there. The area is also an important area for eider ducks, who gather there in large numbers during the summer.

A few kilometres further west is the Natura 2000 area *Stora Nassa.* It is a protected area under both the Species and Habitats Directive (SCI) and the Bird Directive (SPA). The protected natural environments consist of sandbanks, lagoons, reefs, skerries, and small islands in the Baltic Sea, and the identified species are least moonwort, grey seals, silver terns, and large water salamander. The area has a rich bird life with over 50 breeding species and is very important for migratory and nesting birds. It is the most important breeding area for the black scoter in the Stockholm archipelago.

The Natura 2000 areas of the Svenska Högarna hillocks and Stora Nassa also form part of the larger HELCOM and Ramsar area called Stora Nassa-Svenska Högarna hillocks, which is a wetland area of international importance. The area is located about 42 kilometres northwest of the project area and is internationally famous for its magnificent and unspoiled nature and landscape.

Around 50 kilometres southwest of the project area lies Gotska Sandön island, with both a National Park and the Natura 2000 area *Gotska Sandön-Salvorev*. West of the project area, in the Nämdöskärgården archipelago, is a national park, which has a planned opening for 2025. The area is located in a highly diverse and relatively undeveloped part of the Stockholm archipelago. The proposed national park area, about 41 kilometres west of the project area, includes the four existing nature reserves: Bullerö island, Långskär skerry, Långviksskär skerry, and Biskopsö island, which are also part of the EU network Natura 2000. The investigation area also includes a larger sea area east of the nature reserves mentioned.

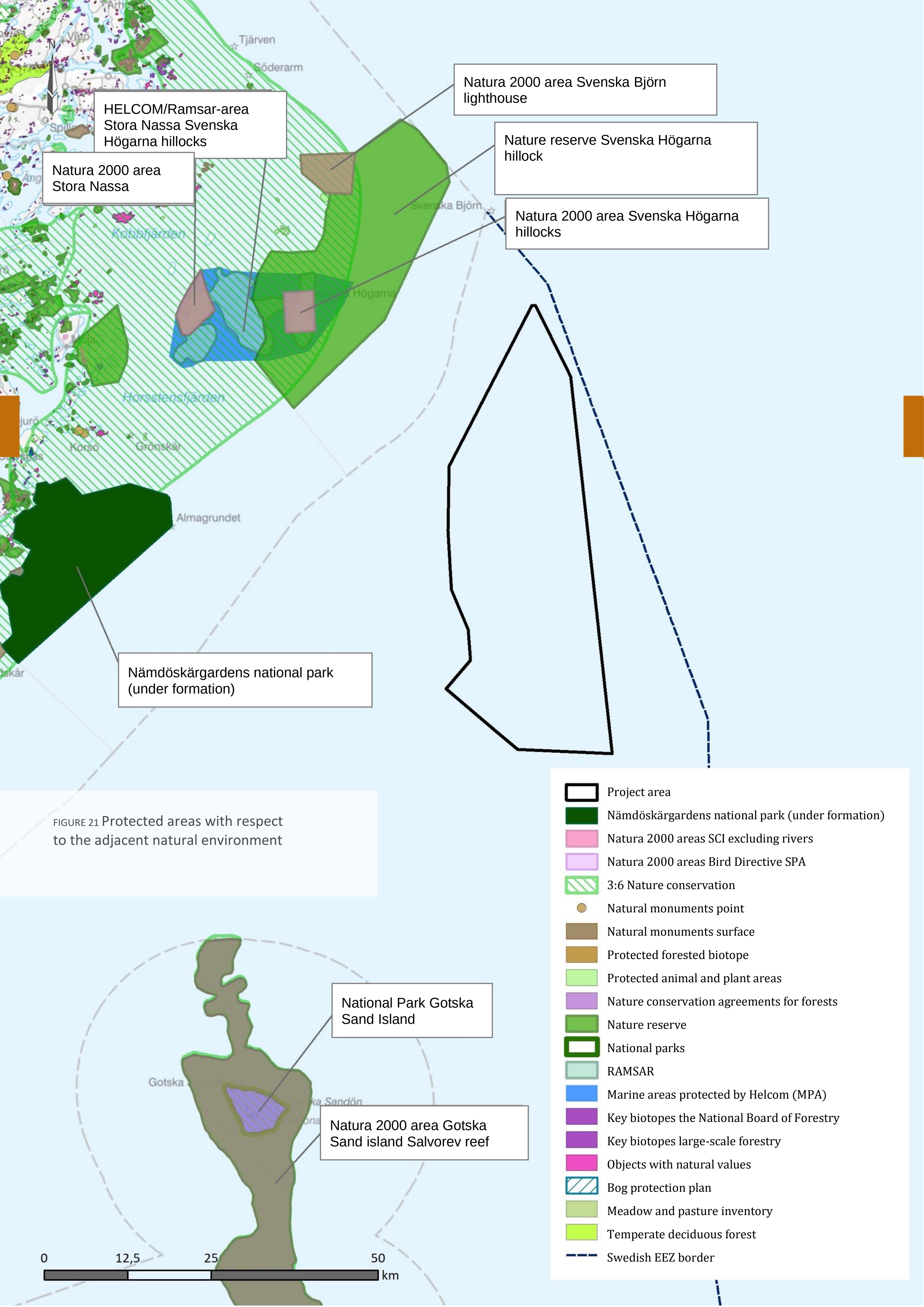


FIGURE 21 Protected areas with respect to the adjacent natural environment

3.9.2 Life on the sea bottom

A large portion of the project area is situated in deep waters, with depths up to 180 metres and an average depth of 100 meters. Measurements from the nearby areas (Station ID BY29/LL19) show a sea water transparency level of 7–18 metres, in an area with a depth of 174–184 metres (SMHI, 2021b). Large parts of the Baltic Sea bottom are oxygen-free, including around the project area. Large depth, limited visibility and oxygen-free bottoms create poor conditions for a lot of life. Plants and animals need oxygen to live, but microorganisms such as archaea and bacteria can cope with the oxygen-free and sulphur-rich environment and contribute to the degradation and metabolism of nutrients (HavsUtsikt, 2008).

Depending on the bottom substrate, construction and excavation may cause severe turbidity, which may also adversely affect animals and plants during the construction phase. However, the impact is local and only occurs during the construction phase. Even an acoustic disturbance may locally affect bottom-dwelling, or benthic, organisms. Most likely, there are microorganisms at the bottom of the project area, which are quick to re-establish themselves. When the foundations are in place, the structures can function as artificial reefs (Swedish Environmental Protection Agency, 2012). These can be used as substrates for benthic organisms, which can then live closer to the surface.

Blue mussels are found down to 30–40 metres, although the densities are often highest at 10–20 metres (Stockholm County Administrative Board, 2016). The shallowest depth of the project area is 47 metres, so the planned activities should not have a negative impact on blue mussels, or an indirect impact on species whose diet includes blue mussels, since the depth is greater than that in the rest of the project area. However, the reef-like structures of the foundations may allow the establishment of blue mussels in the area (Swedish Agency for Marine and Water Management, 2019b). With expected climate change, the range of the blue mussel is expected to change. According to the Agency for Marine and Water Management, an area north of the project area is designated as an important site in the range of the blue mussel (Swedish Agency for Marine and Water Management, 2019b). However, modelling of designated areas is based on the range of the blue mussel in 2099, which is long after the planned wind power farm's operational time.

The wind turbines are obstacles to both fishing and birds, which can create protected environments for both mussels and other benthic organisms.

3.9.3 Fish

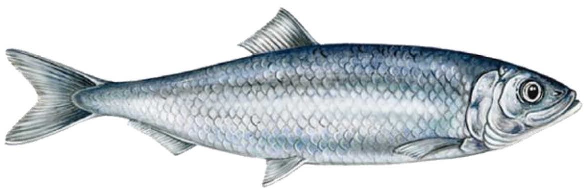
The Baltic Sea contains around 70 marine fish species and 30–40 freshwater species of fish. Freshwater fish are mostly found along the coastal areas and inner archipelagos (Nord Stream 2, 2016). Around 95% of the commercial fish catch in the Baltic Sea consists of cod, herring, and sprat. The project area is not identified as either a breeding or spawning area for any of the three species.

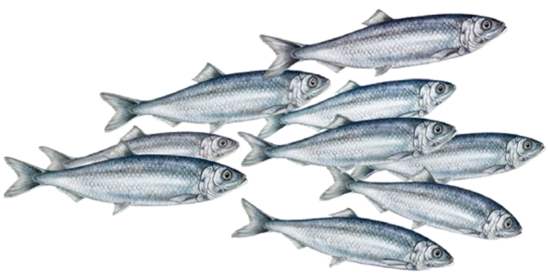
Several fish have an organ, the lateral line, which senses weak electrical currents and vibrations, and which is used to find food, among other things. Many cartilaginous fish have a sense, Lorenzini's ampoules, which detect electrical impulses, which are used to detect prey, and possibly also for navigation. An electromagnetic field is created around electric cables, which can affect fish's use of their senses based on electrical signals, and signals from electrical cables can be confused with game animals (Vindval, 2012). Cartilaginous fish are thought to be affected by electrical fields with a current from 0.5 volt per metre and also weak magnetic fields (Swedish National Environmental Protection Agency, 2001). Eels are particularly sensitive to electromagnetic fields, and their navigation capacity may be affected (Vindval, 2012).

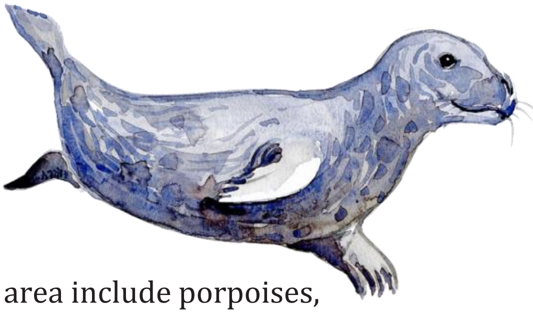
Noise can also affect fish, mainly during the construction phase, and both pile driving and increased boat traffic contribute to acoustic disturbance. It is primarily the effect of noise on catchment environments for endangered or weak populations that have negative consequences.

The artificial reef structures created by the foundations of wind turbines can benefit fish, both by providing structures for them to dwell around and by allowing benthic organisms on the foundations to feed fish and birds. The physical exclusion of fishing over a relatively long period of time and the fact that birds may avoid the wind farm can create protected environments where benthic organisms and fish, such as the commercial species herring/sprat and cod, can be given refuge.

The presence of different fish species in the area and how they may be affected, as well as the measures taken to reduce impacts, will be highlighted in the EIA.







3.9.4 Marine mammals

The marine mammals that can be found in the project area include porpoises, harbour seals, grey seals, and ringed seals. Several species living in the Baltic Sea have adapted to the specific conditions of the brackish water there, which means that many different stocks of Baltic Sea species can be assumed to constitute unique populations and, in some cases, are assessed separately (risk of individual species dying out in Sweden) from the species in the rest of the country.

The porpoise is a species protected by the EU Species and Habitat Directive (Appendices 2 and 4 of the Directive). There are three genetically different populations in Swedish waters, and the population in the Baltic Sea is the one that mainly resides in Baltic Proper, (Benke et al. 2014). The Baltic harbour porpoise is a very small, isolated population and is classified *as Critically endangered* (Swedish Species Information Centre, 2020). The coastal sea and the sea south of the Öland and Gotland are considered important areas for porpoises, see Figure 22 (AquaBiota, 2016).

Data from the SAMBAH project, a project that examined the living conditions of porpoises in parts of the Baltic Sea, have been collected from areas with only 0–80 metres depth (www.sambah.org). Porpoises have been detected within two Swedish miles (20 km) of the project area during the SAMBAH project. However, the project area and its surroundings are not considered to be a particularly important area, although porpoises are likely to pass through from time to time.

There are certain times of the year that harbour porpoises are more vulnerable than others, and times of the year when they are likely to be in different parts of the sea. Disruptive phases that risk stressing porpoises in different ways will therefore be scheduled at times of the year when the disturbance has the least impact. In addition, measures to reduce the impact in the event that harbour porpoises appear in the area will be presented in the EIA.

Modelling has been carried out to illustrate the relative presence of grey seals in the area around the project area, while the harbour seal and the ring seal are not present (Swedish Agency for Marine and Water Management, 2018). The grey seal population is the largest one of Sweden's three seal species (Sweden's Aquatic Environment, 2021).

Wind power emits acoustic noise that can travel far in the water and may adversely affect marine mammals. Depending on the distance from the source of the noise, the impact may involve stress, behavioural changes, and flight, but also hearing damage in some cases. Porpoises are especially sensitive to the affect during the calving and mating season, (County administrative board of Västra Götaland, 2014). Loud underwater noises occur mainly in connection with piling during the construction phase, see Section 3.14. There are ongoing developments and attempts to suppress noise, such as noise curtains, to prevent the noise from being transmitted in the water. The impact of noise during the operating phase is much less than during construction. The impact during the operating phase is not fully investigated by the research community.

In terms of continued work on the EIA, in-depth studies will be carried out to identify the need for measures to protect marine mammals and their habitats from these impacts.

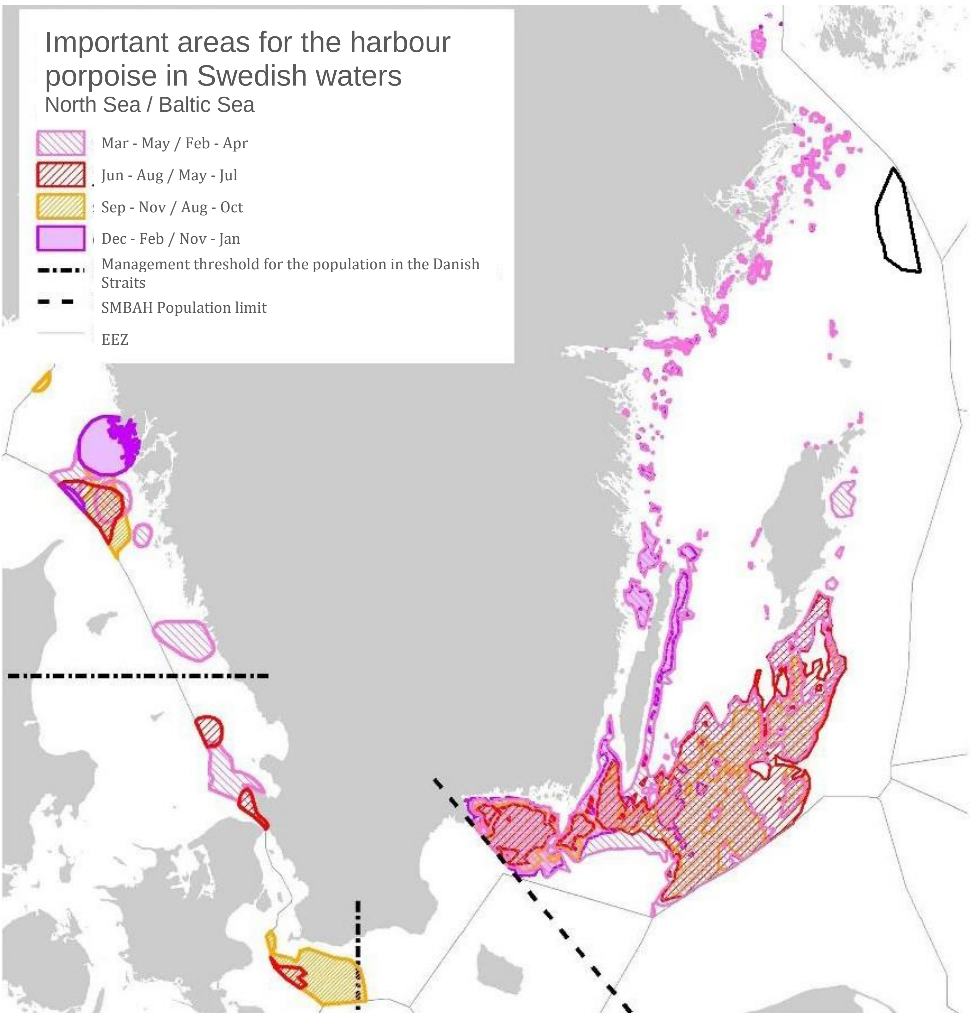


FIGURE 22 Important areas for porpoises in Swedish waters per quarter and full year. To increase understanding of the figures, the location of the project area has been added to the map afterwards. Figure Ref: AquaBiota 2016.

3.9.5 Birds

Several species living in the Baltic Sea have adapted to the specific conditions of the brackish sea. Many of the Baltic Sea stocks can therefore be assumed to be unique populations and in some cases the red list is assessed separately (risk of individual species dying out in Sweden) from the species in the rest of the country.

Different species of birds use different areas of the sea in different ways. There are often flight paths running over the sea along the coastline. A well-known migratory path runs through the Gulf of Finland. Another well-known flight path goes up through the Gulf of Bothnia. The flight path has a very wide front and is controlled by the weather. With westerly winds, the path moves east, and a larger proportion of birds follows the eastern shore of the Baltic Sea. With winds from the east, the path is pushed west and follows Sweden's east coast to a larger extent. The migratory paths, used by ducks, waders, and geese, as well as skuas, terns, seagulls and possibly even passerines (in special weather conditions) could be affected by the planned activities.

The offshore banks in the central Baltic Sea, mainly Hoburgs Bank and the North Sea Bank, south of Gotland, are the areas in the Swedish Exclusive Economic Zone where a wind turbine expansion could have the greatest impact on bird populations (Vindval 2012). Some areas are also used as overwintering areas, such as rest areas during the autumn and spring and as feeding areas. In particular, the northern part of the project area may be affected by the fact that certain species, such as the common guillemot and razorbill, fly out of the coast to search for food (Stockholm County Administrative Board, 2018). However, the distance from the breeding site listed in this report is about 19 kilometres, Table 4, and the distance from the nearest point of land, the Swedish Högarna hillocks, is about 30 kilometres. The depth to the bottom also gradually increases as you head south in the project area and its surroundings, making food like mussels less accessible. Other species can use the project site and its surroundings for resting or for passing through.

The impact of offshore wind on birds depends on their location and how the birds use the area. Some species of birds are at risk of colliding with wind turbines, and many species exhibit avoidance behaviour at wind turbine farms. Establishing wind turbines can also lead to habitat loss, but the impact of them depends on how the specific area is used by the birds. With the right location, the impact of offshore wind power is judged to be less than other human influences on birds (Swedish Agency for Marine and Water Management, 2019b).

The Baltic Offshore Delta project area is not currently considered to be a core area for any bird species. In order to obtain a more detailed picture of how the different bird species use the project area and its surroundings, inventories need to be created, see Section 5.2. Bird inventories will be carried out and will form the basis for developing appropriate protective safeguards in the future environmental impact assessment. Technical solutions, such as radar, with which the turbine will be shut down in the event of bird migration paths will be proposed as protective measures if need be. An in-depth analysis of this will be provided in the EIA.

TABLE 7 The data used in the models for each seabird "Model data diet" refer to the previously developed modelling data for each type of feed. Source and references: Stockholm County Administrative Board, 2017.

Type	Scientific name	Season	Food	Model data diet	Dive depth	Flight distance from breeding ground	Dominant wind direction
Long-tailed duck	Clangula hyemalis	Winter	Mussels, saduria entomon	Blue mussel (coverage ratio >50%), saduria entomon (>500 ind./m2)	30 m	-	-
Eider duck	Somateria mollissima	Breeding	Blue mussels	Blue mussel (coverage ratio >50%)	6 m	-	-
Black	Melanitta fusca	Breeding	Crustaceans, molluscs (infauna)	Soft clams, Baltic Sea mussel, saduria entomon (>500 ind./m2)	9.5 m	-	-
Common guillemot	Uria aalge	Breeding	Fish, mainly sprat	Pelagic fish (quantity/1000 m3)	Unrestricted. Can dive to >180 m. Fish is always available pelagically and within dive depths (Lack of oxygen >80 m depth)	Average: 13.12 km; Max: 19.13 km	Calculated from SMHI data, measuring station at the Svenska Högarna hillocks (April 15 - June 30 2016)
Razorbill	Alca torda	Breeding	Fish, mainly sprat	Pelagic fish (quantity/1000 m3)	Unrestricted. Can dive to > 120 m. Fish is usually available pelagically and within dive depths (lack of oxygen > 80 m depth).	Average: 13.12 km; Max: 19.13 km	Calculated from SMHI data, measuring station at the Svenska Högarna hillocks (April 15 - June 30 2016)

3.9.6 Bats

Bats can fly long distances, and there are descriptions of how the pipistrelle bats cross the Baltic Sea between the Valsörarna islands in Finland and Holmögadd lighthouse in Sweden (Västerbotten County Administrative Board, 2018). Studies in southern Sweden have shown that 11 out of 18 species of bats surveyed flew as far as 14 kilometres out to sea to search for food (Ahlén et al, 2009). This can be compared to the fact that land (the Svenska Högarna hillocks and the Svenska Björn lighthouse) is about 16 kilometres from the project area. The height at which the bats fly is usually less than ten metres above sea level, which means that they would fly under the rotor blades.
However, as they are hunting, they can quickly change their altitude and thus are at risk of colliding with the rotor blades.

Bats likely prefer to pass over the sea where the flight path is as close as possible to the open water (Västerbottom County Administrative Board, 2018). This likely means that any flight paths will pass north of the project area, above Åland, where the Baltic Sea can be crossed over open water.

In order to investigate the possible migration of bats across the project area, a desktop study will be conducted within the framework of the EIA, where previous observations, knowledge and probability are reviewed by an expert in bats.

3.9.7 Species protection

RED LIST

The red list is an account of species' relative risk of dying out from the area covered by the red list, in our case Sweden. Even common species may become red-listed if their populations are in severe decline.

The red list is divided into six different categories, each with its commonly used abbreviation: Lack of knowledge (DD), national extinction (RE), near threatened (NT), vulnerable (VU), highly threatened (EN) and acutely threatened (CR). Species in the last three categories are referred to with the common term, "threatened species."

The Swedish Red List is produced by the Swedish Species Information Centre according to international criteria and is revised regularly. The most recent red list was published in 2020.

SPECIES PROTECTION ORDINANCE

The species protection ordinance is legislation that provides for the conservation of a number of species and all wild birds, as well as the protection of their habitats. The Species Protection Ordinance implements the EU Species and Habitat Directive and the Bird Directive into Swedish legislation. The ordinance includes two lists of species: Appendix 1 and Appendix 2. In short, all the species listed are protected, which means that the species listed must not be collected, damaged, or killed. In addition, for the species listed in Appendix 1, the habitats of the species are protected and must not be destroyed.

In total, 14% of all 132 fish species present in the Baltic Sea are threatened, and 22% are red listed, including cod which is deemed vulnerable (VU) and also included in the IUCN: Global Red List (SLU, 2020a). The population of harbour porpoises in the Baltic Sea is considered to be under acute threat, and they are protected throughout Sweden and included in international conventions or EU directives (SLU, 2020a).

The knowledge of marine invertebrates (spineless animals) needs to be increased in order to know their status. Today there is not enough knowledge to be able to make assessments for 172 species. To remedy this, more areas need to be investigated. At present, 14 species are considered to be critically endangered, 442 species are designated as Least Concern, and a total of 157 species are somewhere on the scale between those two (SLU, 2020b). One step to strengthen the viability of marine invertebrates is to protect areas from bottom trawling and other exploitation and to reduce emissions of both fertilizers and pollutants.

Inventories will provide knowledge of species covered by the Species Protection Ordinance, and an impact assessment will be carried out as a basis for future environmental impact assessments. The study will be based on knowledge from sources such as the Artportal (Swedish Species Register Portal), and based on findings made in connection with inventories and other studies. Several red-listed species may be present in or around the project area, such as porpoises and cod.

Preliminary assessments cannot be made prior to completion of the species protection study.

3.9.8 Biodiversity and environmental engineering

Loss of biodiversity is an acute crisis that is comparable to the climate crisis. Biodiversity is shrinking rapidly around the world, and the number of species on the red list has increased in Sweden. Figures from 2020 show that the Swedish Species Information Centre has red-listed 21.8 percent (4,746 out of 21,740) of the estimated Swedish species, which is an increase from 19.8 percent in 2015. Climate change is contributing significantly to the loss of biodiversity. How wind energy contributes to reducing CO_2 emissions and climate change is explained in Section 4.1. In addition to climate change, the destruction of habitats, the over-exploitation of species, invasive species and pollution are the greatest threats to biodiversity. Biodiversity is a prerequisite for the ecological services that we, as humans, depend on for our well-being and quality of life.

In addition to the fact that wind turbine farms promote biodiversity by reducing climate change, setting up wind power farms can also help to create variation in a landscape. Offshore wind turbines can, depending on the conditions of the specific area, be both positive, negative, or both, and for the ability of different plants and animals to coexist (Swedish Energy Agency, 2021c). Various proposals for measures that address biodiversity will be presented in upcoming EIA.

3.10 Cultural heritage

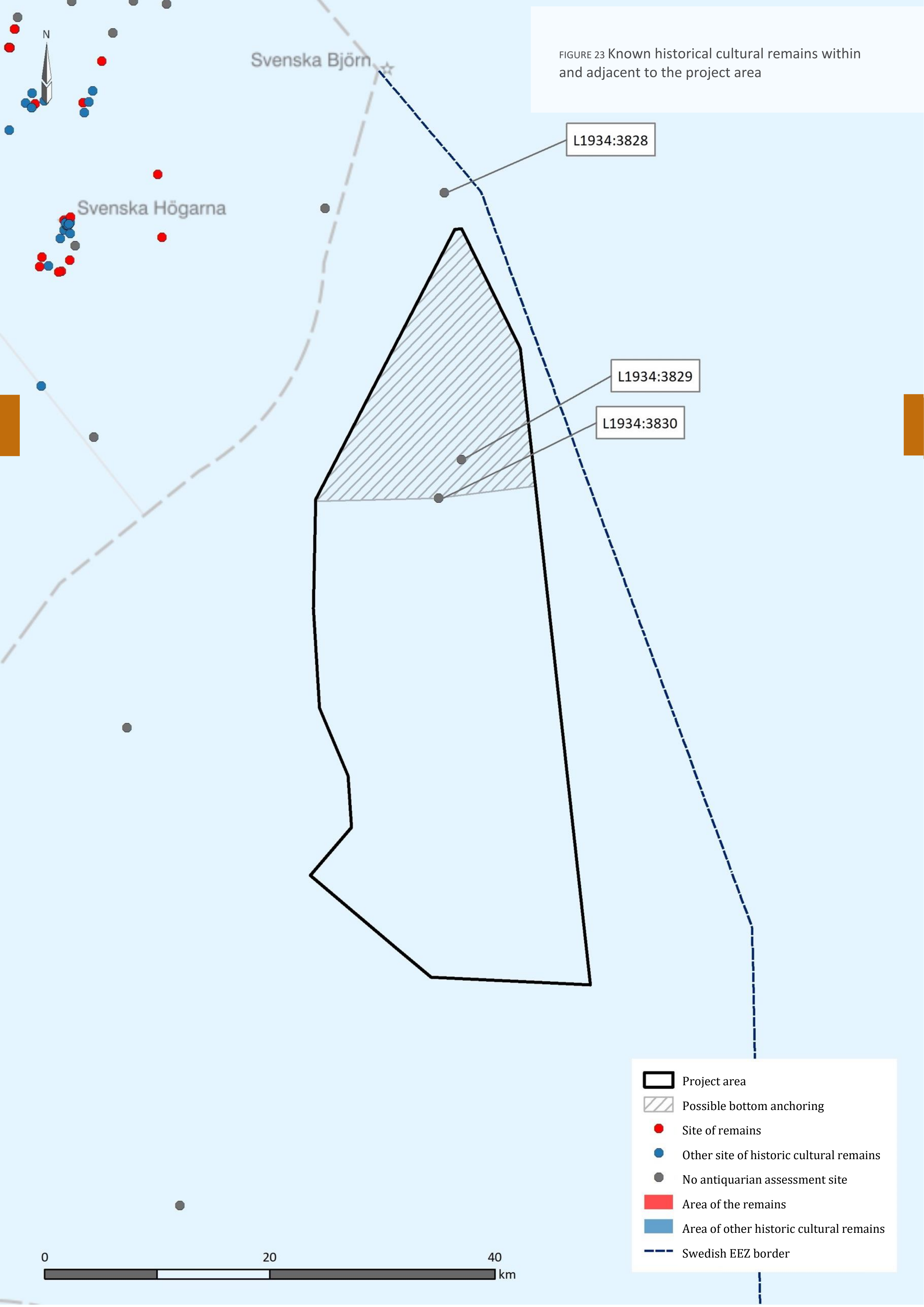
Within a radius of 10 kilometres from the project site, there are three historic cultural remains that are registered in the National Heritage Board's database, Figure 22. There is no national interest in terms of the cultural environment. The three famous historical remains are all shipwrecks that have not been assessed in terms of their historical value. Since two of the remains are within the project area, and specifically within the part where there is a potential for bottom-anchored foundations, it is important to investigate how these should be avoided during the project. A marine archaeological investigation will be carried out within the framework of the EIA. Table 8 shows the Swedish National Heritage Board number and the approximate size of those remains.

Any findings made during surveying or construction will be reported to the County Administrative Board, and any structures on the bottom will be constructed at least 100 metres away from the remains and any new findings.

TABLE 8 Excerpt from the National Heritage Board's Research database (2019) of known historic cultural remains within 10 kilometres of the project area.

ID	Name	Value description	Distance from the project area
L1934:3828	No name	Shipwreck, approximately 57x21 metres	Within the project area
L1934:3829	No name	Shipwreck, approximately 48x10 metres	3.5 km
L1934:3830	No name	Shipwreck, approximately 68x25 metres	Within the project area

FIGURE 23 Known historical cultural remains within and adjacent to the project area



3.11 Outdoor activities and recreation

The impact of a wind turbine farm on outdoor activities and recreation can consist of physical intrusion and the utilization of areas of great value for outdoor activities and recreation, as well as changes in the view of the horizon and a change in the value of the experience in surrounding areas. No areas within or close to the project area are known as areas of interest for outdoor activities. A national interest in various outdoor recreation activities lies about 6.5 kilometres from the western side of the project area, and further toward the Stockholm archipelago there is an area designated as a national interest for outdoor activities, see Figure 16. In the framework of EIA, any impact on these will be investigated together with possible municipal and regional programmes for outdoor activities.

3.12 Natural resources

Within or near the project area, there are no areas that are identified as important for natural resources. There are no areas for sand extraction near the project area according to the Swedish Agency for Marine and Water Management's marine plan. (Swedish Agency for Marine and Water Management, 2019)

3.12.1 Commercial fishing

No designated area for commercial fishing exists within or adjacent to the project area. The presence of fishing boats in the area is also very limited (AIS-data, EMODnet, 2021), see Figure 23.

Commercial fishing in the Baltic Sea is carried out over very large areas, and the areas used generally change over the years and the season (Swedish Agency for Marine and Water Management, 2019c). Pelagic commercial fishing, in other words, fishing in open waters, takes place across the entire North Baltic Sea from the municipality of Värmdö and southward to a smaller area in the southern Kvarken Strait. In the area, herring and sprat are mainly fished by trawling (Swedish Agency for Marine and Water Management, 2019b). Analyses of catch statistics, that is, how much fish are trawled in the area, will be carried out. Available ICES data (2020) show that fishing around the project area is mostly done by pelagic trawling and seine fishing, which is most commonly used to catch herring and sprat. Fixed installations, such as a wind turbine farm, may inhibit trawling (Swedish Agency for Marine and Water Management, 2019b).

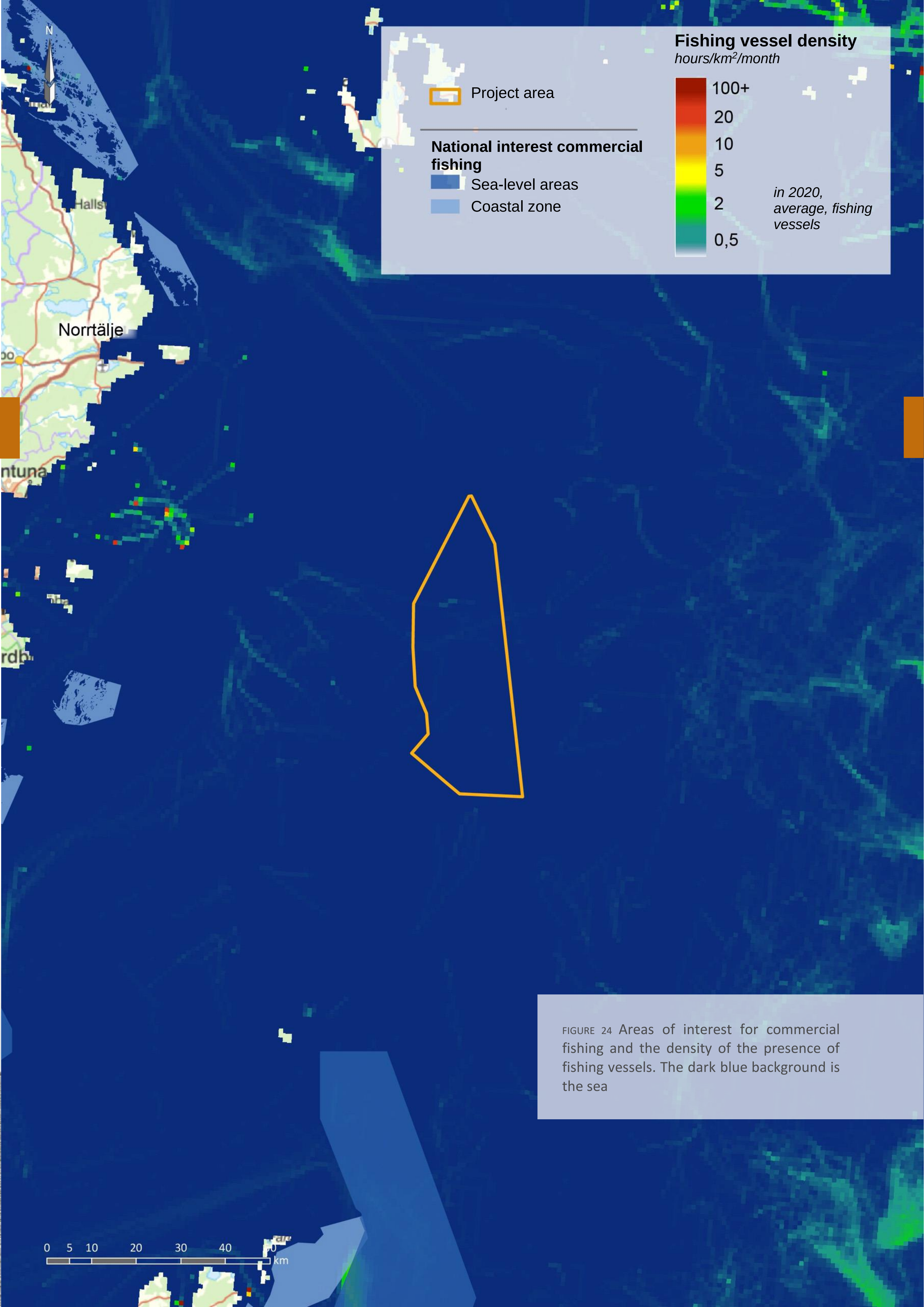


FIGURE 24 Areas of interest for commercial fishing and the density of the presence of fishing vessels. The dark blue background is the sea

3.13 Maritime traffic

The Baltic Sea is of great importance to international trade and is therefore also one of the most congested areas in the world (Swedish Agency for Marine and Water Management, 2019c). Most of the intensive maritime traffic that passes by the project area consists of cargo and tanker vessels that go to ports in the Baltic Sea, the Gulf of Bothnia, and the Gulf of Finland (EMODnet, 2021). The traffic in the area involves international commercial shipping, which is an important part of the region's maritime transport system. Passenger ferries between Sweden, Finland and Estonia are also a major part of the traffic.

The project area partly overlaps with a waterway of national interest for shipping in the east, see Figure 25. The motivation for this placement is based on AIS data from 2020. The AIS data shows that the route is very sparingly used, and that most traffic passes further east.

The project area's current location was chosen after consulting with the Swedish Maritime Administration to determine the project area that is best located in relation to the low-use area of national interest in the east and the high-use shipping routes in the west. This means that actual vessel traffic in the area is more important for shipping in the area than the designated area of national interest.

Proposed division of the area to accommodate maritime traffic

Since the proposed project area runs for a long distance in a north-south direction, it needs to be divided into sub-areas in order to accommodate maritime traffic. The following is an alternative proposal which will be discussed in consultation with the Swedish Maritime Administration, Figure 26. The main focus of this analysis has been:

- Maintain existing ship routes as far as possible, focusing on actual ship traffic from AIS data.
- In cases where less-used routes cannot be fully maintained, the alternative route should involve the minimum adjustment in terms of increased distance compared with the original route.
- Three roughly equal areas divided according to sea depth, other impacts and the possibility of creating divisions based on different installation technologies for wind turbines and foundations.

Figure 26 shows how the alternative planning allows for maritime traffic in the area. The east-west shipping route that runs through the southern part of Delta I (blue dotted line) is then allowed to go slightly further south toward deeper waters. This is to maximize the size of the area that may be built with bottom-anchored foundations. The small amount of traffic running through the south-east part of Delta III may have to go slightly further south-east, represented by the dotted red line.

Using the example 20 MW turbine, see Section 2.4.1, the area of the turbine layout in this alternative proposal would be reduced to two thirds of the original total area, while production would be reduced by only six percent.

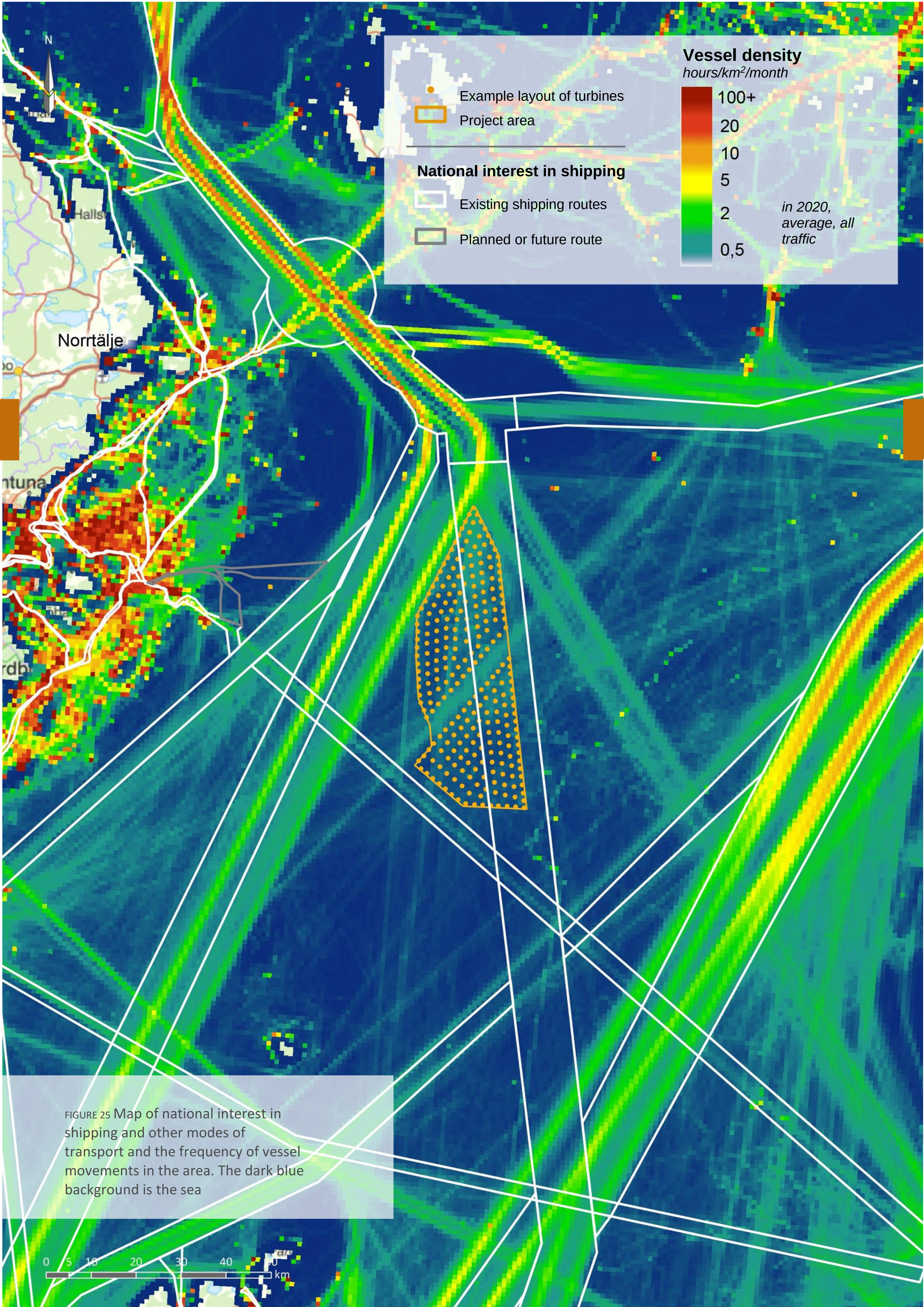


FIGURE 25 Map of national interest in shipping and other modes of transport and the frequency of vessel movements in the area. The dark blue background is the sea

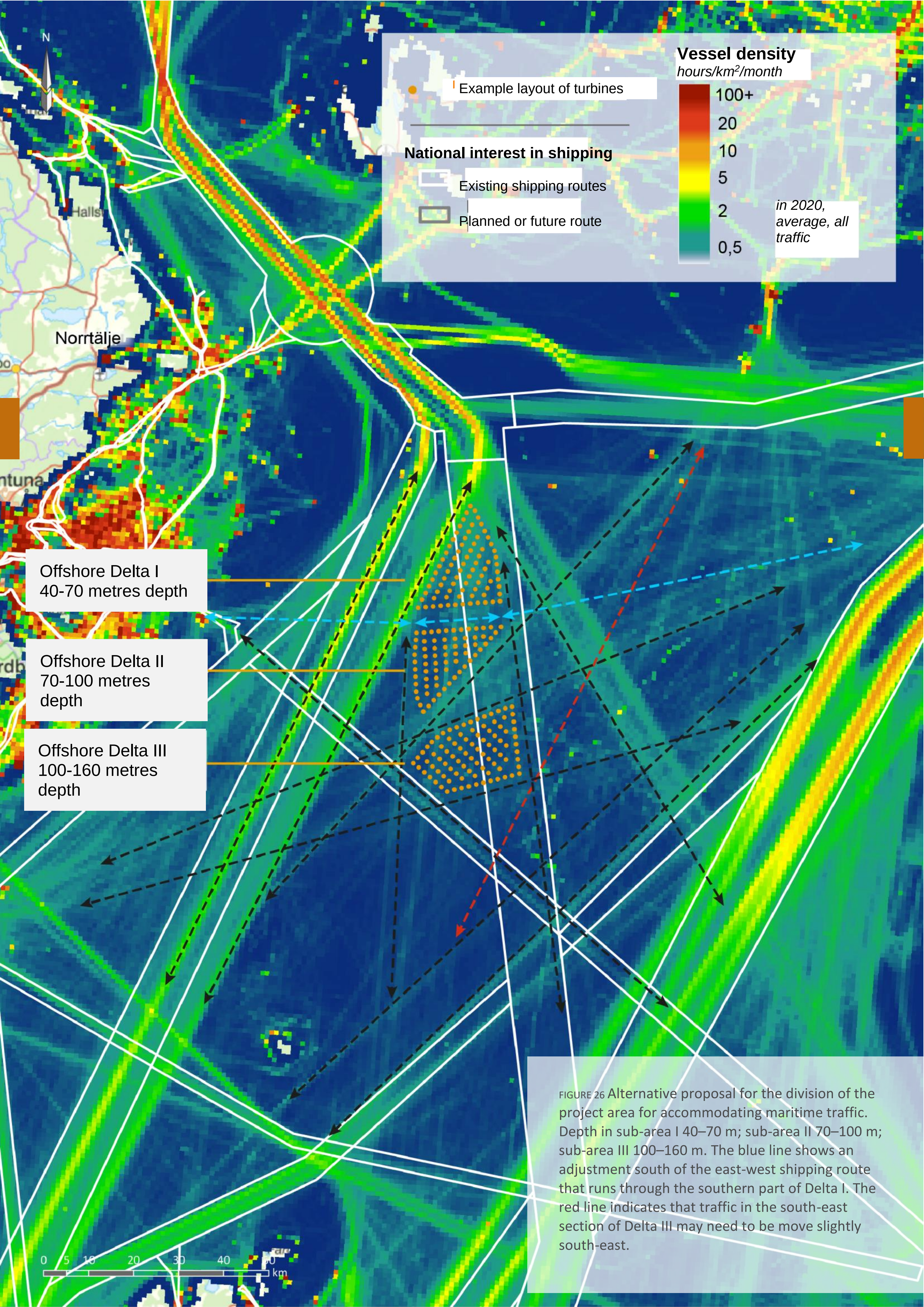


FIGURE 26 Alternative proposal for the division of the project area for accommodating maritime traffic. Depth in sub-area I 40–70 m; sub-area II 70–100 m; sub-area III 100–160 m. The blue line shows an adjustment south of the east-west shipping route that runs through the southern part of Delta I. The red line indicates that traffic in the south-east section of Delta III may need to be move slightly south-east.

3.14 Noise

The noise generated by modern wind turbines is essentially an aerodynamic, swishing sound caused by the passage of the blades through the air. The noise is determined by the velocity of the blade tip, the blade shape, and the turbulence in the air. The wind turbines also emit a machine noise that originates within the nacelle.

There are several calculation models available for calculating wind power noise. The Swedish Environmental Protection Agency recommends either the Swedish calculation model for wind power or Nord2000. The Swedish calculation model is relatively simple, while Nord2000 is a much more advanced calculation model and requires special software.

The preliminary noise emissions from Baltic Offshore Delta have been analysed with Nord2000 in the WindPRO calculation program. The calculation is done to illustrate a so-called worst-case scenario with the lowest possible noise suppression, Appendix 3.

The result from Nord2000 has also been compared with calculations in the Danish model (Danish Environmental Protection Agency, 2021) that corresponds to the Swedish Environmental Protection Agency's model, and which has been used in offshore mode, where an extra correction for multiple reflections from the sea surface is also included. When calculating noise emissions from offshore wind turbines, reduced noise suppression is used, and a correction for possible reflections from the sea surface is also included. The correction depends on the frequency and height of the turbine and the distance above the water. This calculation is also made with the calculation program WindPRO, Appendix 4.

The results of the Danish calculation model show that, at most, there is a distance of 2.5 kilometres between the outside wind turbines and the calculated 40 dB(a) line and 3–4.5 kilometres to the 35 dB(a) line. However, the results from the Nord2000 calculations show a shorter spread of the noise, which essentially means that only those who are close to the offshore wind turbines will hear them, see Figure 27.

A cumulative noise analysis will be carried out below the surface of the sea, mainly in relation to vessel traffic. It is important to consider that the decibel scale is logarithmic. For example, this means that 37+37 dB equals 40 dB.

NORD2000 - 8.0 m/s

Calculation: Offshore Delta Extent

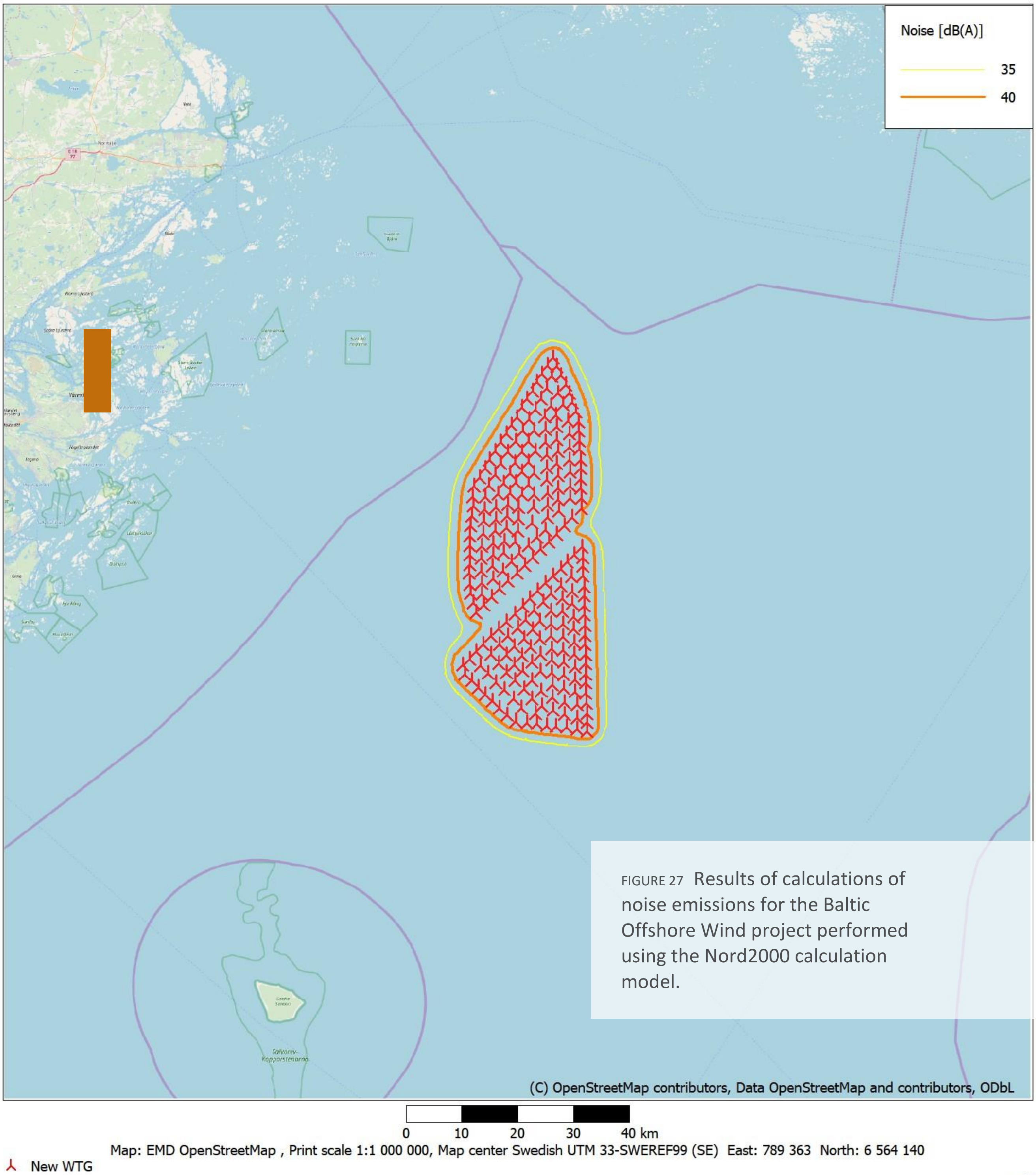


FIGURE 27 Results of calculations of noise emissions for the Baltic Offshore Wind project performed using the Nord2000 calculation model.

Map: EMD OpenStreetMap , Print scale 1:1 000 000, Map center Swedish UTM 33-SWEREF99 (SE) East: 789 363 North: 6 564 140

windPRO 3.5.552 by EMD International A/S, Tel. +45 69 16 48 50, www.emd-international.com, windpro@emd.dk

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windPRO

3.14.1 Low frequency and infrared noise

Low frequency noise is sound in the frequency range of 20–200 Hertz. Sounds below 20 Hertz are known as an infrared sound and are usually not audible but can adversely affect people if the noise level is high enough. The rotation of the wind turbine causes infrasound that is often around 1 Hertz, and in that frequency range, a level of about 120 dB is required to have an impact on humans. (Swedish National Environmental Protection Agency, 2020b).

Low frequency noise generated by offshore wind power is particularly likely to affect marine mammals and fish, but there is currently no knowledge of the effects of long-term, continuous low frequency noise (Swedish Agency for Marine and Water Management, 2019b).

The possible impacts from low frequency noise and ultrasound noise that may be caused by the project will be reported in the EIA.

3.14.2 Underwater noise

During operation, in addition to noise from the turbines themselves, there is also noise from service vessels. Disruptive noises can come from propellers and engines, but also technology that emits sonar and echo-sounder noises that can primarily affect porpoises (Västra Götaland County Administrative Board, 2014). The biggest impact of noise from offshore wind power is generated during the construction phase. Noise may come from ships and during survey work. However, pile driving, especially in connection with the construction of monopiles and foundations, produces loud noises that can travel long distances in the water. The sound produced depends on the choice of foundation. Foundations with several smaller piles emit less noise than those consisting of a large pile, and when building foundations that are buried or drilled down into the bottom, no such noise occurs at all (Swedish Agency for Marine and Water Management, 2019b). The noise generated during pile driving risks affecting marine wildlife, especially porpoises. The impact varies depending on distance from the sound (Västra Götaland County Administrative Board, 2014). The possible effects of noise from pile driving are currently not clear (Swedish Agency for Marine and Water Management, 2015). See also Section 3.9.4 regarding marine mammals.

To minimize the impact of noise, you can choose foundations that require less or no pile work at all, gradually increase the force and therefore the sound of pile driving so that larger animals are scared and able to leave the area, use noise-reducing devices such as cofferdams (insulating framing) or use various types of sound-dampening curtains. (Västra Götaland County Administrative Board, 2014 and Swedish Agency for Marine and Water Management, 2015).

3.15 Visualisations and visibility analyses

The visual impact on land of the Baltic Offshore Delta has been analysed using high-resolution photo montages. The photo montages contain corrections to take into account the effect of reduced visibility at large distances. The results of the analyses show that from most of the photograph locations, the wind turbines are hidden by either the horizon or are obscured by the sea's curvature. Even at photo locations where the turbines are visible with relatively high magnification, the turbines are relatively difficult to see at large distances from land. The visibility analyses available to date can be found in Appendix 5 and via www.njordroffshorewind.eu/pagaende-projekt/Delta/.

3.16 Shadows

In sunny and clear weather, flickering shadows may occur from the turbine's rotor blades. The shadows can be seen at a relatively large distance, depending on the topography of the environment, for a few minutes at times when the sun is low. Depending on the size and surrounding environment of the wind turbine, the shadows can be seen up to about two to three kilometres away. Increased distance will reduce the impact of shadows. At large distances, shadows are only seen as diffuse changes in the light.

The project area is located in the open sea at a long distance from land, and therefore only people who are close to the offshore wind power farms will see the shadows. In the water, the shadow effect only reaches a depth of at most 18 metres, as the sunrays do not penetrate further (SMHI, 2021b).

3.17 Risk and safety

Obstacle marking

The regulations and general advice from the Swedish Transport Agency concerning the marking of objects which may pose a danger to aviation (TFS 2020:88) state that wind turbines higher than 150 metres in a structured grating with a distance between them of more than 1000 metres need to be fitted with high-intensity, flashing, white obstruction lights on the nacelle (machine housing). When the nacelle has a height over 150 metres above ground or the water surface, the turbine tower should also be marked with three, low-intensity obstruction lights halfway up the height up to the nacelle. Since the distance between the wind turbines in Baltic Offshore Delta is planned to be two kilometres. All the turbines therefore need to be equipped with flashing, white, obstruction lights on the nacelle and low intensity obstruction lights halfway up the tower. Since the total height of the wind turbine exceeds 315 metres above the water surface, additional marking and lighting may also be required if the Transport Agency requires it.

In addition to flight obstruction lights on the nacelle and in the middle of the tower, light markings for maritime traffic are also required in accordance with the Transport Agency's regulations and general recommendations (TFS 2017:66) regarding sea markings using maritime safety devices. In order to ensure the safety of the facility for shipping, a maritime risk analysis will also be carried out during the EIA process, see Section 5.2.

Air traffic

The airspace is divided into controlled and uncontrolled air space. In the controlled airspace, there is an air traffic management system that communicates with the pilot and directs air traffic. In uncontrolled airspace, the pilot is responsible for avoiding collisions, but the air navigation service can provide information (LFV 2021). The project area is located within the Swedish Flight Information Region (FIR), where Sweden is responsible for its airspace, but close to the FIR of Finland. This will be monitored in the event that the project area will be changed.

The project area is not within any MSA areas or areas of national interest for air traffic.

Risks of accident

The report of the Swedish Rescue Services Agency regarding new accident risks in a future energy system (Swedish Rescue Services Agency 2007) states that wind turbines cannot be classified as hazardous, with the exception of health and safety risks associated with construction, repair and service work involving working at heights.
Accidents associated with the operation of the wind turbines are rare. Special precautions have been prescribed by, among other things, the Swedish Work Environment Authority.

The project area is located in the Baltic Sea, which is one of the world's busiest seas (Swedish Agency for Marine and Water Management, 2019c), and there is a risk of collisions with ships and boats. Collisions can occur if the vessels/boats run into or over structures within the wind power farm. Due to the long distance from land, it may take a long time to obtain assistance. A risk analysis will be created within the framework of the EIA, which will, among other things, investigate the risk of collision and what happens if wind turbines collapse, for example if they sink or fly off. The emergency and protective measures taken in the event of an accident during construction will also be reported.

The technologies and measures that will be used to prevent oil spills into the sea will also be described in the context of the EIA.

Mines and dumped ammunition

In the Baltic Sea, there are areas at risk of the presence of dumped munitions and the risk of the presence of sunken mines from the World War II (Swedish Agency for Marine and Water Management, 2019c). To the south of the project site there is one area and just west of the project site boundary there are three areas with a low to medium risk for the presence of mines, see Figure 28. The nearest known area of dumped ammunition is south of Gotland (EMODnet, 2021). During the continued planning of Baltic Offshore Delta, exploratory investigations will be conducted to identify possible munitions and mines within and adjacent to the project area.

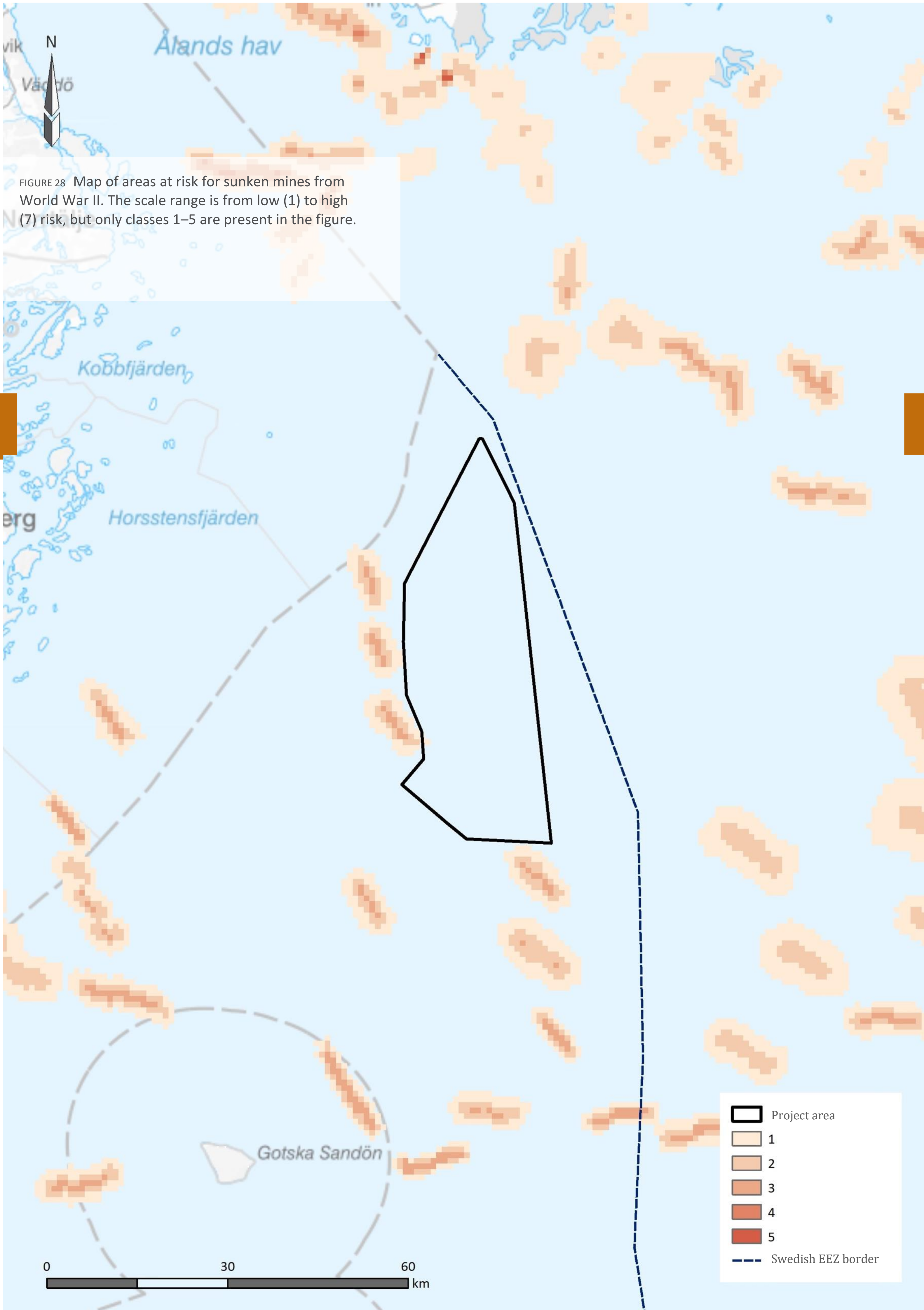

FIGURE 28 Map of areas at risk for sunken mines from World War II. The scale range is from low (1) to high (7) risk, but only classes 1–5 are present in the figure.

Wear and extreme weather conditions

The turbines are normally operating at wind speeds of approximately 4–30 metres per second. A turbulent wind affects the performance and life of wind turbines. The intensity of turbulence differs from site to site, but generally the conditions at sea are more favourable (about 8 percent) than over flat plains (13 percent) or in forests (20 percent) (Petersen et al. 1998). At higher wind speeds, there is a high degree of stress on the ball bearings of the wind turbine and the turbines are at risk of being damaged. To reduce the load, the turbine blades can be angled to allow a higher proportion of wind energy to pass through. In extreme winds, the rotor can also be temporarily turned off.

Wind conditions and sea conditions (currents, waves), as well as the interaction between them, will both be measured and modelled in detail to ultimately help select the turbines and the design of towers and foundations. Extreme winds and extreme waves, as well as extreme combinations of loads between wind and waves, provide the basis for securing the turbine in the case of extreme design loads. In the case of fatigue loads, this is largely determined by the turbulence of the air together with the wind distribution, but also by waves and the interaction with waves. All final designs of the complete wind farm will be certified and approved.

Fire

Fire can occur in the wind turbine nacelle, and the most common causes are lightning strikes or electrical failures. In the case of fire, this occurs in confined spaces, and therefore the risk of fire spreading is small. The turbines are equipped with a monitoring system that will issue an alarm and shut down the turbine if the temperature in the turbine becomes too high.

Ice formation and ice load

In cases where water moisture is present in the air, such as fog or low clouds, if the temperature falls below zero degrees, ice may form on the blades of the wind turbine. This results in a loss of production, a change in the load on the turbines and also a risk of ice falling off. In the case of offshore wind, there is also a potential problem of ice formation on towers and foundations.

Low occurrence of turbine icing is expected for the proposed project. Calculations based on conditions on land at an altitude of 100 metres show that all adjacent coastal areas in a normal year have between 0–100 hours of active icing, that is, time when new ice can form on the wind turbines (Kjeller Wind Technology 2012). Just over 50 kilometres out of the Baltic Sea, low temperatures are much less common, which reduces the risk of ice forming on the rotor blades.

Based on this, the expectation is that the effect of ice on wind turbine power generation will be negligible. Furthermore, any problems with ice falling from the turbines will be unusual, but not negligible. The current guidelines for falling ice states that ice is transported at most 600 metres from an average turbine with a total height of 330 metres. The large distance between the wind turbines in the project area means that it will be possible to travel through the wind power farm beyond the danger zone.

If need be, safety measures such as warning systems for the presence of falling ice hazards, can be installed.

The frequency of falling ice and the maximum falling distance will be further investigated.

Electromagnetic fields

Electromagnetic fields are used as a collective name for electrical and magnetic fields. They arise, among other things, when electricity is produced, transported and consumed. The fields are located everywhere in our environment, e.g. around power lines, transformers and electrical appliances. Wind turbines themselves do not produce strong electromagnetic fields. However, transformers and power lines/electrical cables can do so.

All electrical cables generate electromagnetic fields that can affect marine organisms to varying degrees. The impact depends on the type of cable used, the amount of electricity transmitted, and the animal involved. The impact can be minimised as well by taking various protective measures, such as the use of special cables and digging the cable into the seabed (Swedish Agency for Marine and Water Management, 2015).

However, electromagnetic fields around electric cables appear to have a limited impact on fish, especially those using magnetic fields or electricity to navigate and search for food, such as eels and cartilage (Vindval, 2012).

3.18 Assembly/construction phase

For an offshore wind power farm, the construction phase includes preparing for foundations, bottom anchorages and laying cable, as well as the installation of foundations, wind turbines, substations, and other electrical infrastructure. Construction work is expected to last at least two years and is sensitive to adverse weather conditions. Normally, construction and installation are not carried out in the entire project area at the same time, rather in stages. During construction, a safety zone is established to protect the assembly, personnel and third parties.

Different parts of the Baltic Offshore Delta project area have different technological solutions for anchoring the turbines to the bottom. The different technologies lead to differences in the construction work and installation of the turbines. A brief description of this is given below.

Since the project area is extensive, the construction period extends over a number of years, see Section 5.4. The turbines will be installed by a few installation vessels simultaneously. This means that a disturbance will occur locally for a relatively short period of time during the construction process.

Bottom-anchored wind turbines

As described in Section 2.4.2, there are primarily two types of bottom-anchored foundations for Baltic Offshore Delta, based on current technology. Today's monopile and gravitational foundations are not currently considered appropriate at sea depths of 60 metres and more. The remaining options with today's technology are Jacket Foundations and Tripod technology. Monopile technology may become appropriate if technology for deeper foundations is developed.

Jacket foundations and tripod foundations are available in different designs, but mounting them to the bottom is usually done with either suction pipe/anchor (a technique based on a created vacuum in the mounting tube by pumping out the water) or steel pipes that are pile driven or drilled into the seabed. The choice of technology depends on the seabed conditions at the site.

Both types of foundation are assembled on land and transported to the project area by boat. At the site, the structures are lowered to the sea bottom with a crane and secured using one of the techniques above. Depending on the conditions and the design of the foundation, erosion protection can be provided either before or after installation of the foundation. Erosion protection is used to prevent the bottom around the foundation from eroding and undermining the anchoring. The corrosion protectors usually consist of a lower layer of gravel and an upper layer of mixed-size rock.

The most common construction method for installing deep-water offshore wind turbines is transporting the main components (tower, nacelle, and composite rotor) to the site by barge and assembling the turbine on site using cranes.

Floating turbine

The floating technology, on the other hand, enables almost all of the assembly to be carried out on land. The foundations and wind turbines are assembled in port and then towed floating to the project area where they are connected to the prepared anchoring lines to the bottom.

Offshore substation (OSS)

An OSS (offshore sub-station) is normally installed on its foundation by means of a crane vessel. Depending on how the OSS and its foundation are designed, they can also be floated out or installed using other lifting methods, for example, with their own outriggers.

Internal cable network and connection cables

The internal cable network and connection cables for the wind turbine farm are laid using cable vessels. If protection is needed, for e.g. anchoring, cables can be coiled, ploughed into or buried in the seabed, normally to a depth of approximately 1.5 metres. Coiling is usually applied for softer bottoms, while ploughing and digging is used with harder bottoms. The final depth depends on the geological conditions and the level of protection desired. Where geological conditions do not allow cables to be placed in the seabed, they can be protected by covering them with, for example, stone or placing them in pipes. If a cable needs to cross another cable, the cables are usually protected by concrete carpets or stone.

3.19 Operating phase

Both wind turbines and offshore substations are unmanned and monitored remotely during normal operations. However, the wind power farm is continuously maintained, which requires personnel and materials to be transported to the wind turbines by small service boats, ships, or helicopters. An office for personnel, equipment and equipment storage will be established on land near the wind farm.

For more extensive operations, such as replacement of major components, a support gas carrier, a floating crane, or equivalent may be used. Cables are inspected if necessary to ensure, for example, that the cable guards at the base of each wind turbine are intact. In the event of cable damage, this is repaired by lifting the relevant cable section by a cable-boat for repair, after which the cable is placed back in the seabed. To protect the cables from damage, it is inappropriate to run bottom trawls and anchor them across other connecting cables inside the wind farm.

3.20 Dismantling and decommissioning

The expected lifetime for an offshore wind farm is between 30 and 35 years. After that, the wind farm will be decommissioned, and the area restored. In the event of decommissioning, wind turbines, any floating foundations and substations will be dismantled and transported away from the site.

In some cases, it may be beneficial to leave foundations, bottom attachment assemblies and cables laid on the bottom as artificial reefs (Andersson and Öhman 2010). If, in consultation with the relevant authorities, this is deemed inappropriate for the project area, foundations and other underwater components will also be removed from the site, and the site will be restored in accordance with the requirements of the authorities at the time of decommissioning.

4. CLIMATE AND SUSTAINABLE DEVELOPMENT

The concept of sustainable development was created by the United Nations World Commission on Environment and Development and is defined as "a development that meets today's needs without jeopardizing the ability of future generations to meet their needs" (Brundtland Commission, 1987). This chapter gives a brief description of the objectives which underpin the environmental considerations pursued in achieving sustainable development. The next EIA will analyse how well the planned wind power farm is in line with the global goals, environmental targets, reduced emissions and increased production of renewable energy.

4.1 Climate and renewable energy

In 2015, the countries of the world agreed on a new climate agreement, the Paris Agreement, which is a legally binding international agreement ratified by Sweden in 2016. In the Paris Agreement, the EU is a party, which means that the EU is submitting a jointly agreed climate plan that all EU member states support. Sweden's long-term goal of zero net greenhouse gas emissions into the atmosphere by 2045 and the goal of fully renewable electricity generation by 2040 is linked to the Paris Agreement. The government has stated that a major expansion of wind power is likely to be a prerequisite for Sweden being able to meet its targets for net zero emissions and renewable electricity generation. The national strategy for sustainable wind power development assumes the total expansion of national wind power needed by 2040 to be at least 100 TWh, of which about 80 TWh is land-based and the remainder offshore (Swedish Energy Agency 2021). The strategy assigns the various county councils in Sweden the task of producing regional planning data for wind power and proposes distributing the need for expansion between the counties.

The latest report (August 9, 2021) by the Intergovernmental Panel on Climate change (IPCC) is unambiguous and is based on observations of actual development, not only on modelling (IPCC 2021). The climate situation is acute and the increase in global average temperatures is a clear effect of human greenhouse gas emissions.

We are in danger of passing the target of limiting the global temperature increase to 1.5 degrees, within 10–20 years. Climate change is taking place here and now, and the recent increases in extreme weather in the form of drought, forest fires, and floods will become even more extreme and frequent. Climate change must be addressed as a direct threat to life on earth. Huge reductions in emissions are required and required quickly.

Sweden is part of the common northern European electrical system in which the share of electricity production from fossil fuels is still high. Considering our closest EU neighbouring countries, with whom we are directly linked, fossil-based electricity production amounted to just over 50% of total electricity production. Increased wind power production in Sweden, with increased electricity exports, will replace fossil-based electricity production from coal and gas power plants in Europe, which provides considerable climate benefits.

There is currently an imbalance in the electrical system in Sweden; where there is high electricity production and relatively low consumption in northern Sweden, but low electricity production and high consumption in southern Sweden. There is also an increased demand for renewable electricity as the industrial and transport sectors are working to transform themselves and become fossil-free, but also for new electricity-intensive industries such as data halls.

The use of fossil-free energy, and thus the reduction of carbon dioxide emissions, has a major positive impact on the sea. High levels of carbon dioxide in the atmosphere lead to acidification of the sea when carbon dioxide in the air is dissolved in sea water. Acidification of the seas has major negative consequences for life in the sea, including lime becoming less soluble, hence a reduction in the availability of lime for animals and plants to use for their shells and bones. Warmer sea temperatures cause the sea level to rise, affecting the seabed and the animals and plants living there. Warmer water also means that invasive species can be more easily established, while species adapted to the current climate need to migrate north, to colder water, or die.

4.2 The global sustainable development goals

The global sustainable development goals have been developed by UN member states and the system consists of 17 goals, see Figure 29. These targets aim to achieve four main objectives by 2030 (www.globalamalen.se). The four objectives are to

- eliminate extreme poverty
- reduce inequalities and injustice in the world
- promote peace and justice
- solve the climate crisis.

The 17 goals are linked to global development, which includes everything from how marine resources are to be used, to how cities are built, and what consumption patterns need to look like in order for us to achieve sustainable development. Of the 17 goals, 9 can be linked to wind power, as shown in Table 9. The connection can be that wind power can help achieve these goals, but also that they are something to consider during construction so as not to work against the goals.

FIGURE 29 The global sustainable development goals (www.globalamalen.se).

TABLE 9. The link between global sustainable development goals and the establishment of wind power.

Goal No.	Focus	Connection to wind power establishment
Goal No. 3	Good health and well-being	A general goal involving all aspects of sustainable development for all ages. Specifically for wind power, the connection is mainly to psychosocial health (involving everything between potential perceived disturbance to one's living environment, to a feeling of hope for the future as a result of increased renewable energy), as well as a reduced risk of death associated with chemical discharges and other pollution of soil, water and other habitats.
Goal No. 6	Clean water and sanitation for everyone	The link to Goal No. 6 is to ensure drinking water for everyone and to protect water-related ecosystems. When setting up wind power facilities, it is important to take sufficient consideration that this goal is not being counteracted.
Goal No. 7	Sustainable energy for all	Goal 7 aims, among other things, to increase the share of renewable energy in the world. Wind power plays a central role in this expansion, together with other renewable energy sources. The more general goal also focuses on the availability of clean energy for everyone.
Goal No. 9	Sustainable industry, innovation, and infrastructure	Goal 9 highlights the safety and stability of road networks, mobile technology, and electricity networks, among others. To create a sustainable industrial sector, renewable energy is also needed. Wind power generation can be a positive contribution to this.
Goal No. 11	Sustainable cities and communities	Sustainable urban development means, among other things, electrifying transport to a greater degree. This requires environmentally sound and sustainably produced electricity, and wind power can help with this. This goal also includes the protection of the natural and cultural heritage, which in some cases concerns areas where wind power is established. In addition, the development of wind power technology helps to enable wind power development in more countries and cities. The need for renewable energy is high in cities worldwide.
Goal No. 12	Sustainable consumption and production	Goal 12 is about how to use and manage the natural resources available with regard to the environment, society, and the economy. Wind is a renewable resource that should be used efficiently, and the location where wind power set up should also be evaluated based on these aspects. The goal also deals with responsible management of chemicals and waste and reducing the amount of waste. In both the construction, operation and decommissioning of wind power, it is important to manage chemicals and waste in a resource-efficient and responsible manner, and to ensure that as much as possible of the materials used can be recycled.
Goal No. 13	Combating climate change	The objective of goal 13 is to mitigate climate change. The focus is foremost on the need to be prepared for a changing climate. This goal also includes the Paris Agreement on the reduction of greenhouse gas emissions and that global warming should not exceed 2 degrees.
Goal No. 15	Ecosystems and biodiversity	Goal 15 deals with the sustainable use of ecosystems, among other things. The establishment of wind power must take into account the ecosystems and biodiversity in the area and the cumulative effects of setting up wind power farms in order not to work against the goal.
Goal No. 17	Implementation and global partnership	Goal 17 is a general objective of global solidarity. The fact that the wind power industry is being driven forward (both in terms of technical and scientific capacity) can contribute to the development of the global market and promote wind power globally.

4.3 The Swedish environmental objectives system

Sweden's environmental objectives system consists of one generational goal, 16 environmental quality goals, and 17 intermediate goals (www.miljomal.nu). The environmental objectives system defines how Sweden should proceed in order to achieve the ecological aspects of the global sustainable development goals.

The aim of the environmental objectives system is to guide the work of sustainable development and to act as a guide for all Swedish environmental work, regardless of where and by whom it is conducted. The installation of wind power directly and indirectly contributes to achieving the environmental quality goal of limiting the impact on the climate, while at the same time not preventing the achievement of other environmental quality goals. However, in order for wind power to be consistent with the environmental quality goals, the location and design of the planned activities need to be taken into account. Wind power is primarily concerned with the objectives of limiting impacts on the climate, creating a non-toxic environment with healthy seas, living coasts and archipelagos, as well as a rich flora and fauna. Which of the goals are involved and whether the impact is positive or negative depends on location, considerations, and other factors. The other goals have no clear connection to expanding wind power capacity if it is carried out according to established methods.

5. FURTHER WORK

This chapter provides a brief description of how future environmental assessment work is structured, what underlying studies are planned and what the timetable for the project will look like.

5.1 Environmental Impact Assessment (EIA)

After the consultation procedure has been completed, an EIA will be prepared. An EIA is a central document included with the permit application. The purpose of the EIA is to lay out the environmental considerations when planning operations and to form the basis for decision-making by the approving authority.

An EIA will identify and describe the direct and indirect environmental impacts on human health and the environment and enable an overall assessment of the consequences of the planned activities.

Content and scope of future EIA

It is recommended that the future EIA follow the same approach as this consultation document. However, the focus will be on clarifying and providing a deeper analysis of the environmental impacts of the planned activities and highlighting the significant environmental effects of them.

The EIA will also describe the security measures taken during the project and which one are intended to be taken during construction, operation and decommissioning in order to avoid, minimise, restore, and compensate for adverse environmental effects. Based on the information available at this stage, we assess whether there are significant environmental effects on:

- Natural environment - negative for birds, marine mammals, and bats
- Natural environment – positive for certain species such as bottom-dwelling organisms, fish, and some seabirds linked to "artificial reef formation" and reduced disruptions from trawling and shipping traffic
- Sound/noise and turbidity in the water
- Shipping - with regard to occupying maritime areas
- Climate – positive effect of renewable energy production in a region with greater demand than current production

In the ongoing EIA work, these issues will be investigated and described in more detail.

The results of the studies that will be carried out at various stages of the project's implementation should be able to contribute to increasing knowledge of the conditions in the field for the majority of the factors to be analysed.

5.2 Planned studies until the environmental permit is issued

A number of surveys and investigations will be carried out within the framework of the EIA. The results will form the basis for the layout of the wind power farm in the application, since the location of the wind power turbines and the internal electrical and communication networks will be adapted as far as possible to the identified circumstances in order to minimise negative impacts. The following inventories and investigations have or will be carried out:

Seabed and water surveys

In order to be able to assess the environment on the seabed for the EIA, a number of different bottom samples will be taken from the area. The planned studies are aimed at analysing the infauna (bottom-dwelling animals that are buried in the seabed) and epiphauna (bottom-dwelling animals that live on top of the seabed), as well as the grain size and composition of the bottom substrate. This is complemented by video-based investigations using drop-down video (DDV). Samples of sediment are taken using a clamshell bucket, and infauna samples are taken using cylinder samplers, for example "Haps-corer".

In addition, the oxygen content at the bottom will be measured and model data for sea currents and salinity in the area will be generated.

Any findings, cultural objects, mines, or other items, will be reported to the relevant authorities.

Permits for surveys of the seabed require separate applications, see Table 1.

Natural and cultural values

Infauna samples are taken to survey the fauna on the bottom and in the bottom. Using sediment samples, the grain size, composition, and oxygen content of the bottom substrate can be determined. This can in turn be used to assess the opportunities for maintaining life, the possible risk of spreading environmental toxins, and later provide input for calibration of geophysical mapping.

- Fish and invertebrates
- Bottom surveys of bottom fauna, but also any bottom flora
- Marine mammals: Initial desktop study to clarify the importance of the area in relation to primarily porpoises and grey seals, and to investigate the need for conducting surveys of marine mammals
- Birds: Surveys will be carried out in different seasons depending on the life patterns of the species concerned. The density can be determined by plane, boat, or gps.
- Bats: A desktop study will be conducted where previous observations, knowledge and probability are reviewed for any migration across the project area.
- Species protection: investigation of protection for relevant species
- Marine archaeological investigation

Visualisations, measurements, and modelling

- Synthesis analysis
- Photo montage
- Obstacle light animation
- Sound calculation
- Sound calculations, including the diffusion of low frequency sounds below the surface of the water
- Cumulative effects of the project combined with other influences from, for example, other wind power farms and shipping
- Analysis of possible combined effects, which could be affected by the wind farm, with regard to changes in water circulation, oxygen content and eutrophication

Maritime traffic

An analysis of shipping-related risks will be conducted based on the location of the area from a maritime perspective. The impacts on maritime trade, risks and appropriate security measures will be analysed and evaluated in depth, mainly in terms of the risk of disruption to ships' navigation equipment, the risk of collision, the need for safe distances between the wind farm and nearby shipping routes, changes in maritime traffic patterns due to the wind farm, the need to change, move, establish maritime safety devices in the area; risks and measures relating to the construction and decommissioning phase, conditions in the event of marine and environmental recovery efforts, and marking the wind farm for maritime traffic in accordance with the regulations and general recommendations of the Swedish Transport Agency (TFS 2017:66) regarding maritime safety devices at sea. Cumulative effects in relation to other offshore wind farms (existing or planned) in the immediate vicinity will also be taken into account.

National defence interests

A study of the co-existence between the project and national defence, mainly based on the national interest of Swedish national defence, has been initiated in dialogue with the Swedish Armed Forces.

Electrical connection and internal grid

An application for the electrical connection has been submitted to the Swedish National Grid, who conducts a preliminary study on connection options. As soon as advance notice is provided regarding the appropriate point of connection, an agreement of understanding and technical feasibility study will be initiated. The electrical connection will likely include cable routing to a land-based substation. This will be investigated in a separate consultation process and permit application.

Any impact on plant and animal life from internal grid and substations, both during the construction phase and operation, will be analysed and clarified in the EIA and form part of the risk and vulnerability analysis in the event of accidents or sabotage.

5.3 Planned studies according to given environmental permit

Wind measurement

On-site wind conditions will be investigated by constructing one or more measuring masts or alternatively using laser-based equipment (LI- DAR) to increase the accuracy of production and load calculations.

Seabed surveys

Based on the results of surveys performed on the seabed prior to submitting the application, further studies will be required after an environmental permit is provided for the final design of foundations and fastening installations. The scope of these will depend on the results of the studies and choice of technology for creating foundations and anchoring the wind turbines.

Based on the permit, the planned turbine locations and corridors for internal cable networks will be investigated in more detail in terms of geophysics and geoengineering. Geophysical surveys will be conducted to identify potential obstacles and evaluate the seabed in the layout area. The studies will be carried out using echo sounder and sonar equipment. In addition, seismic surveys will be carried out to gain more knowledge of what is beneath the surface of the seabed. Finally, geotechnical drilling samples at the relevant turbine positions may be performed.

At this stage, a detailed analysis of the presence of undetonated munitions (UXO) will also be carried out to ensure the safety of future construction work around the turbine locations. The investigation is conducted using magnetometers and will be performed in detail before any work is carried out on the sea bottom. The results of the investigation will be reported to the relevant authorities.

In parallel with the geophysical survey, a marine archaeological survey of potential turbine positions and cable corridors will also be conducted. The discovery of marine archaeological findings will be reported to the relevant authorities, and no construction activity will take place closer than 100 metres from any findings.

In order to avoid disturbing porpoises and other marine mammals prior to the seabed surveys, Passive-Acoustic Monitoring (PAM), which listens with four hydrophones installed on a work vessel will be performed. When it is ensured that there are no porpoises or other mammals in the area, the bottom survey instruments are launched with soft start to keep any marine mammals at a distance before switching to more disturbing frequencies.

High amplitude sound pulses used by sub-bottom profiles such as Innomars SBP (Innomar, 2016) may affect the hearing ability of marine mammals. The sound pressure level (SPL), sound exposure level (SEL) and the volume where these measurements exceed certain limits must be taken into account for the risk assessment. Due to the short sound pulses that are commonly used and the high-directional sound pulse transmission for parametric sub-bottom profiles, the risk of impacting marine mammals is much lower than when using conventional (linear) acoustics such as a boomer, sparker, chirp systems or seismic equipment such as air guns. For Innomars SBP, it can be concluded that the SPL/SEL generated will not exceed any known limit for temporary hearing disturbance (TTS) at a horizontal distance of more than 20 metres around the sensor. Although it is unlikely that a mammal will be near the vessel when SBP is switched on, it will end up outside the affected region in a very short time. For this reason, parametric subbottom profiles like Innomars SBP have been selected as the preferred method.

5.4 Preliminary schedule and implementation

The timeline for realizing Baltic Offshore Delta is estimated to be roughly ten years. An overall distribution between different project phases up until construction is provided in Figure 30 below.

The goal is for Njordr Offshore Wind AB to submit a permit application in accordance with the Swedish Exclusive Economic Zone Act and the Continental Shelf Act for the construction and operation of the planned wind power farm in 2023.

The in-depth investigations listed above take place during 2022–2026, which will form the basis for the layout of the planned wind power farm. The investigations in their entirety will be attached to the prepared EIA.

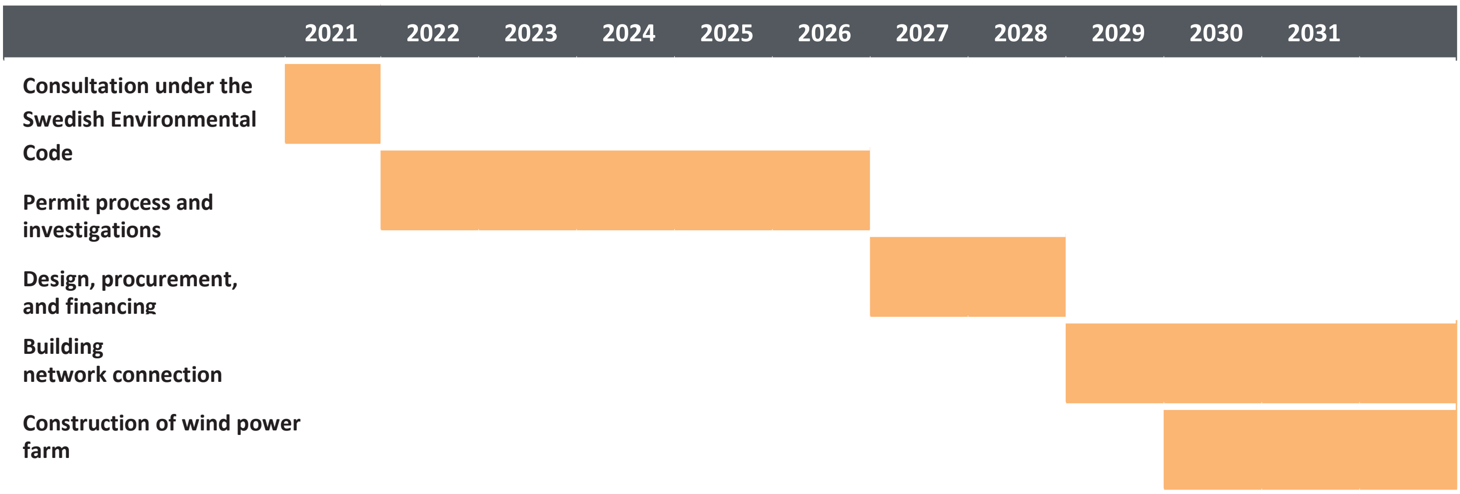

FIGURE 30 Schedule for the permit process, studies, and implementation.

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Appendix 1.
TERMS AND DEFINITIONS

To make it easier for the reader, we have here compiled specific terms and definitions that we use when describing the planned activities and when describing the project's conditions and expected environmental effects.

TABLE 10 Definitions of abbreviations used in the document:

Term	Definition/explanation
Power	The speed of energy conversion. Production capacity is measured in kilowatts (kW) and its multiples: 1 000 kW = 1 megawatt (MW) 1 000 MW = 1 gigawatt (GW) 1 000 GW = 1 terawatt (TW)
Energy	The product of power and time. Produced energy is measured in kilowatt hours (kWh) and its multiples: 1 000 kWh = 1 megawatt hour (MWh) 1 000 MWh = 1 gigawatt hour (GWh) 1 000 GWh = 1 terawatt hour (TWh)
Associated activity(s)	A collective name for the activities required by the wind turbines: Internal electrical lines within the wind turbine farm, electricity connections to land, piling and building foundations, and ship transportation of parts to the wind power farms.
Environmental effects	According to the Swedish Environmental Code, Section 6. 2, the impact on human health, the environment, and more. For a more detailed explanation can be found in Section 1.2 *Current Legislation*.
Environmental Impact Assessment (EIA)	A document attached to the permit application. The document shall describe the direct and indirect environmental effects on human health and the environment and enable an overall assessment of the consequences arising from the planned activities.
Project area	The area in which the wind power contractor has estimated that the project of constructing wind turbines will take place.
Consultation document	A document containing information on the planned project, and on an overall basis, describes the environmental effects that the planned activities are deemed to have.
Precautions	The measures taken to avoid, minimise, restore, and compensate for adverse environmental effects.
Total height	The turbine hub height (tower height) plus the length of the rotor blade, i.e. the turbine height up to the blade tip when the blade tip is at the top.

APPENDIX 2. CONSULTATION CIRCLE

Obstacle test

The following organisations have been sent an inquiry with an obstacle test for the Baltic Offshore Delta project.

- The Swedish Armed Forces
- Swedish Civil Aviation Administration
- Swedish Civil Contingencies Agency
- Swedish Maritime Administration
- Swedish Transport Administration
- Swedish Transport Agency
- Arlanda Airport
- Bromma Airport

- Hi3G access AB (Tre)
- Post and Telecom Board
- Tele2
- Telenor
- TeliaSonera AB (Telia Company)
- Teracom AB

Proposal for a consultation circle

The suggested consultation circle consists of:

- Swedish National Board of Housing, Building and Planning (Boverket)
- Swedish Energy Markets Inspectorate
- Swedish Energy Agency
- Greenpeace
- Haninge Municipality
- Marine and Coastal Fishermen's Organisation
  Swedish Agency for Marine and Water Management
- Swedish Institute for the Marine Environment
- Swedish Board of Agriculture
- Swedish Legal, Financial and Administrative Services Agency
- Royal Swedish Sailing Society (KSSS)
- Swedish Coast Guard
- County Administrative Board of Gotland County
- Stockholm County Administrative Board
- Swedish Civil Contingencies Agency (MSB)
- Swedish Museum of Natural History
- Society for Nature Conservation Stockholm

- Swedish National Environmental Protection Agency
- Northstream
- Norrtälje municipality
- Region Stockholm
- Swedish National Heritage Board
- Swedish Maritime Administration
- Stockholm County Archipelago Foundation
- SLU Aqua
- Swedish Meteorological and Hydrological Institute (SMHI)
- State maritime and transport history museums
- Swedish Anglers Association
- Ports of Stockholm
- Stockholm Chamber of Commerce
- Stockholm Ornithological Society
- Swedish Boaters Union
- Swedish National Grid
- Swedish Cruising Association
- Swedish Society for Nature Conservation
- Swedish Fish Producers Organisation (SFPO)
- Geological Survey of Sweden
- Swedish Geotechnical Institute (SIG)
- Swedish Fish Producers Organisation (SFPO)
- Swedish Ornithological Society (Birdlife Sweden)
- Swedish Pelagic Federation
- Swedish Confederation of Transport Enterprises
- World Wildlife Fund (WWF)
- The Municipality of Värmdö
- World Maritime University
- The municipality of Österåkers

International

- All the countries concerned based on the Espoo Convention

APPENDIX 3. NOISE CALCULATIONS NORD 2000

Separate report

APPENDIX 4. NOISE CALCULATIONS (DANISH MODEL)

Separate report

APPENDIX 5. PHOTO MONTAGE

Separate report

living planet solutions

On behalf of

OFFSHORE WIND