Simply Blue Group

Skidbladner

FLOATING WIND

Consultation document for scoping documentation concerning the construction and operation of a wind farm in the Baltic Sea, Sweden's Economic Zone.

09/11/2022

WIND SWEDEN

ADMINISTRATIVE INFORMATION

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Mapping documents are from the websites of relevant authorities including the Land Survey, County Administrative Boards, Swedish Maritime Administration, Swedish Agency for Marine and Water Management.

SKIDBLADNER

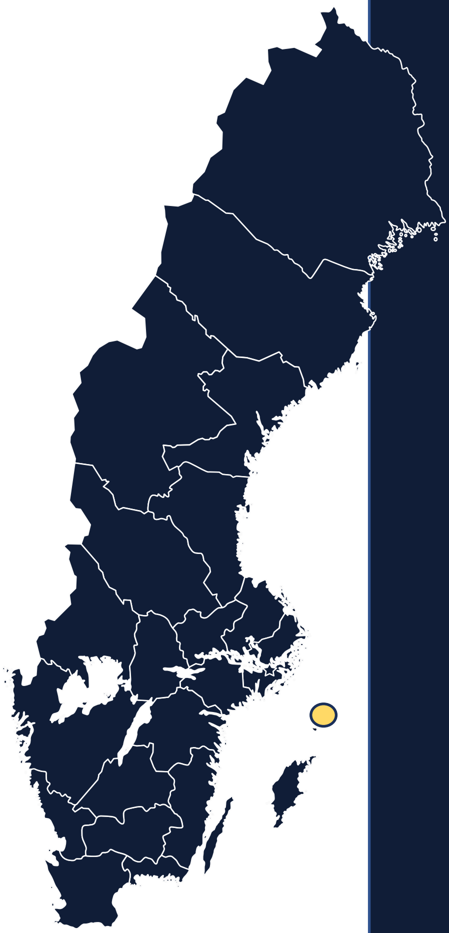
Simply Blue Group (see applicant/company) intends to apply for the necessary permits under the Swedish Economic Zone Act (SEZ) and the Continental Shelf Act for the construction of an offshore wind farm.

The planned wind farm covers an area of approx. 1,423 km^2 with a limit of 111 wind turbines with a maximum total height of 360 m to be sited within the project area. Annual production is expected to be approx. 12 TWh.

The planned activities are expected to have a significant environmental impact. Where activities are expected to involve a significant environmental impact, the operator must consult on the scope of the Environmental Impact Assessment. These documents provide the information required for the scoping consultation and have been designed to fulfil the requirements of the Environmental Code.

The project area, located approx. 22 km north of the Gotska Sandön, has been developed through a location survey which included screening competing interests, electricity requirements, biological and geological conditions. A detailed description of the siting process can be found in Chapter 2.1.

The consultation documents are based on available information from mapping, data sources, existing investigations and experience. More detailed surveys of the ground conditions, natural values, bird life, bats, marine mammals and marine archaeology will be carried out within the scope of the forthcoming permit application. The studies, together with the information and comments from the consultation, will form the basis of the final design of the wind farm and for the assessments in the environmental impact assessment which will be produced as a basis for the permit application.



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1 INTRODUCTION

1.1 Target for wind power and electricity production

At the start of 2022, the EU Parliament voted to agree a strategy for renewable offshore renewable electricity. The strategy laid out the parliament's recommendations to establish at least 60 GW offshore wind power by 2030 and 300 GW by 2050. This is the same goal proposed by the European Commission in its 2020 strategy. To achieve the 2030 and 2050 climate goals, more rapid expansion of renewable offshore energy is required, while marine areas and coastlines must be sustainably managed, as emphasised in the adopted strategy(Svensk vindenergi, 2022).

Wind power is an important source for Sweden to achieve its energy policy targets. The targets state that Swedish electricity production will be 100 % fossil fuel free by 2040[1] and that there will be no net emissions of greenhouse gases into the atmosphere by 2045 (Energimyndigheten, 2021a). This target means that wind power is an important part of the transition to a more ecologically sustainable society. Only by means of streamlined electricity usage and a move to renewable energy sources with environmentally acceptable technology will this target be achieved. In 2021, approx. 17 % of the country's electricity production was from wind power, corresponding to 27.4 TWh(Holmström, 2022).

The demand for electricity is expected to increase significantly in the coming years. In the Swedish Energy Agency's long-term scenarios for the energy system, total production from wind power is estimated to be between 64–156 TWh by 2050 of which offshore wind power will provide 34 TWh (Energimyndigheten, 2021b).

According to the *Nationella strategin för en hållbar vindkraftsutbyggnad* report, the expansion requirement for wind power is estimated to be at least 100 TWh by 2040 of which offshore wind power is estimated at 20 TWh(Energimyndigheten, 2021a).

In the recently presented national maritime plan, an area corresponding to an expansion of approx. 20–30 TWh has been put forward. At the same time, the Swedish Energy Agency together with other affected agencies was tasked with highlighting further suitable areas to enable a further 90 TWh offshore electricity production. This will be reported on by March 2023 and the then the proposal will, if possible, be worked into the maritime plan and the Maritime and Water Agency will report their recommendations to the government by December 2024 (Energimyndigheten, 2022).

There are currently three offshore wind farms in the Swedish maritime area: Lillgrund, Bockstigen and Kårehamn. Three further wind farms have permission, Storgrundet, Kriegers Flak and Kattegatt Offshore, but none of these permits have yet been used.

1.1.1 Electricity demand

Sweden has four electricity regions. The different electricity regions have different demands and production which has led to the areas SE1 and SE2 producing more electricity than is used. Areas SE3 and SE4, on the other hand, have an electricity deficit. This means that large quantities of electricity are transported from north to south Sweden. Transporting electricity requires electricity cables and sometimes there is insufficient capacity in the main network to transfer sufficient electricity to the areas with

[1]Government statement by Prime Minister Ulf Kristersson, 18/10/2022.

a deficit. This can mean that electricity consumers in southern Sweden sometimes pay a higher price than they should compared to those living in northern Sweden(Vattenfall, 2021). The project area for Skidbladner is sited outside of SE3 and therefore presents an opportunity to contribute to satisfy the ever-increasing demand for renewable energy in a region which already produces insufficient electricity to meet demand.

1.2 Climate benefits

70% of the world's surface is ocean which means that the ocean is important for regulating the climate. Since 1970, more than 90% of warming has been absorbed by the oceans and since 1990, the rate of warming has doubled. Of the carbon dioxide released since the start of the industrial revolution in the 1800s, the oceans have absorbed around 40% (Naturskyddsföreningen, 2021). To counteract the climate change which is the consequence of the world's oceans warming up, it is necessary to strengthen access to renewable energy and thus reduce carbon dioxide emissions.

One of the Global Goals, *Goal 7*: *Sustainable energy for all,* means that everyone should have access to sustainable, reliable and renewable energy and clean fuel. This is in order to meet other global challenges such as poverty, climate change and inclusive growth. Global demand for energy is simultaneously expected to increase by 37% by 2040. Renewable energy solutions such as wind power are becoming cheaper, more reliable and more efficient by the day. By investing in renewable energy, energy services and electricity can be secured for all without damaging the planet. Target *7.2 Increase global percentage of renewable energy* also involves the proportion of renewable energy increasing significantly by 2030 (Globala målen, 2021a).

Expansion of offshore wind farms involves a large area of ocean which presents questions about the impact on the marine environment. It is important to both conserve biodiversity locally while simultaneously contributing to mitigating climate change. These two interests are connected as the ocean's species and ecosystem are heavily influenced by climate change. Offshore wind power contributes to a reduction in carbon dioxide and other greenhouse gases with the potential to also increase biodiversity through artificial reefs around the foundations (Bergström, o.a., 2022).

Offshore wind power can be linked to Global Goal 14, *Life below water*, which aims to conserve and use marine resources sustainably for sustainable development. A major problem facing oceans today is acidification. This occurs as a result of increased levels of carbon dioxide in the air mentioned earlier. By implementing more wind power, carbon dioxide emissions can be reduced which then reduces acidification, as linked to T*arget 14.3: Minimise ocean acidification* (Globala målen, 2021b).

To achieve the goal of 100% renewable electricity production by 2040 and no emissions of greenhouse gases by 2045, wind power must continue to be expanded and developed. Electricity production from wind power must increase from the current 27 TWh to at least 100 TWh according to the Energy Agency's assessment. Since wind farms are becoming ever more important in the work to achieve Sweden's target and the global goals, new wind turbines must be built where there are good wind conditions. There are several advantages to siting wind farms offshore. The best wind conditions are offshore where there are large areas and winds are often stronger and more even than on land.

1.3 Administrative information

1.3.1 Operations

Simply Blue Group intends to apply for permission for an offshore wind farm within Sweden's Economic Zone. The park encompasses an area of approx. 1,423km^2 with up to 111 wind turbines at a maximum height of 360 m, wind measurement masts and substations (OSS).

The wind farm will consist of wind turbines constructed on floating foundations which are anchored to the seabed. Aside from turbines, offshore substations, wind measurement masts, internal network cabling on the seabed and export cables to shore will be installed.

1.3.2 Operators

Simply Blue Group (SBG) is a leading developer of previous phases of sustainable and transformative marine projects. Simply Blue Group works with the oceans, enabling communities to benefit from 'blue growth' - floating offshore wind power, wave energy, sustainable fuel and sustainable aquaculture - all in harmony with the ocean and the fight against climate change.

Simply Blue Group was founded in 2011 and has its headquarters in Cork Ireland, with offices in England, Scotland, Spain, Sweden, USA and Canada with a rapidly expanding team of over 90 people worldwide.

Floating offshore wind power is the dominant market segment in Simply Blue Group's portfolio. The group has more than 10 GW floating wind projects in development and the company has grown to a position as one of the world's leading floating wind power companies as evidenced by our growing international presence.

Simply Blue Group's biofuel division produces green hydrogen, green ammonia, biofuel, sustainable aviation fuel, methanol etc., from the renewable offshore energy. This biofuel can then be used as "drop in" fuel for aviation, marine transport and chemical production where it is difficult to transition to renewables. At the same time, it enables existing oil and gas infrastructure to be reused to move from fossil-based to sustainable fuel production and storage. This makes it possible to deal with the constraints of the grid infrastructure and variations in renewable energy production that might otherwise affect the robustness and stability of the grid.

In addition, Simply Blue Group has a strategy for Carbon Dioxide Removal (CDR) and aims to evaluate methods for reducing emissions through Direct Air Capture (DAC). Captured CO_2 can either be permanently sequestered and stored or fed into the production of biofuels.

Operating DAC and biofuel plants during times of high wind and low demand creates economic efficiency and sustainable energy production, which reduces the risk and dependency on subsidies and enables projects to support a robust local supply chain.

Simply Blue Group has many years' experience in aquaculture and an ambition to use marine space in the wind farm for seagrass/weed aquaculture. Seaweed farming has the potential to consume CO_2, nitrogen and phosphorous in the sea and produce oxygen. This creates effective artificial habitats which have the potential to support fish populations by providing food and protection. Harvested seaweed can be used for biofuel production, biodynamic fertilisers and, if water conditions are good, so-called "superfoods".

In order to minimise the environmental impact, utilise the marine area to improve sea water quality and create a basis to transition from fossil fuels to renewable sources, all three business areas are assessed in at the same time when Simply Blue Group develop their wind farms. This creates new economic opportunities for coastal communities and ensures projects co-exist with sustainable fishing, improvements in marine environments and support for local industry through the transition.

1.3.3 Consultant

Wind Sweden is the small consulting firm with the big vision to make the future renewable. Our mission is to offer market players proactive and strategic advice with qualified services in the development, implementation, investment and operation of renewable energy in the Nordic region through broad industry knowledge and specialist skills.

Wind Sweden AB is the lead consultant with responsibility for leading the project and drawing up the consultation document. Wind Sweden has robust competence in offshore wind power and is responsible for the development of the Kattegatt Offshore wind farm by Falkenberg.

1.4 Scope of consultation and legislation

These consultation documents relate to an assessment of permission for the installation and operation of the Skidbladner wind farm, including related activities such as substations and the internal cable network. Several different types of permit are required, which are examined by various bodies at different stages. The Table 1 following includes a summary of the main permits required for establishment, with those intended to be applied for at a later stage and therefore not covered by this consultation specifically highlighted in yellow.

Table 1. Main permits for establishment and operation of Skidbladner. Permits highlighted in yellow are not included in these consultation documents since they are intended to be applied for at a later date.

Activity	Area	Permit	Agency	When
Wind power installation	Economic zone	Permit for the establishment and operation of a wind farm in Sweden's economic zone (§5 SEZ).	Government	This consultation with additional application
Internal cable network	Continental shelf	Permit for laying undersea internal cables §3 and § 2 b of the CSA.	Government	This consultation with additional separate application
Natura 2000 authorisation	Economic zone and territorial waters, if appropriate	Authorisation under Chapter 7 § 28 a EC.	Gotland County Administrative Board	This consultation with any additional application
Seabed surveys	Continental shelf	Survey permit under § 3 CSA.	SGU	Separate application in several stages
Export cable	Continental shelf	Authorisation for laying export cable under CSA.	Government	Separate application

Export cable	Territorial waters	Authorisation under Chapter 11 EC for water-related works and required measures onshore.	Land and Environmental Court of Appeal	Separate application
Grid connection	Connection point to be determined at a later stage	Authorisation for connection to the main grid under Electricity Act (1997:857).	Energy market inspectorate	Separate application

1.4.1 Authorisation and legislation

Permit for construction and operation of the wind farm

Construction and operation of the planned wind farm and associated facilities, including substations and internal cable networks (ancillary activities require a permit from the government under § 5 of the Act (1992:1140) on Sweden's Exclusive Economic Zone (LSEZ).

In a permit assessment under LSEZ, certain rules in the Environmental Code (1998:808) (EC) apply, including Chapters 2-4 and Chapter 5. §§ 3-5 and § 18 along with relevant regulations in Chapter 6 pursuant to § 6 LSEZ. A specific environmental assessment will be conducted and an Environmental Impact Assessment (EAI) will be produced pursuant to § 6 a LSEZ.

Permit for laying submarine internal cables.

The wind farm will be connected by cables which form the so-called internal cable network within the farm area. Laying submarine cables for the internal cable network on the continental shelf requires a permit under § 3 and § 2 b of the Act on the Continental Shelf (SFS 1966:314) (ACS) subject to governmental review (Department of Enterprise). The company intends to apply for such a permit in connection with the permit application for the wind farm. In a permit assessment under CSA certain rules in the Environmental Code (EC) apply, including Chapters 2 and Chapter 5. §§ 3-5 EC and the provisions of Chapter 6 of the EC under § 3 CSA. A specific environmental assessment will be conducted and an Environmental Impact Assessment (EAI) will be produced.

Survey permit

For preparatory geological and biological seabed surveys a survey permit is required under § 3 CSA. Once permission is granted for the wind farm, furthermore detailed surveys may need to be conducted in order to design the wind farm in detail. The provisions in the EC in section 1.4.1.3 are relevant for authorisation for investigation. A specific environmental assessment will be conducted and an Environmental Impact Assessment (EAI) will be produced. For investigations which include blasting or drilling, Chapter 6 of the EC is not appropriate.

Natura 2000 authorisation

The wind farm is planned in an area adjacent to the Natura 2000 area Gotska Sandön-Salvorev. Any Natura 2000 permit is applied for and examined by the County Administrative Board of Gotland according to Chapter 7 § 32 of the EC. A specific environmental assessment will be conducted and an Environmental Impact Assessment (EAI) will be produced.

1.4.2 The permit process for the construction and operation of the Skidbladner wind farm

The permit process for the Skidbladner wind farm begins with a consultation and investigation stage in which the applicants consult with agencies, organisations, the general public and those with a special interest under Chap. 6. of the EC. During this consultation period, the applicants receive input and information from all stakeholders. This input and the information received then informs which surveys will be conducted, which material is presented and which aspects go into the EIA.

The consultation begins with Gotland County Administrative Board and Region. This is in a written consultation with the proposed consultation group, see Annex 1.

Public consultation is proposed to take the form of a face-to-face meeting where attendees have the opportunity to raise issues and comments. Following the consultation meeting, there will be a further opportunity to submit comments to the operator within 3 weeks. The consultation will be announced in the press, with information on where to find information about the project and how to submit comments.

Following consultation with agencies, organisations, the general public and those with a special interest an EIA will be produced.

The permit process is shown in the schematic below.

Figure 1. Schematic of the permit process. Förstudie – Feasibility studies; Samrådsunderlag – Scoping report; Avgränsnings-samråd och miljöbedömning – Public consultation and impact assessment; MKB och ansökan tas fram –EIA report and permit application development; Tillståndsansökan lämnas in – Submission of the permit application; Handläggning – Processing of the permit; Eventuell komplettering – Any additional documentation; Prövning -Permit examination; Beslut om tillstånd och villkor – Decision on permit and permit conditions; Genomförande av verksamhet och kontrollprogram – Project realisation and monitoring program; Idrifttagande och kontrollprogram – Operation and monitoring program continuation.

1.4.3 Scoping consultation

This consultation document has been prepared as a basis for scoping consultations in accordance with Chapter 6 §§ 29-32 of the EC. Survey consultation in accordance with Chapter 6 §§ 23-25 EC has not been conducted as it is only relevant if significant environmental impacts cannot be predicted in advance.

A scoping consultation under the provisions in Chapter 6 § 30 of the EC and consultations will be consulted with the County Council, supervisory authority and individuals likely to be particularly affected by the operations. In addition, consultation will be conducted with other government agencies, municipalities and the public who may be affected by the planned operations.

A scoping consultation aims to inform agencies, individuals and the public, about the planned project's location and give a comprehensive account of the potential environmental impact of the planned activities. Consultation documents will contain information on:

- Design and scope of operations
- Location of operations
- Environmental sensitivities in the affected area
- Aspects of the environment which can be assumed to be significantly affected
- The environmental affects likely to result from the operations or external events, to the extent such information is available.
  - The assessment conducted by the applicant as to whether or not the operations have a significant impact on the environment.

The consultation document shall also provide examples of appropriate protection measures. The consultation document shall include information on all aspects of the project, the construction phase, operational phase and decommissioning phase. The purpose of a scoping consultation is also to provide the applicant with guidance from the County Administrative Board which will work to ensure that the content of the forthcoming EIA contains the scope and detail required for an assessment.

1.4.4 Scope of consultation

Substantive limitations

The present consultation document concerns the application for a permit for a wind power development under the SEZ and internal cable network under CSA and, where applicable, the assessment for a permit under Natura 2000 rules. Further permits are considered separately and are not covered by this consultation document.

The power connection point to the overhead network has not yet been determined but will be surveyed at a later stage and coordinated with Svenska kraftnät. For this reason, the consultation document does not cover the laying of export cable in the Swedish economic zone and territorial waters according to the CSA (1966:314) §§ 2b-3. The consultation document also does not cover permits under Chapter 11 of the EC for laying cables in territorial waters or other permits required under the EC or other relevant legislation for onshore measures, for example. Permits required for these will be applied for at a later stage.

Connection of the wind farm to the transmission grid and the construction of an electrical power line in accordance with the Electricity Act (1997:857) is a separate authorisation process, known as a grid concession for a line, and is not covered by this consultation.

Since the project may have an impact across borders, consultations will be held and information provided in accordance with Chap. 6 of § 33 EC to satisfy the requirements of the provisions on transboundary consultation in the EIA directive and on the Environmental Impact Assessment in a transboundary context under the Espoo Convention. The Swedish Environmental Protection Agency is responsible for conducting the procedure with other countries under the EC and Espoo Convention, see Chapter 6. 33 EC and § 21 Environmental Assessment Regulation (2017:966).

The consultation process is limited to that which includes the construction phase, operational phase and decommissioning phase for the Skidbladner wind farm and related infrastructure. This includes the wind turbines and their foundations, measuring masts, internal cable network and substations.

This consultation process also gives an overview of what the forthcoming EIA will contain along with which environmental impact will be further investigated.

Geographical scope

The geographical scope for the consultation and environmental assessment is based on the area covered by the project as well as the surrounding area which may be impacted by the operations in the application, i.e., the survey area. The geographical scope for the survey area varies due to respective factors.

Time limitations

Consultation for the Skidbladner wind farm will be conducted between autumn 2022 and spring 2023. A comprehensive EIA with related surveys is expected to begin after the consultation.

Definition of the scope of consultation

Stakeholders identified for inclusion in the consultation are listed in Annex 1.

2 LOCATION

According to the code of conduct in Chapter 2 of the Environmental Code, a site must be chosen for an activity or measure that is suitable both in terms of its purpose and in terms of human health and the environment. The location principle (Chapter 2 § 6 environmental code) is extremely important for new installations. It is therefore particularly important to highlight how the location principle has been observed in the environmental impact assessment in a permit evaluation. The location principle (Chapter. 2 § 6 environmental code, involves activities or measures being placed in a location where the end goal of the activity or measure can be achieved with minimum intrusion and nuisance to human health and the environment. Intrusion and nuisance to human health in the location principle means anything which contradicts the aim of the environmental code. Sometimes several locations may be suitable for an activity. In such cases, the best of these locations is chosen (prop. 1997/98:45 part 1, p. 218 ff)., i.e., the location which causes least intrusion or nuisance to human health and the environment (Naturvårdsverket, 2022a).

A recent report from Vindval aimed to investigate the possibility for large scale, sustainable expansion of wind power in Swedish waters in the Baltic Sea while also acting as a guidance document (Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022). The report is based on both industry preferences, i.e., wind power producers, and the assessed impact on species at the population level. The outcome of the report shows that offshore wind power with floating foundations is broadly possible in all parts of the Baltic Sea. In general, floating foundations are expected to have lower impact on marine organisms than fixed foundations since they located in deeper areas with lower biodiversity. Areas with deep, dead seabeds where the impact is expected to be particularly low, are particularly suitable for wind power developments.

The choice of project area for the Skidbladner wind farm has been based on a location study. Chapter2.1.1explains how the location of the operation has been chosen and why.

2.1 Location survey

The forthcoming EIA includes a description of the location study and the choice of the design of the farm. It will also include an explanation of alternative.

Along with this consultation document, a location study has been conducted with help of the QGIS programme, in which information on conflicting interests and other available information has been studied.

The area which has been analysed is the Swedish waters in the Baltic Sea between Stockholm and Malmö. The aim of the analysis was to identify areas suitable for development of an offshore wind farm with regards conflicting interests, environmental impact, distance to shore, wind resource, power requirements and technical conditions.

The first step in the location survey was to exclude conflicting interests which could been heavily impacted by an offshore wind farm development and therefore would be avoided if at all possible. In the second step, an area 7 km from the coastline was removed from the available area to maintain distance from the mainland and reduce visual impact. In the third step, areas were identified which were suitable for an offshore wind farm development with sufficient water depth for floating foundations. In the final step, areas were chosen which had sufficient production capacity.

A summary of the different steps can be seen below in Table 2.

Table 2. Summary of location surveys.

Step	Parameters
1	National park
	Nature reserve
	Natura 2000 area
	Armed forces
	Waterways
	National commercial fishing interest
2	Distance from shore
3	Identify areas suitable for floating foundations based on ocean depth
4	Identify areas with sufficiently large production capacity

In order to then choose the final project area, further parameters were investigated to choose the most suitable area. A summary can be seen below in Table 3.

Table 3. Overview of further parameters which influence the choice of location.

Parameter	Explanation
Electricity demand	SE3 and SE4 - electricity is needed in these electricity areas
National interest	Areas of national interest have been avoided
National maritime plan	Recommendations for use of land areas follow
Good wind conditions	At least 8m/s average wind speed
Porpoises	Adaptations have been made in areas frequented by porpoises
Aviation	Areas of conflict have been avoided
Mine risk areas	Have been avoided
Ice	Areas with high risk of ice have been avoided

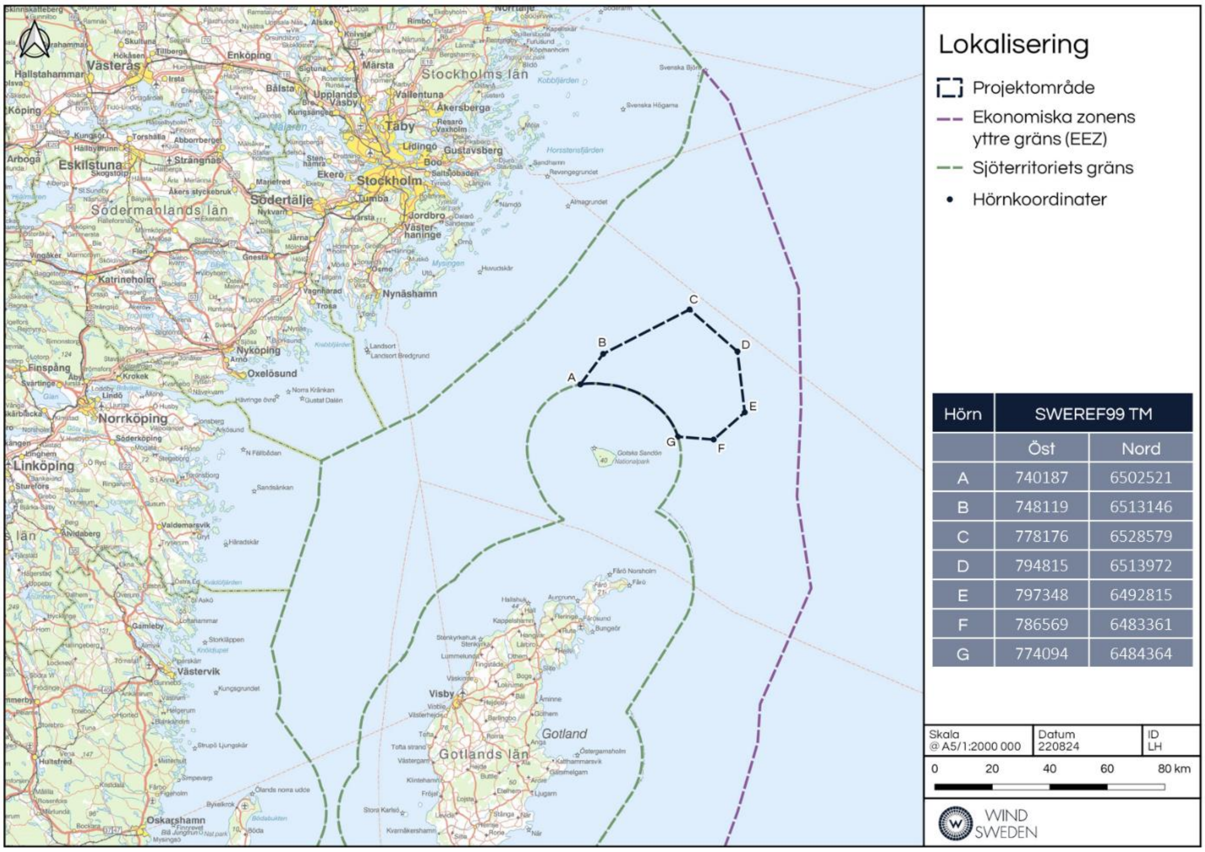
2.1.1 Choice of location

The project area for Skidbladner lies within Sweden's Economic Zone, south east of Gotland covering an area of 1,423 $km^{2,}$ see Figure 2.

The fact that the planned operations is location close to the electricity areas SE3 is considered as a positive aspect since areas SE3 and SE4 have an energy deficit.

The area is judged to have favourable conditions for an offshore wind farm with winds between 9.6m/s and 9.7m/s at 150m above sea level. Ocean depth varies between approx. 14 m and 197 m and the material on the seabed is predominantly hard mud and clay.

The Salvorev-Kopparstenarna nature reserve and the Gotska Sandön lie south east of the project area No national interests are found in the project area and the planned operations have few conflicting interests.



Hörn	SWEREF99 TM	
	Öst	Nord
A	740187	6502521
B	748119	6513146
C	778176	6528579
D	794815	6513972
E	797348	6492815
F	786569	6483361
G	774094	6484364

Figure 2. Overview of location and corner coordinates for the project area. Projetkområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Hörnkoordinater – Corner coordinates.

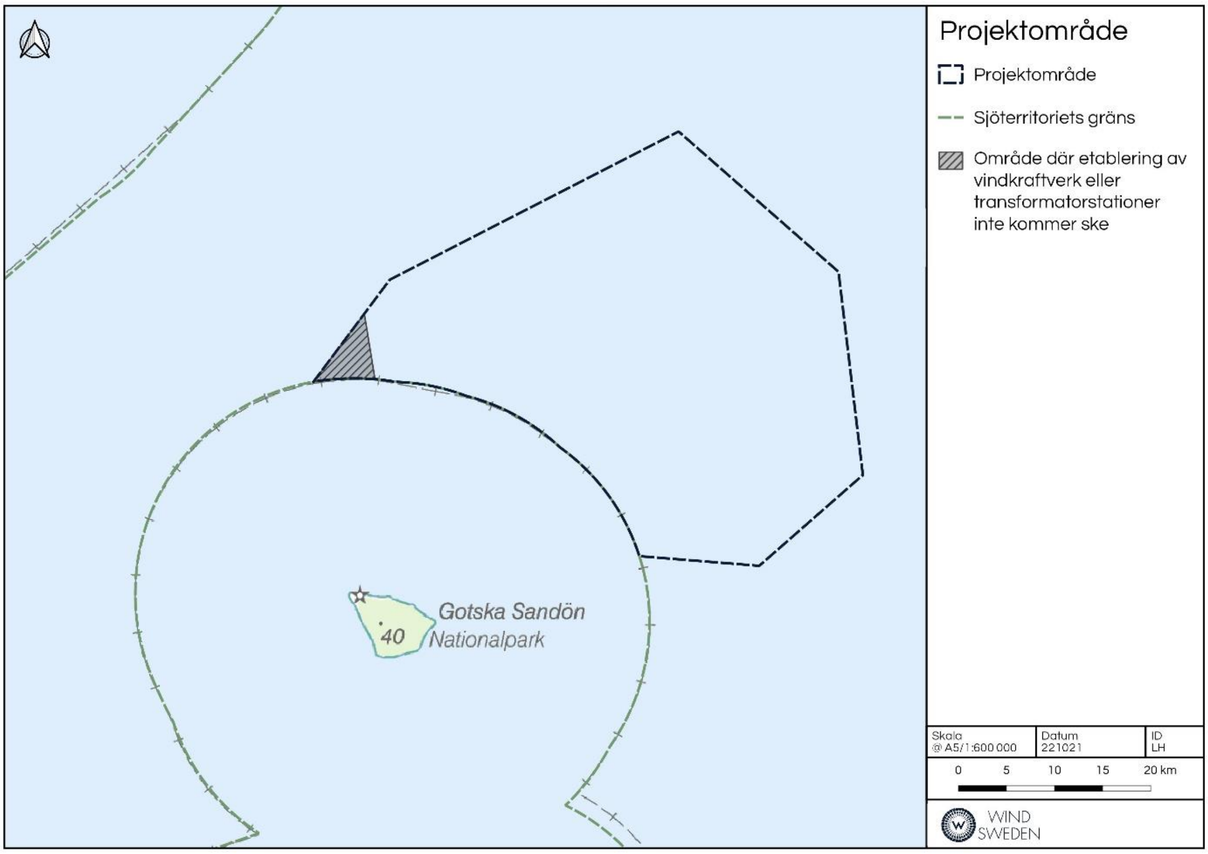


Figure 3. The area marked will not have wind turbines or substations installed. Projetkområde – Project area; Sjöterritoriets gräns – Territorial waters boarders; Område där etablering av vindkraftverk eller transformationstationer inte kommer ske – Area where no windfarms nor transformation stations are planned to be established.

The south west tip of the project area not have wind turbines or substations installed. This is because the area borders an area of high natural value and has a depth which is in part shallower than 30 m, see Figure 3.

The selection of project area for Skidbladner coincides to around 99% with an area without restrictions or existing area protection (national parks, Natura 2000 areas and nature reserves) according to Vindval's report *Ekologisk hållbar vindkraft i Östersjön* (Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022), see Figure 4.

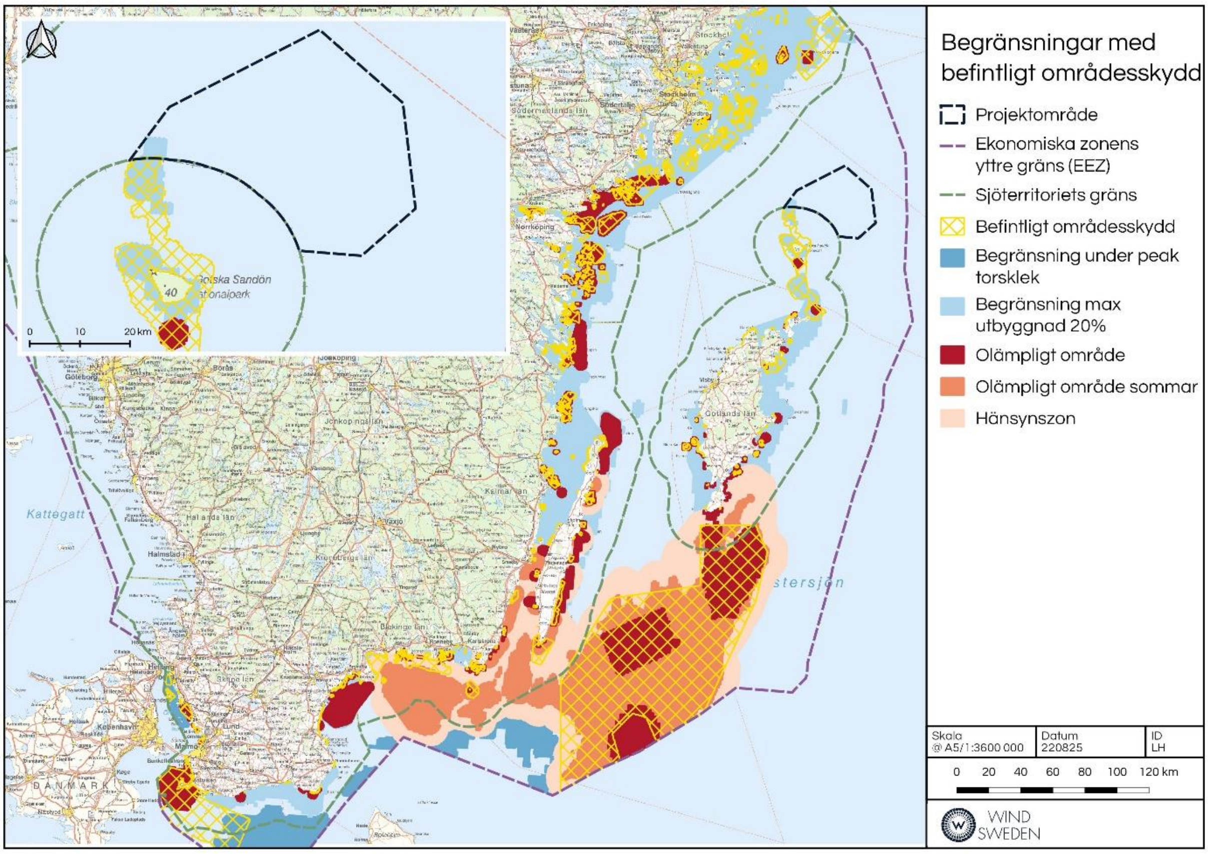


Figure 4. Restricted areas and areas with existing environmental protection (national parks, Natura 2000 areas and nature reserves) (Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Befintligt områdesskydd – Existing protection area; Begränsning under peak torsklek – Restricted areas during cod spawning; Begränsning max utbyggnad 20% - Restricted areas where only 20% of are can be exploited ; Olämpligt område – Invalid area for development; Öleämpligt område sommar – Invalid area for development in summer; Hänsynzon – Area of consideration.

2.2 Zero option

The zero option describes a situation where no wind farm is installed within the planned area. A detailed presentation of the zero option will be included in the forthcoming EIA. This will include the assessed environmental impact as a result of the alternative in the application in relation to the zero option.

3 DESCRIPTION OF OPERATIONS

Offshore wind power is considered to have great potential in respect to electricity production in both Swedish waters and globally. This is because winds at sea are both strong and even. Data from existing wind farms in the North Sea show that 91% of the time it is sufficiently windy to produce renewable energy (Ørsted, u.d.). The development of Skidbladner wind farm will contribute approximately 11.7 TWh/year of renewable energy.

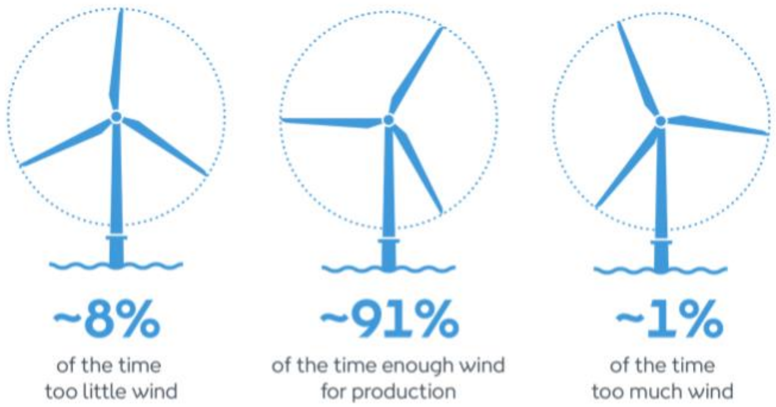


Figure 5. Average values of how often an offshore farm can produce renewable energy. Data based on North Sea wind farms (Ørsted, u.d.).

Construction for the Skidbladner wind farm will begin following receipt of permits, it is currently difficult to determine which model or height of wind turbines will be optimal at the time of development. This is predominantly due to the constant rapid technological development of wind turbines. Hence the consultation document includes a maximum total height and maximum number of wind turbines for the project area. This also applies to the choice of floating foundation and anchoring methods and therefore several alternative methods are presented in the consultation document. This favours the application of the principle of best available techniques, which means that the forthcoming EIA intends to describe potential environmental impacts, allowing for flexibility in the choice of techniques.

The company intends to apply for authorisation for construction and operation of a wind farm with free placement of wind turbines within a geographically defined area, as per the usual procedure for offshore wind power. The positions of the wind turbines will be determined before construction with regard to the best technology available at the time.

Based on the project area, an example design has been developed by the company with the maximum number of wind turbines allowed. In the three different example wind farm designs and calculations, an example turbine is used, the dimensions of which can be seen in Table 4, Chapter 3.2.1. The example design i shown in the consultation stage is only to be seen as an idea of how the planned wind farm may look. The final design of the wind farm in terms of wind turbines, positions, rotor size and total height will be determined at a later stage.

3.1 Scope

Skidbladner wind farm is planned to be designed with up to 111 wind turbines which currently gives a total installed capacity of approx. 2.2 GW with an expected annual production of approx. 11.7 TWh.

The wind farm consists of wind turbines with foundations and an internal cable network which connects all of the turbines and their substations (OSS). The wind turbines will be anchored with floating foundations meaning that the wind turbines float and are moored to the seabed.

3.1.1 Accompanying activities

An export cable (marine cable) is a requirement for the wind turbines to be connected to the grid infrastructure. This involves an export cable being constructed from the wind farm's OSSs, either to land or to one of the offshore connection points proposed by Svenska kraftnät on the border between the territorial waters' boundary and the SEZ. Should the applicant intend to lay a marine cable towards land, this will be constructed all the way to the beach. At the shoreline, the marine cable will be coupled with a land cable which will continue further to a suitable connection point to the Swedish transmission grid.

3.2 Design

3.2.1 Wind turbine

As the permit process for offshore wind assessment takes time, the time from project launch to construction phase can sometimes be as long as 8-10 years. Technological development within wind power, on the other hand, is rapid, meaning it is impossible to know which technology will be the best available on the day the project is realised.

Currently available technology will be further developed both with regards efficiency and height of wind turbines. The current trend is for higher and more efficient turbines and today there are wind turbines with outputs of 15 MW (Vestas, u.d.). If this trend continues at the same pace, we will see turbines with outputs around 20MW within the next decade.

The total height of a wind turbine is determined by the rotor diameter as well as clearance between the water surface and the tip of the rotor blade. Clearance will be between 21 - 35 m for this project. The installed output for wind turbines for the project is expected to be approx. 20 MW. The maximum total height applied for is thus 360 m, see Table 5. An exact number, dimensions and model will be determined in the final contract and detailed projections of the site. Therefore, exact figures cannot be provided at this stage.

Table 4 below lists three alternative designs, which can be seen in Figure 7, and Figure 8a scenario with the maximum dimensions, see Table 5.

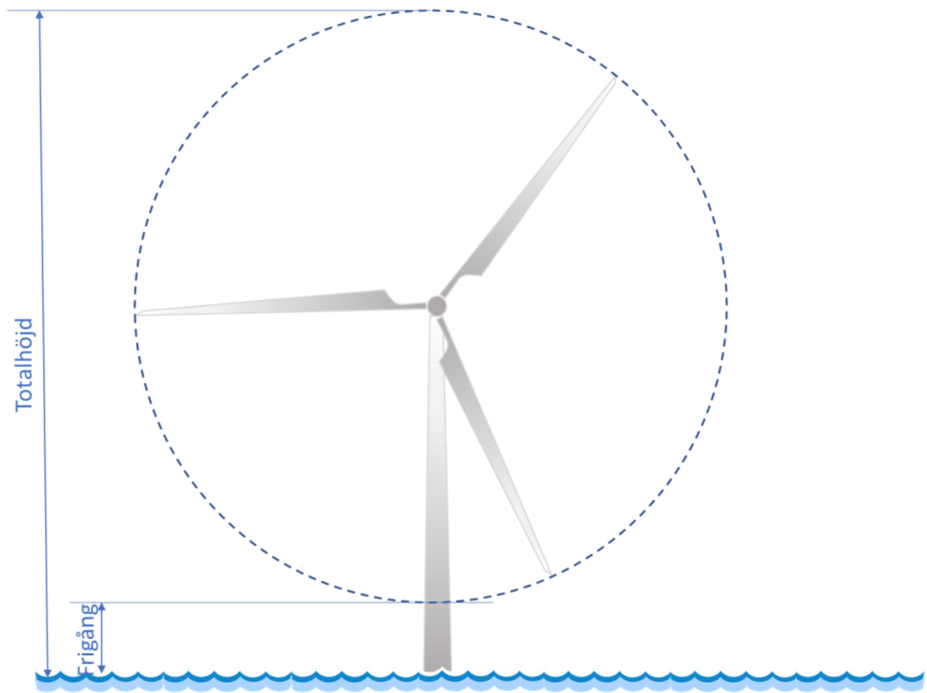


Figure 6. Schematic of example. Frigång – Clearance; Totalhöjd – Total height.

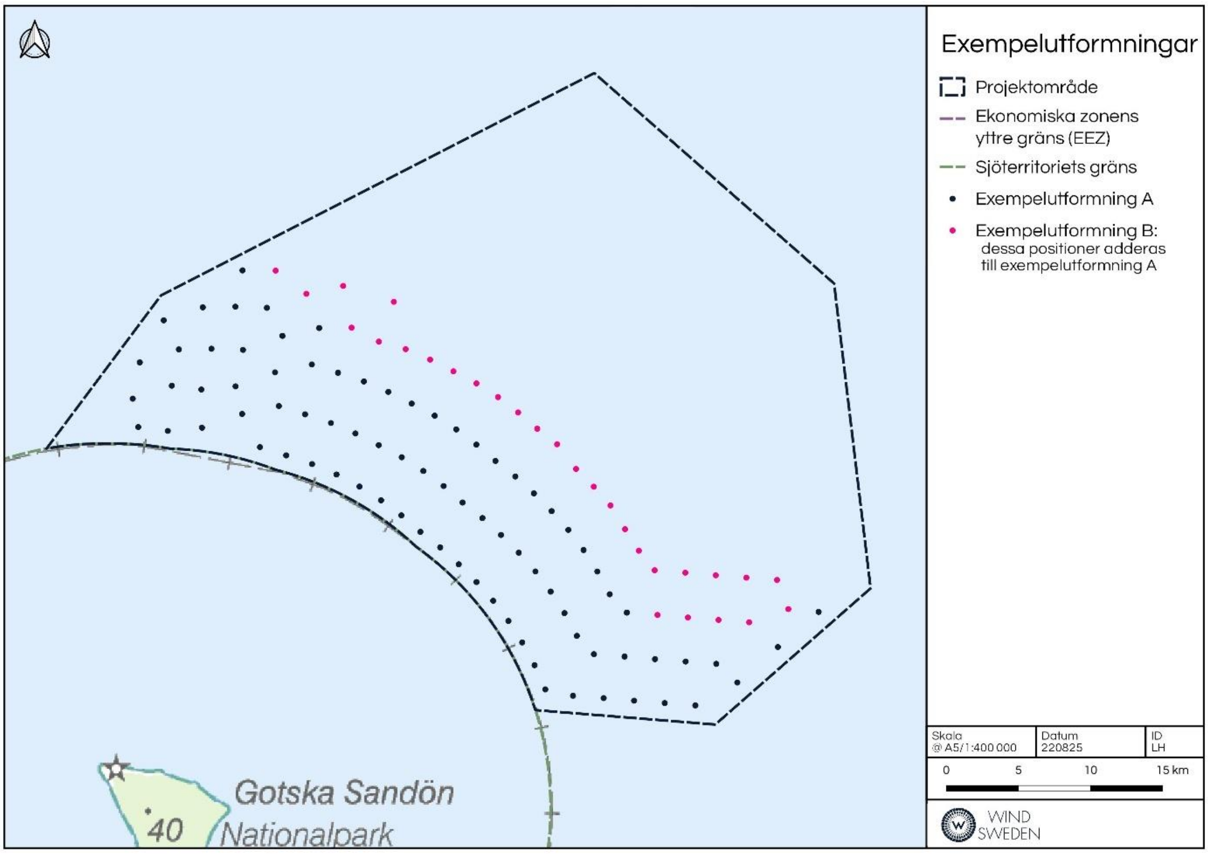


Figure 7. Example designs A and B in the southern part of the project area based on the dimensions in Table 4. For design B, the pink dots are added to design A. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders.

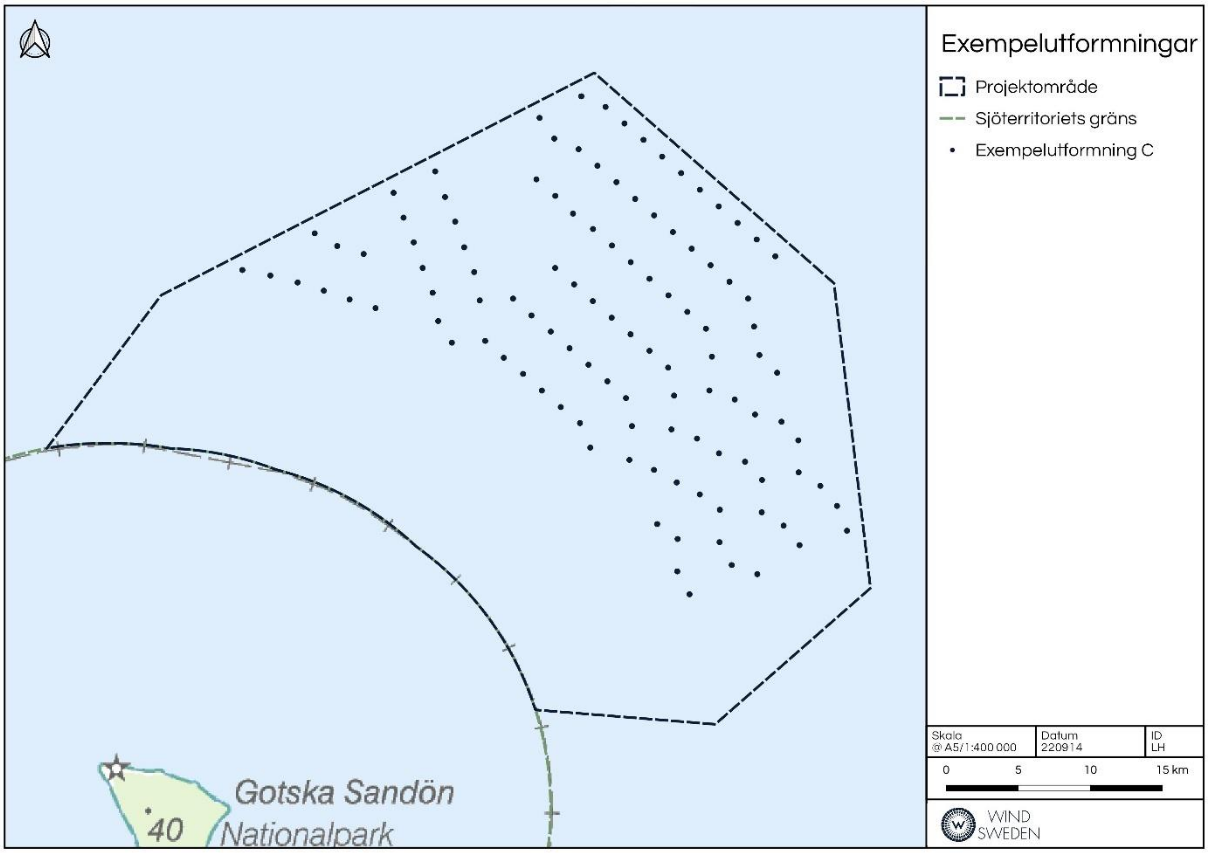


Figure 8. Example design C in the southern part of the project area based on the dimensions in Table 4. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders.

Table 4. Alternative example designs of the wind farm. RD=Rotor diameter.

Example design	A	B	C
Number of wind turbines	82	111	111
Output per wind turbine [MW]	20	20	20
Total installed output [MW]	1640	2220	2220
Clearance [m]	35	35	35
Rotor diameter [m]	290	290	290
Total height [m]	325	325	325
Approximate distance between turbines [RD] Within rows / Between rows	6 / 13	6 / 13	6 / 13
Calculated production capacity [TWh/yr]	8.6	11.7	11.7

Table 5. Maximum dimensions applied for:

Scope of application	Number of wind turbines	Total height [m]
Maximum	111	360

For this evaluation and the forthcoming EIA, the maximum number of turbines and total height are as the given dimensions. Further design alternatives within the framework of the maximum number of wind turbines and maximum total height applied for will be surveyed. This alternative will cover the wind turbines placed in the far north eastern part of the project area, see Figure 8and Figure 7.

The final design will be based on the forthcoming seabed surveys and information received during consultations and will be determined once permission is obtained.

3.2.2 Floating foundations

With regards the depth within the Skidbladner project area, the installation is intended to use floating foundations. Floating foundations use buoyancy to support the wind turbines and are anchored to the seabed. The choice of which type of floating foundation to use depends on several parameters, including the nature of the seabed, wind conditions and the size of turbines. The design will be analysed at a later step to optimise electricity production and economy as well as minimising the negative impact on the environment.

The main types of floating foundation currently on the market can be categorised into three groups depending on the type of mechanism used for stability. These three are as follows:

Stabilised with ballast

Ballast at the bottom of the floating construction moves the centre of gravity to below the centre of buoyancy. This means the construction stays upright and counters movements which unbalance the construction. An example of floating foundations with this technology is SPAR.

Stabilised with buoyancy

In this case, the water surface is the main element for maintaining the construction's stability. Stability is achieved by either having one large pontoon or several smaller pontoons a distance from the centre of the construction. An example of floating foundations with this construction are barge and semi-submersible. The main difference between these two types is that semi-submersible has distributed buoyancy and consists of pontoons connected by arms while barge consists of one flat floating element with no space between.

Stabilised through anchoring to the seabed

This technology relies on lines which are anchored to the seabed under tension and that they can thus stabilise the construction. The volume of water displaced by the construction of the wind turbine must be large enough to create extra buoyancy so that the anchoring lines are always under tension. An example of floating foundation which uses this type of mechanism is Tension Leg Platform (TLP)(Leimeister, Kolios, & Collu, 2018).

A summary of the advantages and disadvantages for three of the floating foundations named above can be seen below in Table 6.

Table 6. Summary of the advantages and disadvantages of the different types of floating foundation (IRENA, 2016) & (Du, 2021).

Types of floating foundation	Advantages	Disadvantages
SPAR	- Simple design compared to semi-submersible and TLP - Lower installation and anchoring costs than TLP - More stable than semi-submersible due to depth of design	- Requires greater depth (>100m) - Wind turbines cannot be installed in port but rather are installed in situ
Semi-submersible	- Easier to construct and transport than SPAR and TLP - Wind turbines can be installed in port and then the whole construction can be transported to be positioned - Can be used for a broad spectrum of water depths, usually from 40m - Lower installation and anchoring costs compared to TLP	- Least stable of the three different structures - Complex and larger construction compared to the other alternatives
Tension leg platform (TLP)	- The most stable construction of these three types - Smaller structure at lower material costs - Wind turbines can be installed in port and then the whole construction can be transported to be positioned - Can be used for a broad spectrum of water depths, usually from 40m	- Difficult to maintain stability during transport and installation - Depending on the design may need a specially designed vessel for installation - Higher installation and anchoring costs compared to SPAR and semi-submersible - Can be affected by high frequency dynamic loads due to the construction's rigidity.

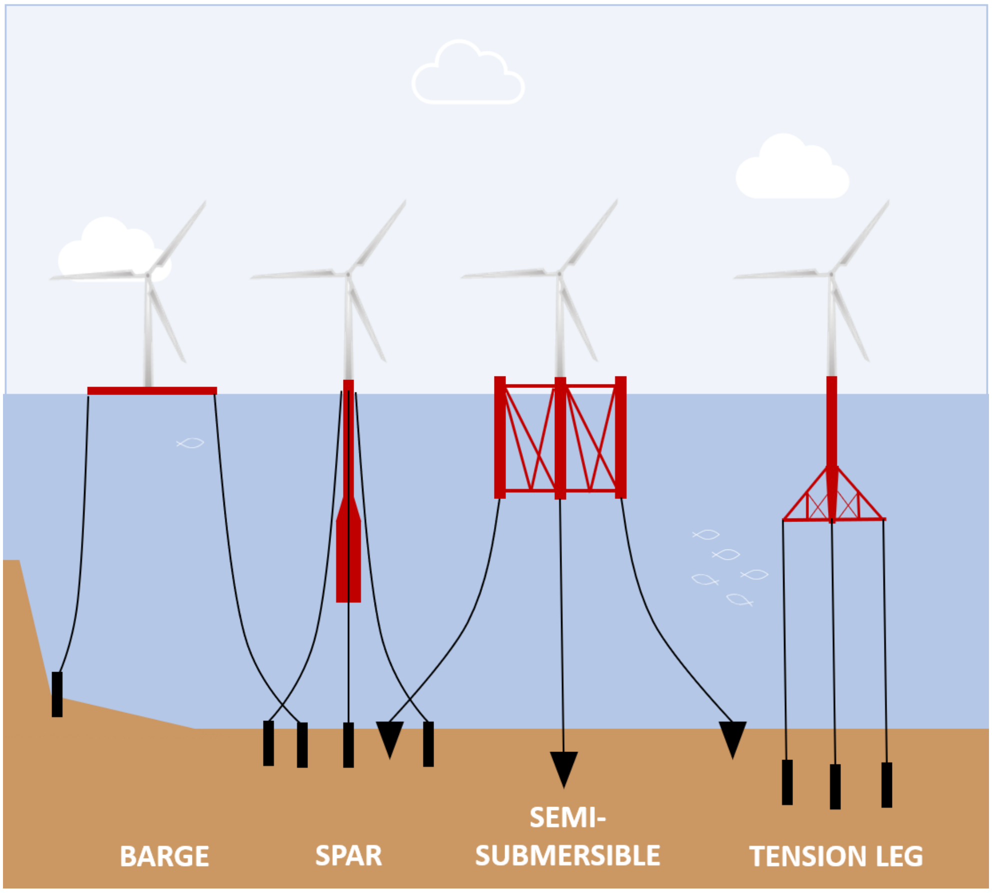


Figure 9. Illustration of the current main models of floating foundations.

3.2.3 Anchoring methods

All of the types of foundation described in Chapter 3.2.2 require anchoring to the seabed. Which type of anchoring method is appropriate depends on the nature of the seabed and sediment in the area and therefore the choice will be based on the seabed survey which will be conducted at a later stage. Tension of the lines between the foundation and anchoring also depends on the type of foundation and anchoring method. Which tension is used affects how much the foundation can move on the surface. The final anchoring method will be determined at a later stage.

A summary of some of the most common current anchoring methods is described below in Table 7.

Table 7. Summary of anchoring methods(Castillo, 2020) & (Vryh of Anchors BV, 2010).

Anchoring method	Information	Advantages	Disadvantages
Gravity anchor (Gravity anchor)	- Made of steel or concrete - Holding force created from the weight of the mooring and friction against the seabed material - Manages vertical loads through its weight and horizontal loads with friction on the seabed	- Can be installed in a wide range of types of seabed - Can manage both vertical and horizontal loads - Low cost	- Material intensive production - Difficult to remove after decommissioning of a wind farm
Piles (Piles)	- Cylinders - Holding force is created through friction between the cylinders and ground - Piles are buried	- Can be installed in a wide range of types of seabed - Can manage both vertical and horizontal loads	- Generates a lot of underwater noise during installations - Difficult to remove after decommissioning of a wind farm
Suction pile (suction pile)	- Another type of mooring with piles - Larger diameter compared to piles - The piles are hollow and a pump creates a vacuum to anchor the pile during installation	- Can manage both vertical and horizontal loads - Low installation costs - Easy to remove and can be reused - Low noise during installation compared to piles - Can be removed after decommissioning of a wind farm	- Can be used on a limited range of seabeds Used on clay soils
Drag embedment anchor (drag embedment anchor)	- Made of steel with a triangular construction at the base which forms capacity for anchoring	- Can resist high levels of horizontal movement - High loading capacity in relation to its weight - Can be removed after decommissioning of a wind farm	- Can only handle horizontal loads. There are certain types which can resist vertical movements. - Can be used on a limited range of seabeds Best suited to sandy soils

3.3 Mains grid

The electricity transmission for a wind farm can be divided into several parts. The internal cable network, substations (OSS) and export cable. Electricity is transmitted from each wind turbine to a substation via the internal cable system. The substation transforms the electricity to a higher voltage before it is transmitted further via the export cable. In some cases several substations and export cables are required.

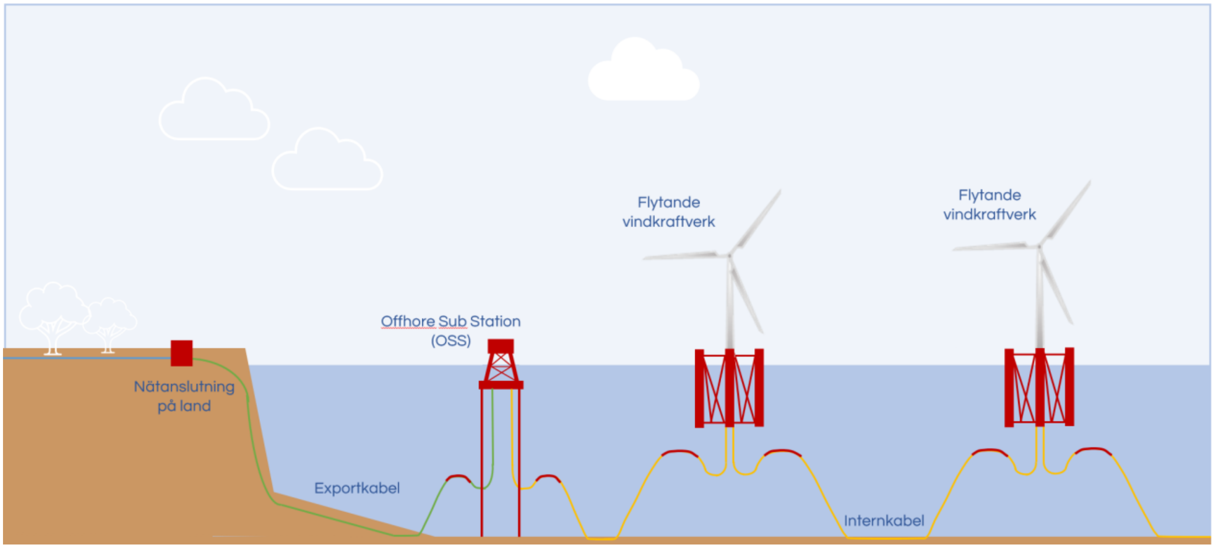


Figure 10. Schematic of the different parts of an offshore wind farm. Nätanslutning på land – Gridconecction on land; Export-kabel - Exportcable; OOS – Offshore Sub Station; Flytande vindkraftverk – Floating wind turbines; Internkabel – Internal cable network.

3.3.1 Internal cable network

Within the wind farm area, a number of cables will be laid to connect the wind turbines to each other, the so-called internal cable network. This network is important for communication between wind turbines and transmission of the electricity produced. It is also importance for operational monitoring and load control.

The internal cables have a dynamic part which moves with the floating foundation and therefore needs a high level of flexibility and strength to be able to handle the impact of waves and currents, for example. Usually, the cable is constructed used the "lazy wave" method where buoyancy modules are added to reduce the load on the cable, see Figure 11. Either only dynamic cables or a combination of dynamic and static cables can be used but this requires the addition of a connection point between the two types (Lerch, De-Prada-Gil, & Climent, 2021).

The internal cable network is then connected to one or more offshore substations (OSS). These stations transform the electricity produced by the wind turbines to a high voltage to reduce loss of electricity during transmission via export cables.

The preferred method of protection for the internal cable network will be by burying them. In those places where this method is unsuitable due to, for example, cables crossing each other or unsuitable seabed material, a different method will be used. Alternative methods for protecting cables is to cover them with stones, concrete mattresses, concrete, artificial seaweed mats[2]or sand bags.

[2] Anti-Scour Frond Mattress:

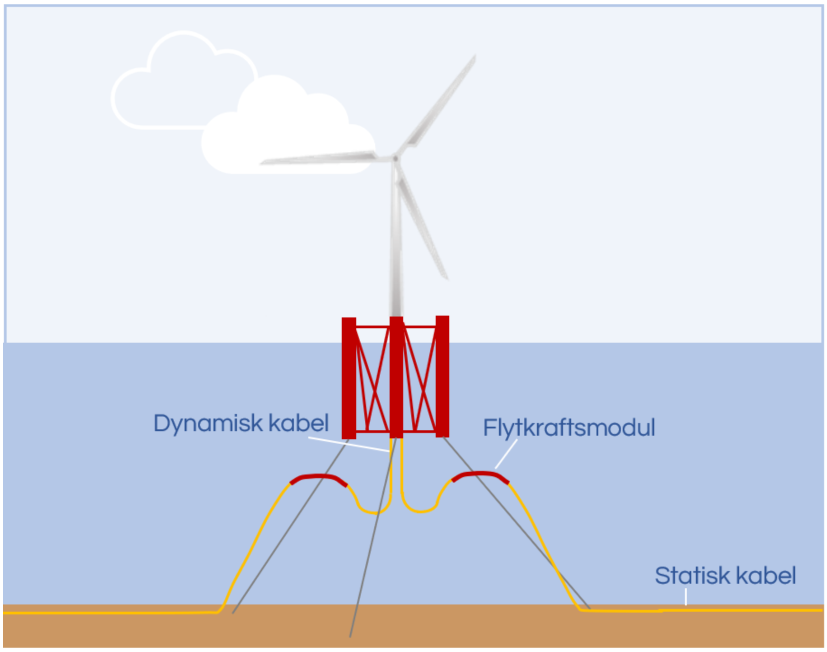


Figure 11. Schematic of the internal cable network. Dynamisk kabel – Dynamic cable; Flytkraftsmodul - buoyancy module; Statisk kabel – Static cable.

3.3.2 Substation

A substation tower with transformer room is built on the foundation for the substation. Within the transformer room the voltage from the wind farm is increased before it is transmitted via the export cable. This reduces power loss to the transmission grid. The number of OSS and their placement depends on the final placement of the export cable. The export cable's exact route has not yet been determined.

Depending on the actual depth of the location of the substation, it may be appropriate to anchor with either so-called jacket-foundations, see Figure 12, or floating foundations with anchoring, see Chapter 3.2. However, other types of foundation may also be appropriate.

Jacket foundations consist of a stable truss structure of steel tubes/beams anchored to the base. This construction is suitable for deeper waters and high loads.

Jacket foundations are secured to the base with either so-called suction buckets or smaller steel pipes which are bored or piled into the seabed. Suction buckets are steel or concrete cylinders which use a vacuum to suction to the seabed. Some preparation of the seabed may be needed for the installation of substations. Large rocks may need to be moved and depending on the choice of anchoring methods, the seabed may need levelling. The final choice of technology will depend on the seabed situation on site. Erosion protection is usually laid around the foundation consisting of a lower layer of gravel and upper layer of stones of various sizes.

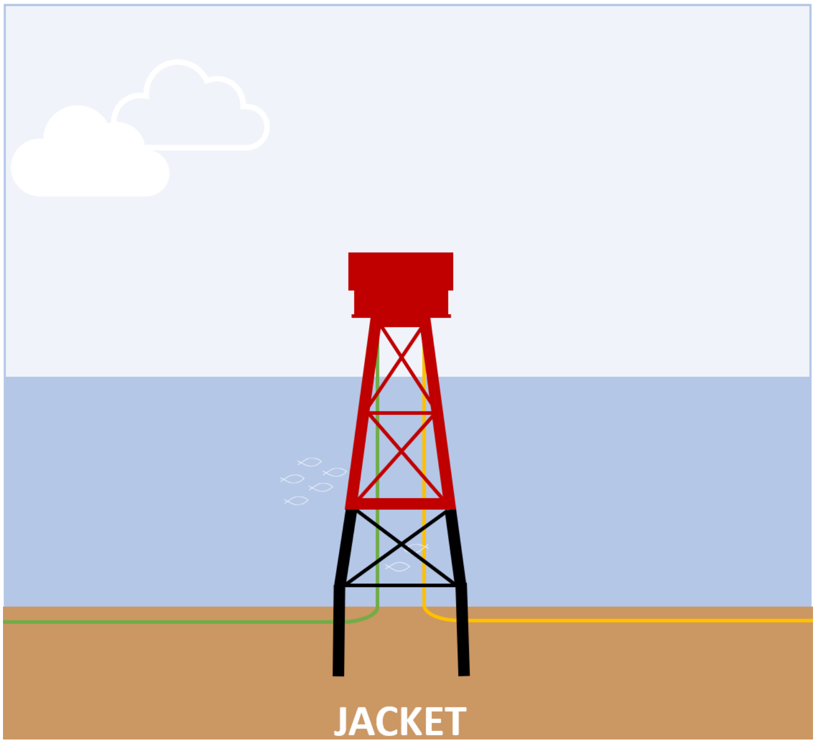


Figure 12. Schematic of a jacket foundation.

3.3.3 Export cables

The electricity produced by a wind farm is transmitted via OSSs to the transmission grid or regional grid. An export cable (marine cable) will be laid either to land on Gotland or to the Swedish mainland, or to one of the offshore connection points proposed by Svenska kraftnät at the boundary or territorial waters and the SEZ.

Should the applicant intend to lay a marine cable towards land, this will be constructed all the way to the beach from the SEZ via territorial waters. At the shoreline, the marine cable will be coupled with a land cable which will continue further to a suitable connection point to the Swedish transmission grid or regional network on land.

As with the internal cable network, the export cable must be protected from damage either by burying in trenches or covering with blocks, depending on the seabed conditions.

The exact route and size of the cable will be determined later in the design process, where conflicting interests and technical conditions will be taken into account.

3.3.4 Site for connection to national grid.

On 1st January 2022, the government asked Svenska kraftnät to evaluate how Svenska kraftnät could extend the transmission network to areas within Sweden marine territory where there is potential to connect several power generation plants. Report published 15th June 2022. Grid development will support Sweden to achieve its renewable energy production targets. The government considers that offshore electricity production has the potential to contribute to achieving the target for renewable electricity production by 2040, partly by meeting increased demand for electricity in the future. The government further considers that it is important that the development of offshore wind power occurs in such a way as to ensure the greatest possible benefit as cost effectively as possible and that offshore wind is able to contribute large volumes of electricity and high efficiency.

Svenska kraftnät has proposed that the expansion of the grid within Sweden's sea territory be organised in calls for tenders for offshore connection points on the border between territorial waters and the SEZ. The first round includes a total of six prioritised areas of water for expanding the network: Skåne's south coast, Halland coast, the southeast Baltic Sea, the north Western Sea, the south Bothnian Sea and the Gulf of Bothnia(SvK, 2022).

In terms of Skidbladner, the onshore connection point for the southeast Baltic Sea is probably not the most cost-effective solution and the project will therefore confirm the connection point later in the development phase when Svenska Kraftnät announces new proposed connection points in 2025.

3.4 Facility

The wind farm facility consists of different phases, the first of which is to prepare the site. This includes preparation of the seabed, pre-installation of electricity cables and anchoring systems.

Since the farm will be installed with floating foundations, the installation process will be somewhat different from solid foundations. The majority of the floating foundations on the market currently can be constructed in harbour and then towed out to site to be moored to the pre-installed anchors and cables. However, the development of offshore construction vessels is progressing, which may change how the process looks in the future.

3.5 Operation

Operation of the wind farm and monitoring of OSSs takes place remotely via an operation centre. Regular maintenance and repairs will need to be carried out during operational times and will involve transporting materials and staff on a service vessel or helicopter. The operation and service centre will be sited onshore near to the wind farm. Floating foundations have the advantage that they can be towed to harbour for repair and maintenance.

3.6 Decommissioning

The lifetime of wind farms is currently expected to be between 30 - 35 years after commissioning. Following that, the farm will be decommissioned and dismantled in the reverse order to installation. That means that the wind farm will be decoupled from cables and moorings and then towed to harbour for dismantling. In the event that removal of parts of the wind farm and cables creates a greater environmental impact than leaving them in situ, then leaving them in situ will be preferred. The dismantling and recovery plan will be developed in consultation with the supervisory authority.

4 AREA DESCRIPTION

The following chapter describes the area intended for the planned Skidbladner wind farm.

4.1 Wind resources

Wind conditions for the project area have been initially evaluated using available wind data from Global Wind Atlas(Global Wind Atlas, u.d.) and a wind rose produced with available wind data (ERA5). At 150 meters above sea level, average wind speeds are between 9.6m/s and 9.7m/s in the project area (Global Wind Atlas, u.d.). Prevailing winds are south westerly, see Figure 13.

Before the final design of the wind power development is determined, wind measurements will be taken in the area which will form the basis of the final design of the wind farm.

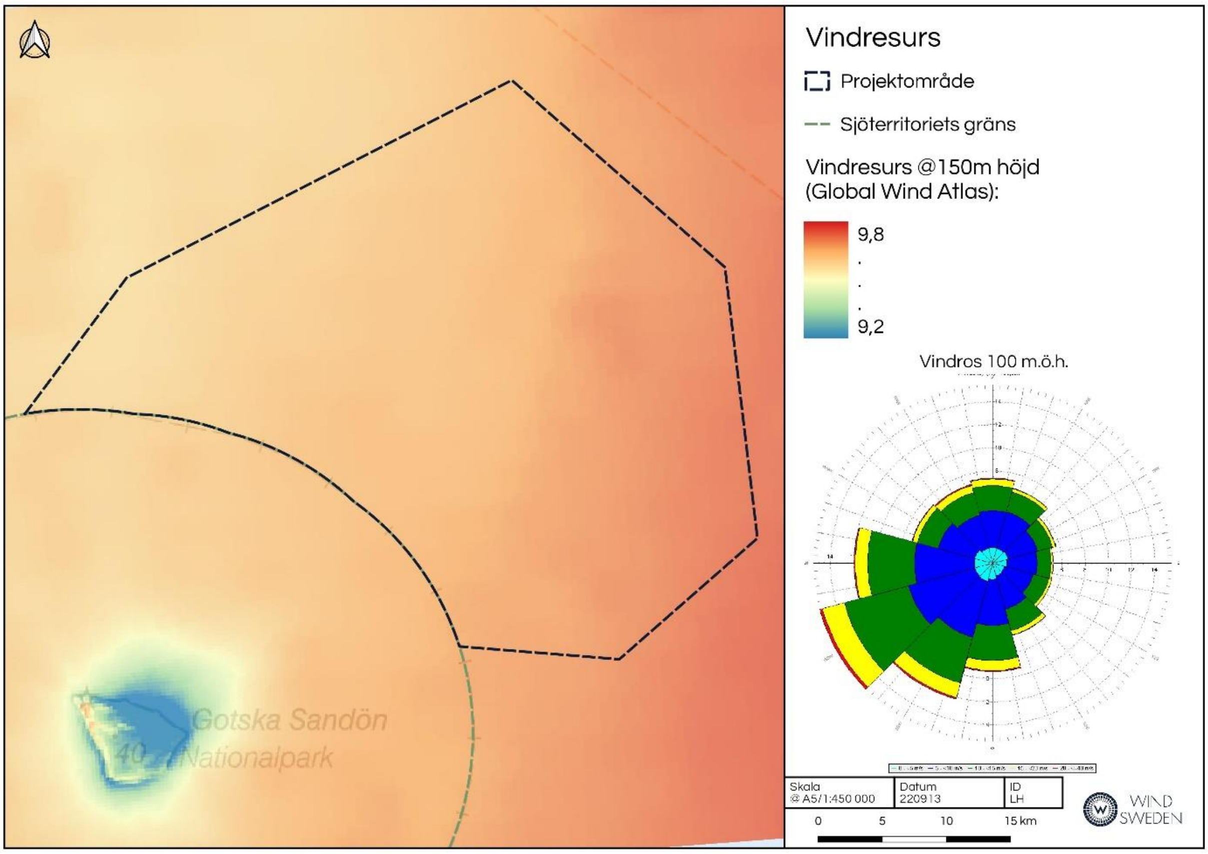


Figure 13. Overview of the wind resources for the project area at 150m above sea level and the prevailing wind direction at 100 metres above sea level (Global Wind Atlas.). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders.

4.2 Planning conditions

This chapter describes the planning conditions which influence the project area.

4.2.1 National maritime plan

Swedish Agency for Marine and Water Management have produced three different marine plans, one for the Gulf of Bothnian, one for the Baltic Sea and one for the Western Sea, which contribute to a long-term sustainable development. The marine plan is not binding but is intended to be guidance around how the ocean can be used in the best way and act as a guide for national authorities, municipalities and courts in the coming decisions, planning and authorisation process. This will also contribute to creating the conditions for Sweden's future need to generate renewable energy including the expansion of wind power.

In the plans, relatively few areas for energy generation from wind power have been identified which are not considered sufficient to achieve the national target. However, the permit application to develop wind power was made in areas which were not identified specifically for that purpose.

The Swedish Energy Agency considers that at least 100 TWh renewable electricity production must be installed in Sweden by 2040-2045 in order to be able to achieve the goal of 100% renewable electricity production. The Agency expects the offshore plan to allow for about 50 TWh of offshore wind power. The areas identified for energy generation in the marine plan, however, only enable a total of between 23 TWh and 31 TWh of annual electricity production possible, depending on what proportion of the areas can be used, considering other interests. Therefore, the Swedish Energy Agency together with other affected agencies was tasked with highlighting further suitable areas to enable a further 90 TWh offshore electricity production. This will be reported on by March 2023 and the then the proposal will, if possible, be worked into the maritime plan and the Maritime and Water Agency will report their recommendations to the government by December 2024 (Energimyndigheten, 2022).

According to the zoning of the marine plan, the planed wind power development, Skidbladner, is located within the Baltic Sea area. Within this area there are good technical conditions for offshore energy generation. However, high natural values have been identified in the marine plan are which may affect future wind power installations. Establishing wind power in this area will be subject to Natura 2000 requirements. Within the marine plan area, there are also extensive defensive interests which mean that wind power is not suitable in several areas according to the Maritime and Water Agency's evaluation. In the overall assessment for wind power in the Baltic Sea marine plan, these parameters have been taken into account as well as negative effects on long-tailed duck populations.

The project area for Skidbladner is located in both the area of the North Baltic Sea and South Kvarken as well as the Central Baltic Sea, see Figure 14. In the North Baltic Sea and South Kvarken the demand for electricity is considered to be high largely due to the Mälardalen region and there are two areas identified of significant importance for exergy extraction in the public interest. One is off of Svenska Björn and the other, for floating wind power, northeast of Kopparstenarna, which also partly lies in the Skidbladner project area, see Figure 15. Currently, these areas are not considered to be compatible with the national interest for defence and the areas are therefore not identified in the maritime plan. In the Central Baltic Sea, there are no areas identified for energy extraction and those identified in the east Gotland archipelago are not compatible with the national interest for defence (Havs- och vattenmyndigheten, 2022a).

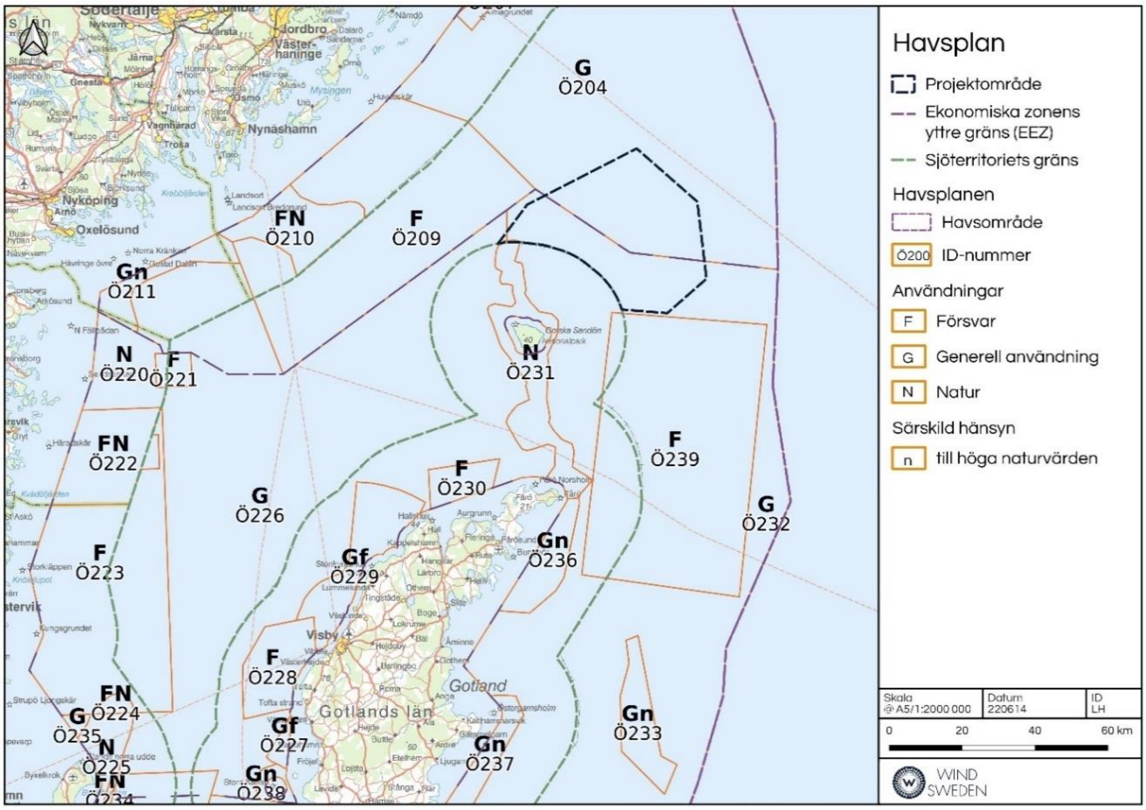


Figure 14. The national maritime plan showing the areas impacting the Skidbladner project area (Maritime and Water Agency, 2022e). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Havsplanen – Maritime plan; Havsområde – Sea area; ID-nummer – ID number; Anvädningar – Uses; Försvar – National Defence; Generel användning – General uses; Natur – Nature; Särskild hänsyn till höga naturvärden – Significant importance for nature.

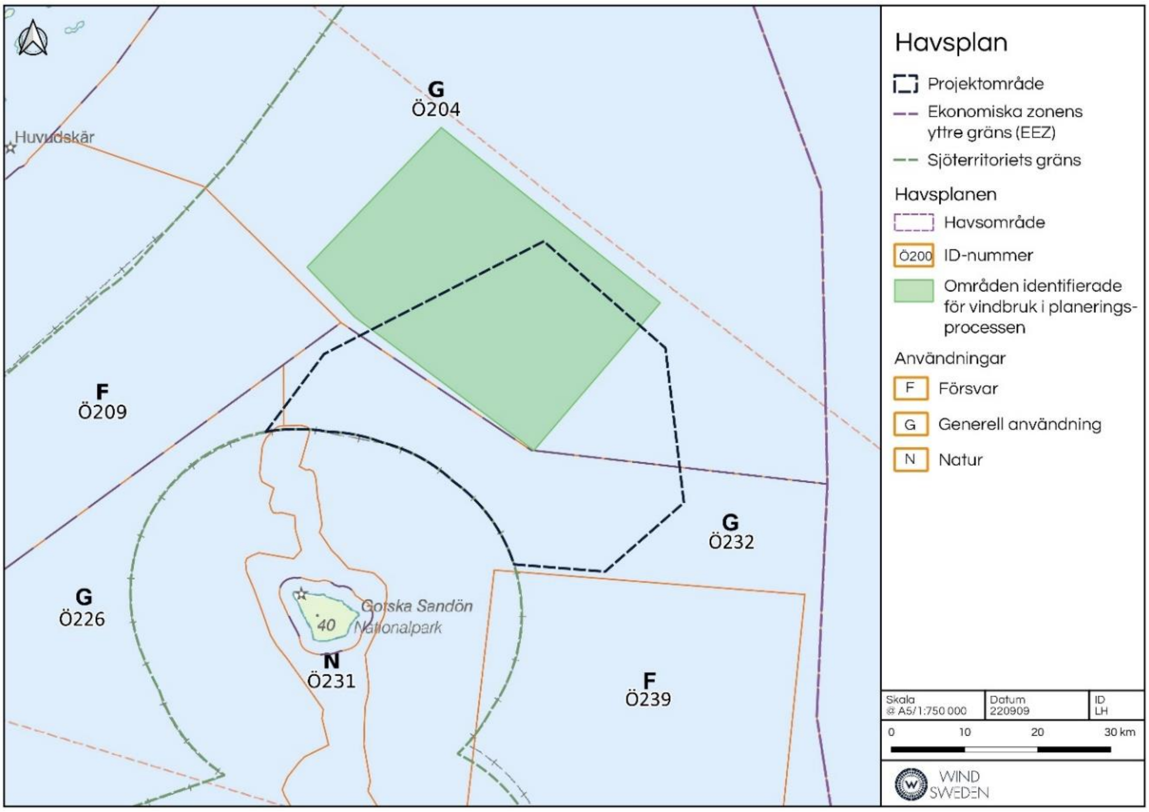


Figure 15. Area identified for wind farm (floating foundations) in the planning process for the national maritime plan (Maritime and Water Agency, 2022d). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Havsplanen – Maritime plan; Havsområde – Sea area; ID-nummer – ID number; Områden identifierade för vindbruk I planeringsprocessen – Areas identified of significant importance for exergy extraction in the public interest; Anvädningar – Uses; Försvar – National Defence; Generel användning – General uses; Natur – Nature; Särskild hänsyn till höga naturvärden – Significant importance for nature.

A run-through of the various areas follows in order to clarify which interests are considered important in the area of the marine plan where the project area is located.

Area **G** Ö204

Within area Ö204 there are two areas identified of significant importance for energy extraction in the public interest as named previously. In the western part there are also areas of cultural and historical value identified by the National Heritage Board that extend into the maritime plan area which require special consideration of their high cultural value. In the northern part of Ö204 a marine national park is planned in the Nämndö archipelago. There are several areas for shipping within the area that are part of the wider Baltic Sea traffic system, see Figure 23. In summary, area Ö204is identified for general use and shipping with special consideration to high cultural heritage value(Havs- och vattenmyndigheten, 2022a).

Area **G** Ö232

Area Ö232 is one of several areas that provide shipping in several shipping lanes in the Central Baltic Sea . A shipping lane from the Bay of Riga connecting to the deep shipping lane east of Gotland lies within Ö232 and has been identified as of significant importance to the public interest, see shipping lanes in Figure 23. In summary, in addition to the above, Ö232 is designated for general use, shipping, shipping survey area and commercial fishing. For area Ö232, no special consideration or priority or special adaptation for coexistence is indicated(Havs- och vattenmyndigheten, 2022a).

Area **G** Ö226

The tip of the eastern part of the Skidbladner project area lies within area Ö226 which is identified for general use, recreation, shipping, shipping survey area and commercial fishing. Should energy extraction and defence be in conflict, defence is judged to take precedence (Havs- och vattenmyndigheten, 2022a).

Area **N** Ö231

The part of area Ö231which passes the territorial border in the northern part is included in the Skidbladner project area. Area Ö231 is covered by several different natural protections such as Natura 2000 and marine protected areas (MPA) (HELCOM). However, neither Natura 2000 or the MPA go over the territorial border into the project area, only the national interest for natural value does that according to Chapter 3 Environmental Code. In addition to the identified use of nature in the area, it is also identified as a survey area for shipping and commercial fishing. No preference or special adaptation for coexistence is identified for the area (Havs- och vattenmyndigheten, 2022a).

4.2.2 HELCOM, Baltic Sea Action Plan

To protect the Baltic Sea's marine environment, the countries with a Baltic coastline have a shared agreement. Work to improve the Baltic Sea's condition is organised by HELCOM, which consists of representatives from the different countries which are signatories to the Helsinki Convention. This convention is a regional environmental convention which addresses issues such as eutrophication, the spread of environmentally hazardous substances and the protection and conservation of marine biodiversity(Havs- och vattenmyndigheten, u.d.).

HELCOM's work is directed by the Baltic Sea Action Plan (BSAP) which is a programme put forward by representatives within the convention, to restore the good ecological status of the Baltic Sea's marine environment(WISE Marine, u.d.).

In the latest BSAP from 2021, it was raised that HELCOM sees the need to develop offshore wind to be able to achieve the climate goals for 2030 and 2050. They also establish that steps should be taken to expand sustainable with respect for their commitments to biodiversity and a healthy marine environment (HELCOM, 2021).

4.2.3 Marine environmental management and environmental quality standards

The Marine Environment Directive was adopted by the EU in 2008 and into Swedish law in 2010 via the Marine Environment Regulation, which follows the content of the EU Directive. The Marine Environment Directive aims to achieve or maintain a good environmental status in Europe's waters and the directive was introduced into Swedish law through Chapter 5 of the Environmental Code and in the Marine Environment Regulation (2010:1341) and the Marine and Water Agency's regulations HVMFS 2012:18. The Marine Environment Regulation states that marine environmental management shall ensure that good environmental status is maintained or achieved in the North Sea and Baltic Sea. The management includes developing environmental quality standards (EQS) with various indicators to assess whether good environmental status is being maintained or achieved, developing and implementing a programme to monitor compliance with the EQS and describing the measures to be taken to maintain or achieve a good environmental status. 11 Swedish EQS have been determined as a tool to achieve good environmental status.

EQS are provisions for the quality of water, land, air or environment in general which are regulated by the environmental code. The standards should protect human health and the environment. There are currently EQS for noise, air and water. The standards can be designed in different ways. Some provide clear limits while others represent target standards to work towards.

EQS for water includes lakes, rivers, coastal waters and ground water. An environmental quality standard for water describes the quality a body of water should have achieved by a certain point in time. The main rule is that all bodies of water should achieved that which the water agency calls good status (Vattenmyndigheterna, 2022).

All sea water from the coast to the outer limit of Sweden's economic zone fall under the EQS for sea quality. The current project area for the Skidbladner wind farm lies in the Baltic Sea proper, in the basin of the north Gotland Sea outer waters(Havs- och vattenmyndigheten, 2019a). The current project area lies outside of territorial waters, directly adjacent to the border which means that the project may have some impact on the EQS for territorial waters. This will be further investigated in forthcoming EQS following surveys and modelling.

Good environmental status

Good environmental status is the desired condition in the environment and serves as an overarching environmental quality standard for the Baltic Sea. The parameters involved in maintaining or achieving good environmental status in the sea are physical and chemical conditions, habitats and biological conditions. Pressures can include physical disturbance, introduction of nutrients and organic matter, introduction of hazardous substances and biological disturbance.

The description of good environmental status is divided into 11 themed area, descriptors, see Table 8, and are found in Annex 2 of the Marine and Water Agency's regulations (HVMFS) 2012:18 (Havs- och vattenmyndigheten, 2012). Each descriptor is then divided into one or more criteria based on the description of what conditions constitute good environmental status within that descriptor. In turn, each criterion has indicators which are the parameters for measurement/investigation by the environmental monitoring in order to determine whether the conditions in the criterion are met (Havs- och vattenmyndigheten, 2022b).

Table 8. Good environmental status 11 themes (Havs- och vattenmyndigheten, 2022b).

Themes
1. Biodiversity 2. Non-native species 3. Commercially beneficial fish and shellfish 4. Marine food webs 5. Eutrophication 6. Integrity of the seabed 7. Existing changes in hydrographic conditions 8. Concentrations and effects of hazardous substances 9. Hazardous substances in fish and other marine life 10. Marine debris 11. Underwater noise

The themes which are considered to potentially impact the planned wind farm are:

- Biodiversity
- Integrity of the seabed
- Underwater noise

Each theme in turn has indicators which are measured and investigated in the environmental monitoring programme. Eutrophication, hazardous substances, marine debris, noise, physical loss and physical disturbance to habitats, fish including by-catch and non-native species.

What impact development of an offshore wind farm can have and the scope of the impact will be investigated in the forthcoming EQS.

4.3 Overview of nearby wind farm developments

Where there are nearby wind farms, so-called cumulative effects can occur. Table 9below lists the off-shore wind power developments which are current being processed by the reviewing authorities. Figure 16shows an overview of the surrounding wind power developments which have been built, received authorisation/permits to build or are under consideration.

All the wind turbines constructed in the vicinity of the Skidbladner wind farm are onshore.

Table 9. Summary of nearby planned offshore wind power developments within 50 km of the offshore project area. Distance is from the outer limit of the Skidbladner project area.

Name	Distance	Operators	Status
Baltic Offshore Epsilon	0 km	Njordr Offshore Wind AB	Managed by
Erik Segersäll Vindpark	0 km	Deep Wind Offshore DWO Sverige AB	Managed by
Baltic Offshore Delta	8 km	Njordr Offshore Wind AB	Managed by
Baltic Offshore Alpha	39 km	Njordr Offshore Wind AB	Managed by

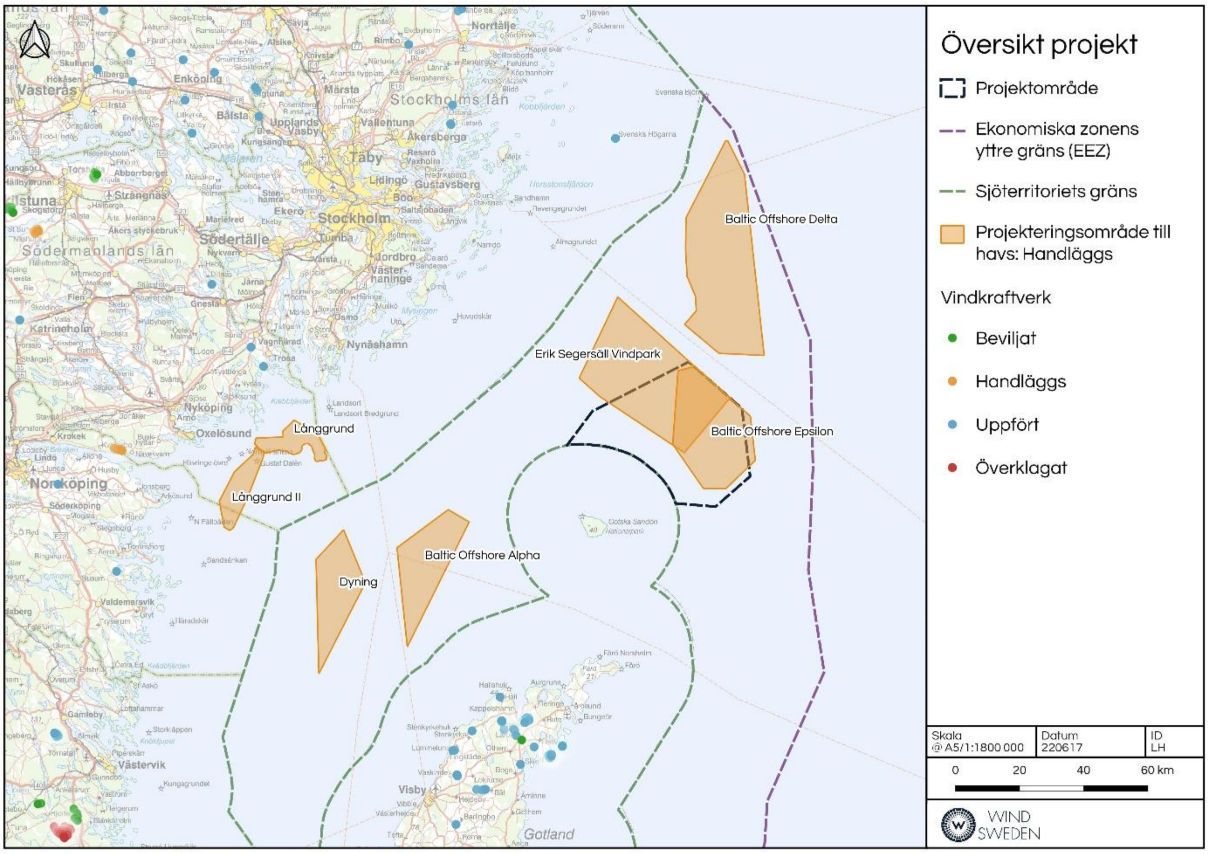


Figure 16. Overview of the nearby wind power developments (Vindbrukskollen). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Vinkraftverk – Farma wiatrowa; Beviljat – Permit approved; Handläggs – Permit in the process; Uppfört – Permit being submitted; Överklagat – Permit appealed.

4.4 Existing cables and lines

Along the Baltic seabed there are several different cables and lines for telecommunications, electricity transmission and gas. Those lying close to the project areas are the gas lines Nord Stream 1 and 2 between Russia and Germany, see Figure 17. Nord Stream 2 which is under construction borders the outer project area which will be considered in the process. In addition, there is a fibre cable, called C-Lion1, located approx. 500m east of the project area's limit, but otherwise there are no further cables or lines within or adjacent to the project area other than those known from available material.

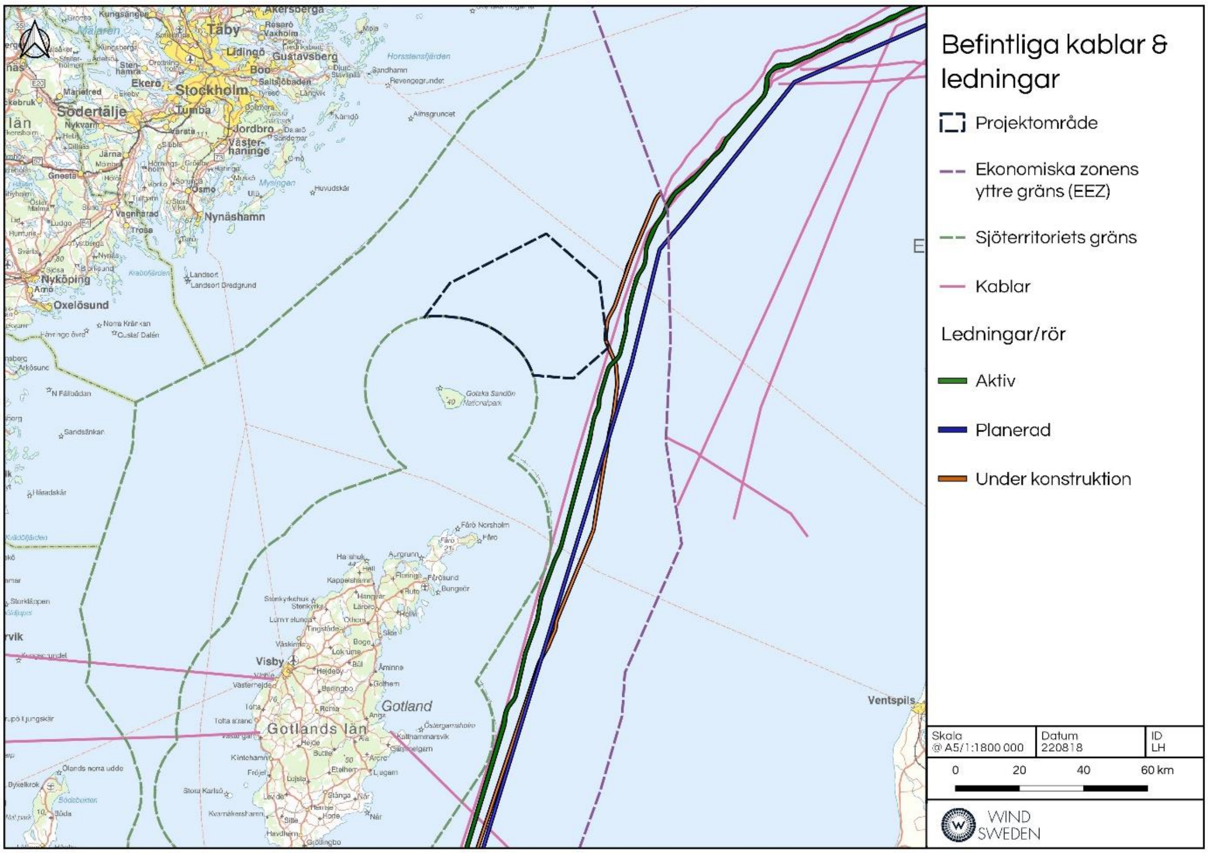


Figure 17. Existing cables and lines/pipes in the vicinity of the project area (EMODnet, 2022a) & (HELCOM, 2018). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Kablar – Cables; Ledningar/rör – Pipelines-, Aktiv – Active; Planerad – Planned; Under konstruktion – Under construction.

4.5 Depth and marine geology

The ocean depth in the project area varies and lies between 14 m and 197 m, see Figure 18. Since the depth in the project area is over 60m, it is well-suited to a development of a wind farm with floating foundations. Approx 0.6% of the project area has a depth shallower than 30 m.

The geology of the area consists predominantly of hard clay and mud. For part of the project area there is also data on the dominant material for the upper metres from the Geological Survey of Sweden, which can be seen in Figure 19. From this it can be deduced that there are mainly postglacial clays, muddy clays and clay muds as well as glacial clays. In places there are also areas of moraine, postglacial silt and postglacial sand and gravel.

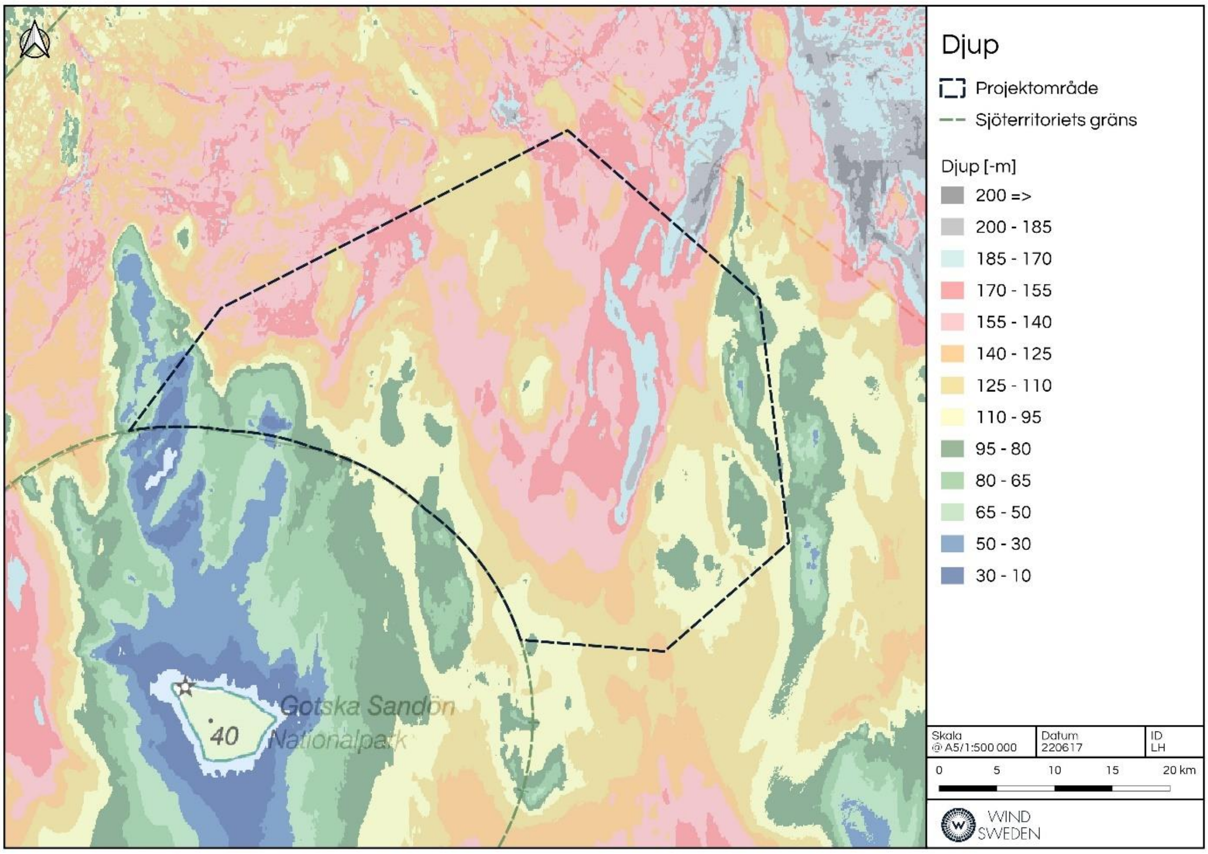


Figure 18. Depth conditions within and around the project area (EMODnet). Projektområde – Project area; Sjöterritoriets gräns – Territorial waters boarders.

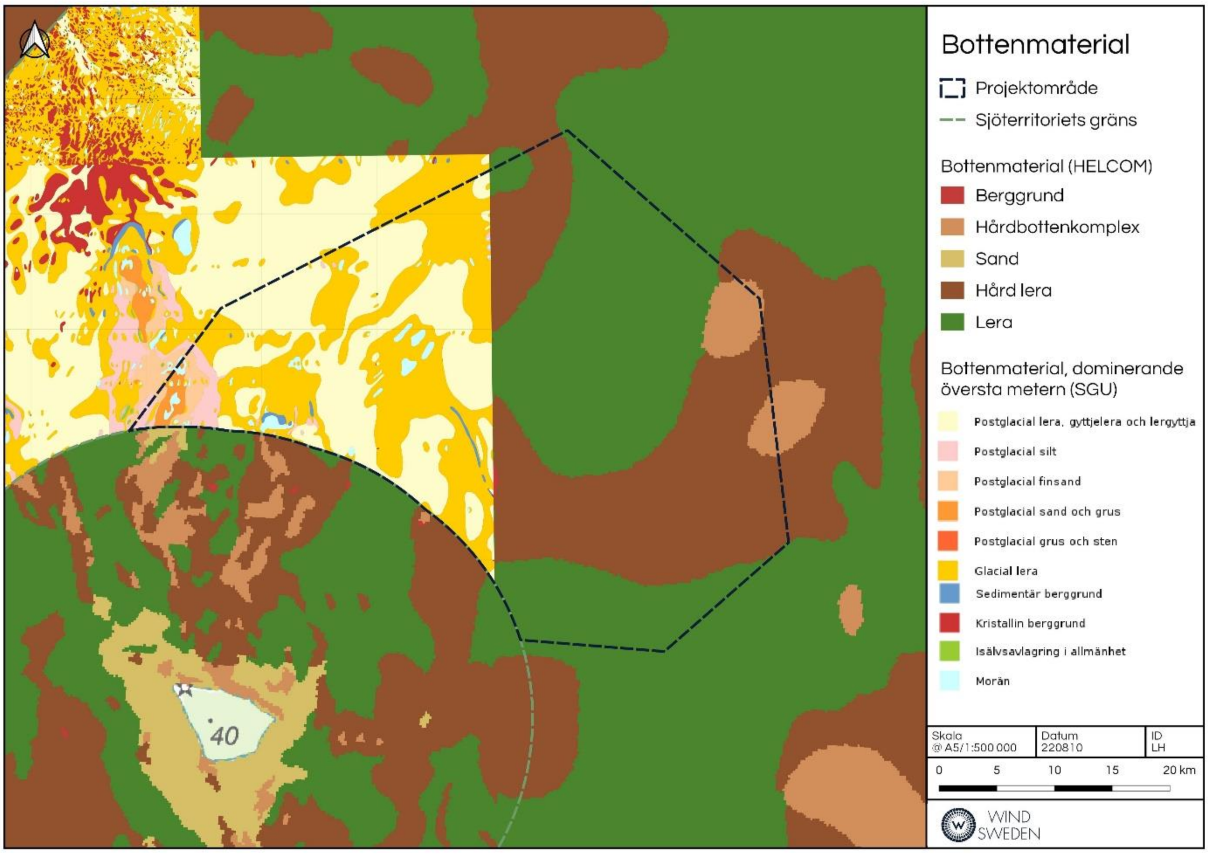


Figure 19. Overview of the seabed material within the project area for Skidbladner (HELCOM 2008a & SGU). Projektområde – Project area; Sjöterritoriets gräns – Territorial waters boarders; Berggrund – Bedrock; Hårdbottenkomplex – Mixed hard bottom; Sand – Sand; Hård lera – Hard clay; Lera – Clay; Postglacial lera – Postglacial clay; Postglacial silt – Postglacial silt; Postglacial finsand – Postglacial fine sand; Postglacial sand och grus – Postglacial sand and gravel; Postglacial grus och sten – Postglacial gravel and stones; Glacial lera – Glacial clay; Sedimentär berggrund – Sedimentary bedrock; Kristallin berggrund - Crystalline bedrock; Isälvsavlagring i allmänhet – Glacial desposition; Morän - Moraine.

4.6 Oceanographic parameters

The Baltic Sea is a semi-enclosed sea surrounded by nine countries with limited flow to the ocean. Water circulation is dominated by salinity and temperature difference rather than by winds. Surface water salinity, halocline strength [3] and surface water temperature decrease to the north where the impact of winter ice cover increases. Due to the shallow thresholds in the Baltic Sea, the turnover time of the water is around 30 years in the southern Baltic Sea and 40 years in the northern part. This means that the Baltic Sea is heavily affected by drainage from the surrounding land masses (Snoeijs-Leijonmalm, Schubert, & Radziejewska, 2017).

4.6.1 Currents & salinity

Ocean currents are created by differences in water levels, salinity and temperature, the moon and sun’s gravitational pull as well as winds. In addition, currents are also influenced by coastlines, seabed topography, the earth’s rotation and friction between bodies of water and the seabed. Sea water is always moving and the greatest movements occur horizontally while vertical movements are smaller due to density stratification(SMHI, 2011).

[3] The divide between two bodies of water with different salinities. Also known as the saltier layer.

Salinity in the Baltic Sea is heavily impacted by the drainage of fresh water from the surrounding land masses. The average salinity in the Baltic Sea is 7g salt per kg water, which can be compared to the average salinity of sea water of 35g. Salinity reduces northwards with around 20g per kg water in the south and 2g in the Gulf of Bothnia. The location of the project area for Skidbladner has salinity of around 6 g per kg water (Östersjön.fi, u.d.).

In the Baltic Sea there is no strong permanent system of currents, so it is mainly locally produced currents as a result of wind and other factors which can have an impact on the proposed wind power development. The fresh water which drains into the sea lies in a thin layer and moves over the heavier salt water turning to the right due to the earth's rotation. Gradually, the fresh water mixes with sea water, creating a large-scale coastal current which slowly moves southwards along the coast(SMHI, 2021).

Inflow into the Baltic Sea comes from Skagerrak and Kattegatt. The inflow consists of salty and oxygen-rich water which affects the oxygen conditions in the Baltic Sea. Since the incoming water has a higher salinity, it settles underneath the fresh water. Water is distributed by seabed currents in the Baltic Sea to the east and north, where salinity decreases over time as a result of mixing with the existing water, see Figure 20. This process heavily influences the ecosystem in the Baltic Sea (SMHI, 2012).

The nearest measuring station to the project area for oceanographic parameters is Huvudskär Ost Buoy which is located to the north of the project area. From open data, the 2m depth average current speed is calculated at 10.8cm/s between May 2001 and May 2021. At 40 m depth the average speed was 20.5cm/s and at 90 m depth the average speed was 10.6 cm/s during the same period(SMHI, u.d.).

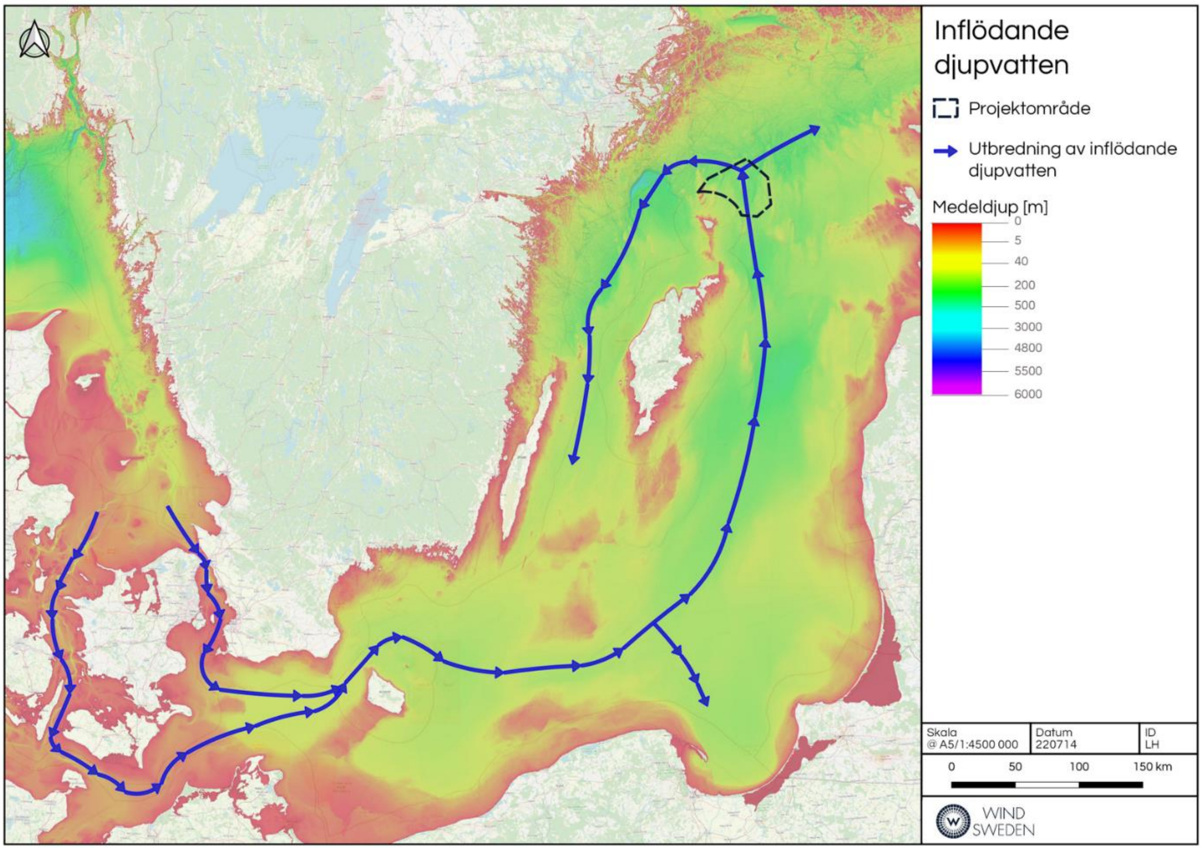


Figure 20. Schematic of the spread of inflowing deep water into the Baltic Sea (SMHI, 2012). Projektområde – Project area; Utbredning av inflödande djupvatten – Inflow of the water.

4.6.2 Depth of visibility

Data recorded between 2010–2021 from measuring station BY29/LL19, located inside the project area, shows that the depth of visibility [4]varies during and across years between 3-18m. This means that there is limited depth of visibility in large parts of the project area(SMHI, 2022b). The greater the depth of visibility, the deeper sunlight penetrates.

4.6.3 Oxygen-free seabeds

Oxygen is required for more life to thrive in the sea. Surface water is oxygenated through plant photosynthesis and exchange with the atmosphere. To oxygenate the deeper water, either a vertical mixing with the oxygen-rich surface water is needed or oxygen-rich water is added horizontally. In the Baltic Sea proper, there is stratification of the bodies of water due to the varying salinities, saltier water deeper and fresh water closest to the surface which make vertical mixing difficult. In addition, there are several deep wells in the Baltic Sea which light doesn't penetrate and where salty water gathers. In these environments it is too dark for plants and no photosynthesis can occur so the oxygen which is present is consumed by the decomposition of organic matter. This leads to the formation of oxygen-free or oxygen-poor seabeds. Oxygen-free seabeds are a widespread problem in the Baltic Sea proper and it is calculated that at depths below 80 m no life exists on the beds seeFigure 21 (Havet.nu, u.d.)

From measuring station Huvudskär Ost Buoy, the average oxygen content was calculated at 0.16m/l at 90 m depth and 13.61 ml/l at 1 m depth during the period from May 2013 to May 2021. (SMHI, u.d.).

The project area consists of 90% oxygen-free seabeds.

[4] A measure of the water transparency.

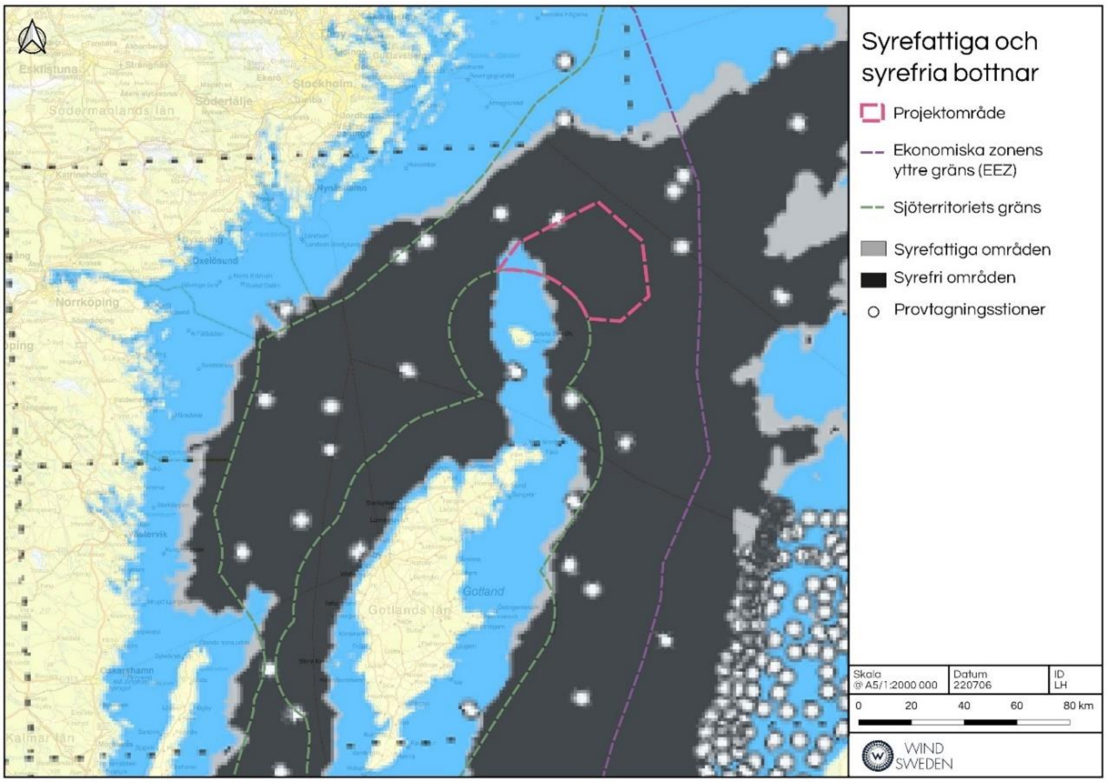


Figure 21. Map of oxygen situation in the Baltic Sea deep water. Black areas show oxygen-free seabeds. Map based on data from 2021(Sveriges miljömål, 2021) Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders.

4.6.4 Waves

One measure used to report the height of waves is the significant wave height. This parameter is determined from all waves during a 30-minute period from which the average height of the highest third of waves in the interval is calculated. This definition corresponds with what a sailor would observe when assessing the height of waves (SMHI, 2022a). From the Huvudskär Ost Buoy measuring station, the average value for significant wave height for the period from May 2001 to May 2021 was 0.95m. The average maximum wave height for the same period was 1.52 m with the max value during the same period being 9.2m(SMHI, u.d.).

4.6.5 Ice

The Baltic Sea usually starts to freeze in November in the Gulf of Bothnia and the inner Gulf of Finland. That is followed by freezing in Kvarken, southern parts of the Gulf of Bothnia and along the coast in the Bothnian Sea. The extent of freezing varies. In a normal winter, the entire Gulf of Bothnia, Kvarken, almost all of the Bothnian Sea, the Archipelago Sea and even some of the Baltic Sea freeze. A mild winter means that the Gulf of Bothnia doesn't freeze at all and the Gulf of Finland only partially (Meteorologiska Institutet , 2022).

As the climate warms up, this leads to less sea ice. More location specific conditions for ice formation around the wind turbine development will be studied further.

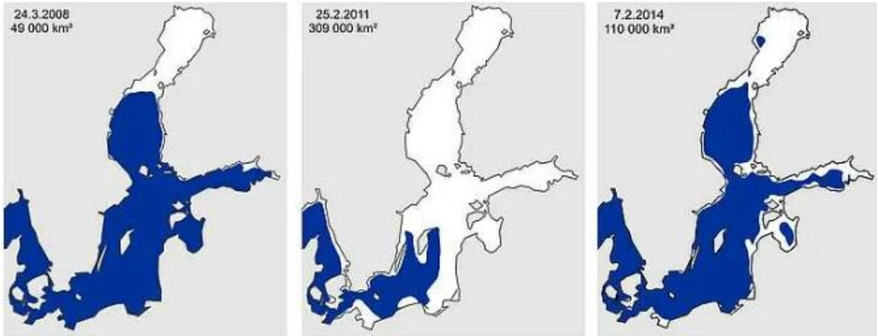


Figure 22. The maximum extent of ice on three different occasions(Meteorologiska Institutet , 2022).

4.7 National Interest

Chapters 3 and 4 of the Environmental Code (EC) set out the provisions for land and water management. With support of Chapter 3 of the Environmental Code, the national authorities highlight areas of national interest such as nature conservation, cultural heritage, energy production and outdoor recreation. National interests under Chapter 4 are written into the Environmental Code directly.

When an area is designated a national interest, it is protected from measures which could seriously damage its purpose or value. The level of protection is regulated by the Environmental Code which is used as guidance in the event of two conflicting interests.

4.7.1 Chapter 3 Environmental Code

The national interests under Chapter 3 EC located in or near to the project area can be seen in Figure 23. The national interest for natural conservation is partly within the project are as it crossed the territorial border by around 500 m and the project area follows the territorial boundary. The national interest for natural conservation consists of a complex ridge formation on the seabed. Marine investigations have determined that this arose as a consequence of the movement of inland ice in the Baltic Sea basin. The area also has a special composition of species and biomasses which are unique to the Baltic Sea(Grönqvist & Martinsson, u.d.).

The project area is also adjacent to the national marine heritage sites of Sankt Olof & Nåttarö, respectively south and north west of the project area. Three adjacent shipping routes are found around the project area. These are described further below under the heading *Shipping routes.*

On the Gotska sandön, approx. 22 km from the project areas limit, there is a national interest for cultural heritage classed as a national interest for the island's history and environment influenced by its isolated position in the middle of the Baltic Sea and which reflects a unique farming environment from Viking times to today(Riksantikvarieämbetet, 2019).

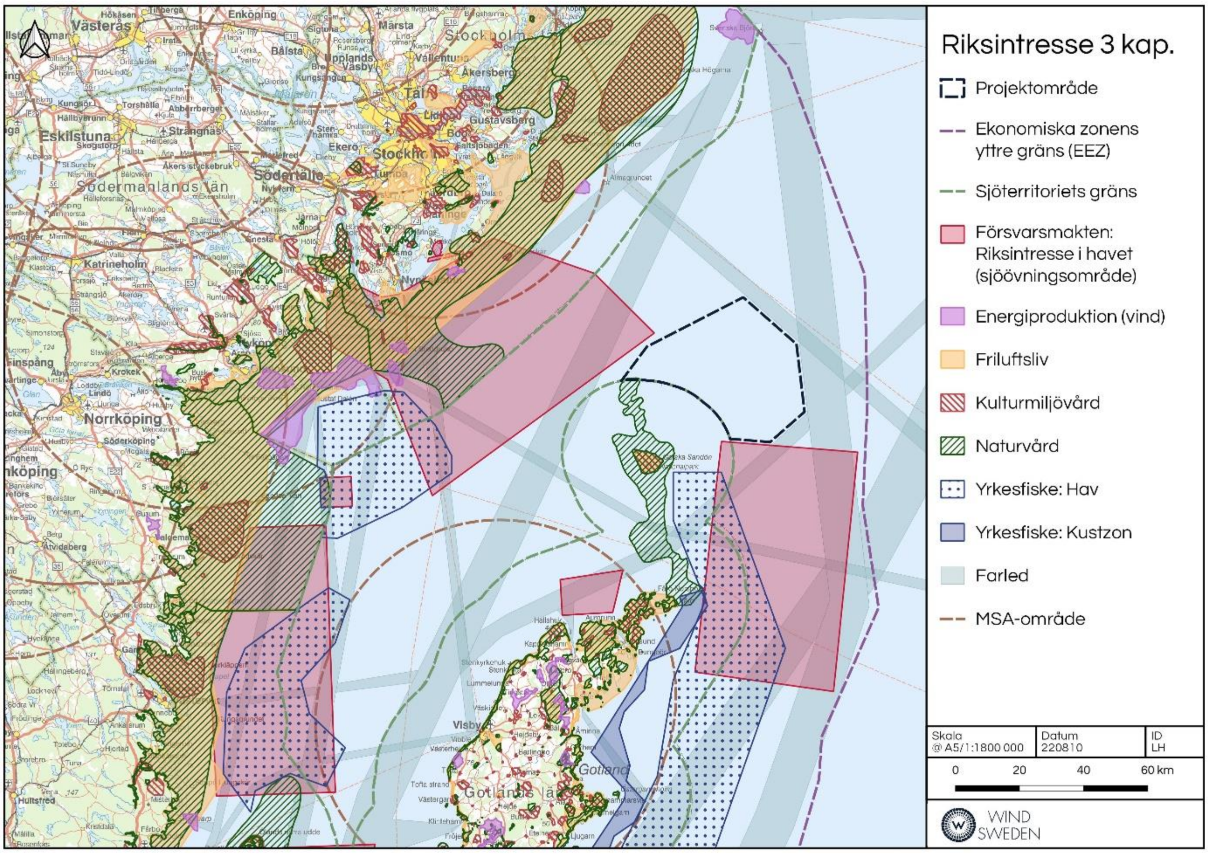


Figure 23. Nearby conflicting interests from Chapter 3 of the Environmental Code. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Försvarsmakten (Sjöövningsområde) – National Defence (Naval exercise area); Energiproduktion (vind) – Energy production (vindfarms); Friluftsliv – Outdoor recreation; Kulturmiljövärd – Cuture heritage protection areas; Naturvård – Nature protection areas; Yrkesfiske: Hav – Commersial fishery, open sea; Yrkesfiske: Kustzon – Commersial fishery, coastline; Farled – Ferry routes; MSA – område –Minimum Safe Altitude area (MSA).

Airports

MSA area (minimum safety altitude) determines the area within which there are determined heights for the highest permitted objects in the area around an airport. In this area, no fixed installations higher than the determined MSA for the area permitted.

Several MSA areas for nearby airports are located west and south of the project area. No MSA areas infringe on the project area.

Shipping routes

The project area is located adjacent to the national interest shipping lane, see Figure 23.

- Bay of Riga - Almagrundet, shipping lane class 0, protected height 65 m, protected depth 19 m
- Gedser – Svenska Björn, shipping lane class 0, protected height 65m, protected depth 19 m
- Stenkyrkehuk - Ristna (Estonia), shipping lane class 0, protected height 65 m, protected depth 19 m
  (Trafikverket, u.d.).

Attention must be paid to existing shipping lanes when locating and designing a wind farm. It is advisable to have a safety distance between the shipping lanes and the nearest wind turbines and any such distance will be determined according to the local conditions. Consultation with the Swedish Maritime Administration will be carried out with the permit application.

According to available material, there are no known lighthouses within the project area. The nearest lighthouse is located on the Gotska Sandön.

The Swedish Maritime Administration will be part of the consultation group for the project.

4.7.2 Chapter 4 Environmental Code

The areas identified as national interests for outdoor recreation are of great importance for people outdoor lives and within these areas, municipalities should consider outdoor recreation in the overview and detailed planning.

The Skidbladner project area is adjacent to the national interest for active outdoor recreation within the territorial waters around Gotland and the Gotska Sandön. This national interests also exists along the mainland coast together with the national interest for highly developed coast in the northern part and unbroken coastline in the southern part, see Figure 24.

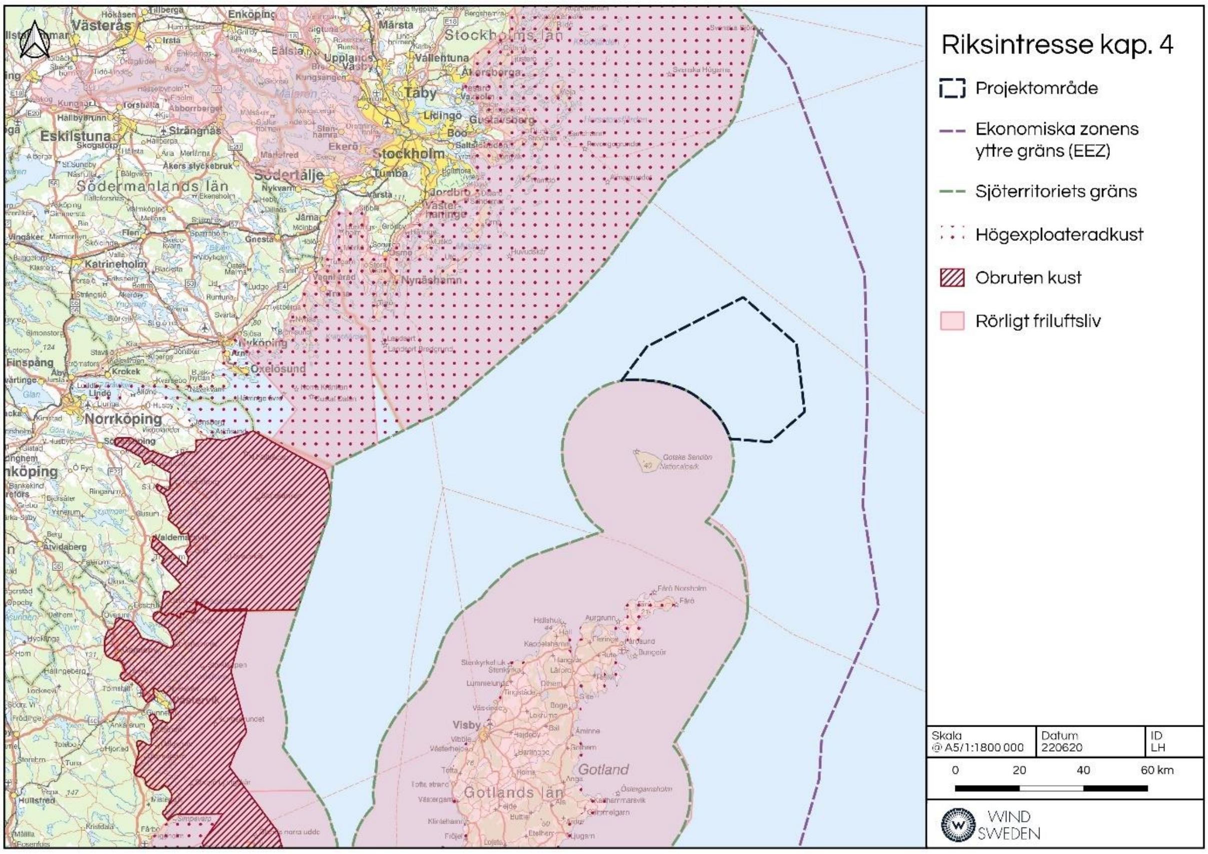


Figure 24. Nearby conflicting interests from Chapter 4 Environmental Code. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Högexploateradkust – Highly exploited coastline; Obruten kust – Unexploited coast; Rörligt friluftsliv – Outdoor recreation area.

4.8 Protected areas

Within the scope of Chapter 7 of the Environmental Code, land and water areas can be protected with different types of designation such as nature reserves, Natura 2000 areas, national parks and specific animal or plant protected areas. The following chapter describe those which lie in the project area for Skidbladner.

4.8.1 Natura 2000

Natura 2000 is a network of protected areas across all of the EU member states. The basis for the network is two EU directives, the Birds Directive and Habitats Directive. Natura 2000 areas contribute to the conservation of biodiversity at an EU level. Natura 2000 areas constitute both protected areas under Chapter 7 of the Environmental Code and national interests under Chapter 4 of the Environmental Code.

Four different Natura 2000 areas have been identified within an area 50km from the project limit. These have been summarised below in Table 10 and a description regarding its natural value follows.

Table 10. Summary of Natura 2000 area within 50km of the project area limit. SCI= Species & habitats directive, SPA= Birds directive

Name	Distance to project area limit	Natura 2000
Gotska Sandön-Salvorev	0 km	SCI
Bullerö-Bytta	49 km	SCI
Fjärdlång	50 km	SCI
Huvudskär	50 km	SCI

Gotska Sandön-Salvorev

Gotska Sandön is located 38 km north of Fårö, 22 km from the limit of the project area and is almost entirely covered by sand with many types of valuable sand environments and special flora and fauna. The island is located at the crest of the 120 km long underwater ridge of moraine, gravel and sand. This stretches from Klint's bank east of Gotland via Salvorev northeast of Fårö up to Kopparstenarna. The climate on the Gotska sandön is different from the mainland. Winters are usually mild, spring comes later, summer is often very hot and dry and autumn is long and mild. In addition, it is very dry on the island with one of the lowest amounts of precipitation in the country with a lot of wind which contributes to the dryness. The insect fauna on the island is of great interest as many species are linked to the sand environment and pine forest. There are also many migrating birds across the island, especially in spring (Länsstyrelsen Gotland, 2018).

The habitats and species protected by the species and habitat directive are:

- Sandbanks
- Reefs
- Baltic Sea sand beaches
- Dunes
- White dunes
- Grey dunes
- Tree-covered dunes
- Dune marshes
- Low grassland
- Leafy meadows
- Grey seals
- Boros schneideri

Bullerö-Bytta

Bullerö-Bytta is a 14,315 ha large Natura 2000 area located approx. 50 km from the limit of the project area for Skidbladner in the Stockholm archipelago. The area consists of four nature reserves of major natural and cultural value both on land and water environments. As the area is largely untouched and has large topographic variation, there are good condition for high biodiversity for animals and plants. Within the area there are also small population of some rare species such as the Barred Warbler and Greater Scaup (Länsstyrelsen Stockholm, 2016a).

The habitats and species protected by the species and habitat directive are:

- Sandbanks
- Lagoons
- Reefs
- Small islands and skerries in the Baltic Sea
- Beach meadows on the Baltic Sea
- Siliceous grassland
- Tree-covered pasture
- Grey seals

Fjärdlång

The Natura 2000 area Fjärdlång lies in Haninge municipality’s archipelago, east of Ornö. The area consists of the large islands Fjärdlång and Ängsön-Marskär, smaller islands, islets and small islands and is a typical example of archipelago nature. The larger islands consist of mostly red and grey gneiss bedrock. There is also an untouched forest on the islands. Mörviken and Marskärsfladen within the project area have been identified as important breeding grounds for pike. One part of the Natura 2000 area, Ängsön-Marskär and surrounding waters, is identified as a bird sanctuary. The reserve’s aim is to conserve vegetation and animal life and the area’s value for outdoor recreation(Länsstyrelsen Stockholm, 2016b).

The habitats and species protected by the species and habitat directive are:

- Sandbanks
- Lagoons
- Reefs
- Small islands and skerries in the Baltic Sea
- Silicate slopes
- Taiga
- Deciduous forest swamp
- Wooded marsh

Huvudskär

The Natura 2000 area Huvudskär is located southeast of north Utö, approx. 10 km southeast of Ornö. This area is an archipelago consisting of around 200 islands and skerries. Vegetation is scant in the area but sometime yellow and white sedum, saxifrage and heart’s ease grow in the shallow rock crevices. There is rich birdlife in the area with many nesting seabirds including ruddy turnstone (red-listed), pomarine jaeger, common ringed plover, common merganser and common redshank(Länsstyrelsen Stockholm, 2016c).

The habitats and species protected by the species and habitat directive are:

- Reefs
- Small islands and skerries in the Baltic Sea
- Northern Crested Newt
- Grey seals

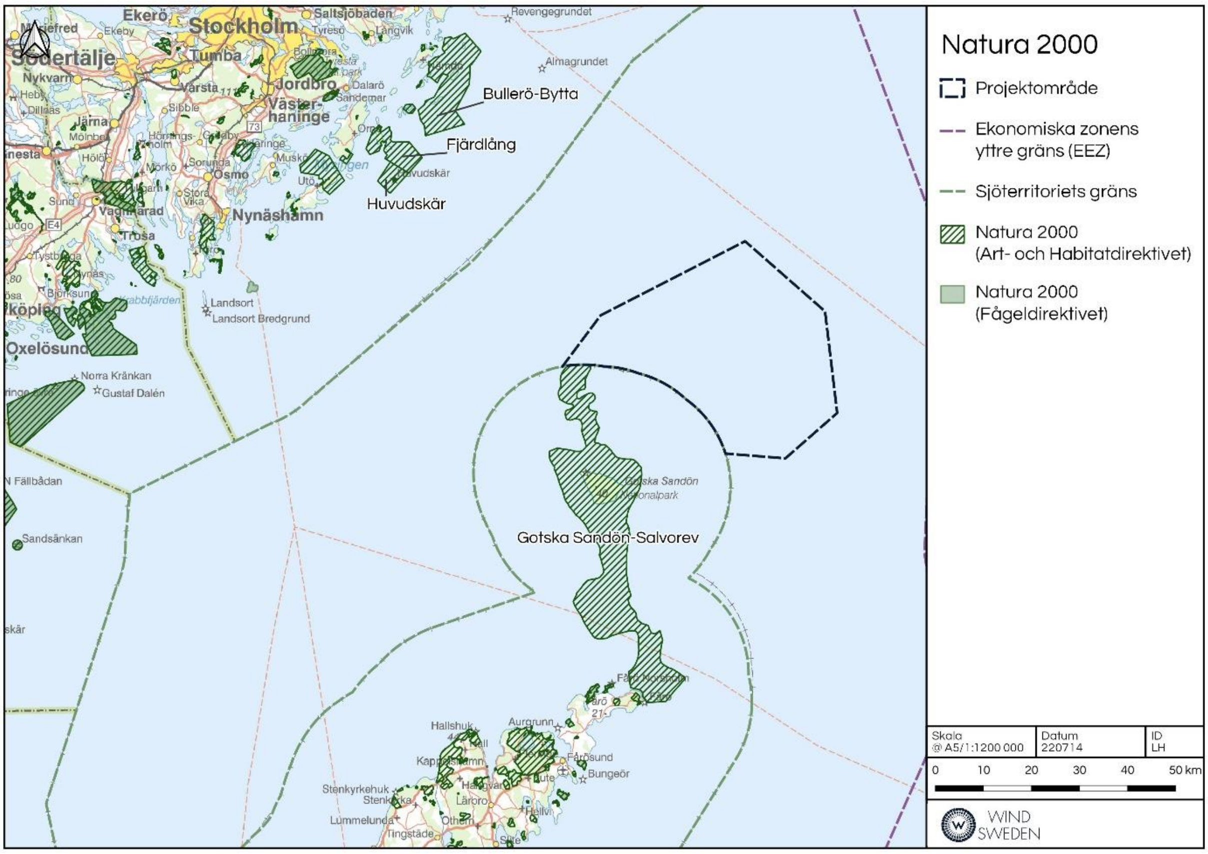


Figure 25. The Natura 2000 areas in the vicinity of Skidbladner. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Natura 2000 (Art- och Habitatdirek-tivet) – Natura 2000 SPI; Natura 2000 SPA.

4.8.2 Other protected areas

Within the project area there are no protected areas as seen in Figure 26.

In addition to the Natura 2000 areas presented in the previous Chapter, the project area is also adjacent to a nature reserve identified by HELCOM as a Marine Protected Area (MPA). This nature reserve and MPA to a great extent cover the same area as the Natura 2000 area Gotska Sandön-Salvorev. In addition, the Gotska Sandön is also a nature reserve and national park located approx. 22 km from the limit of the project area.

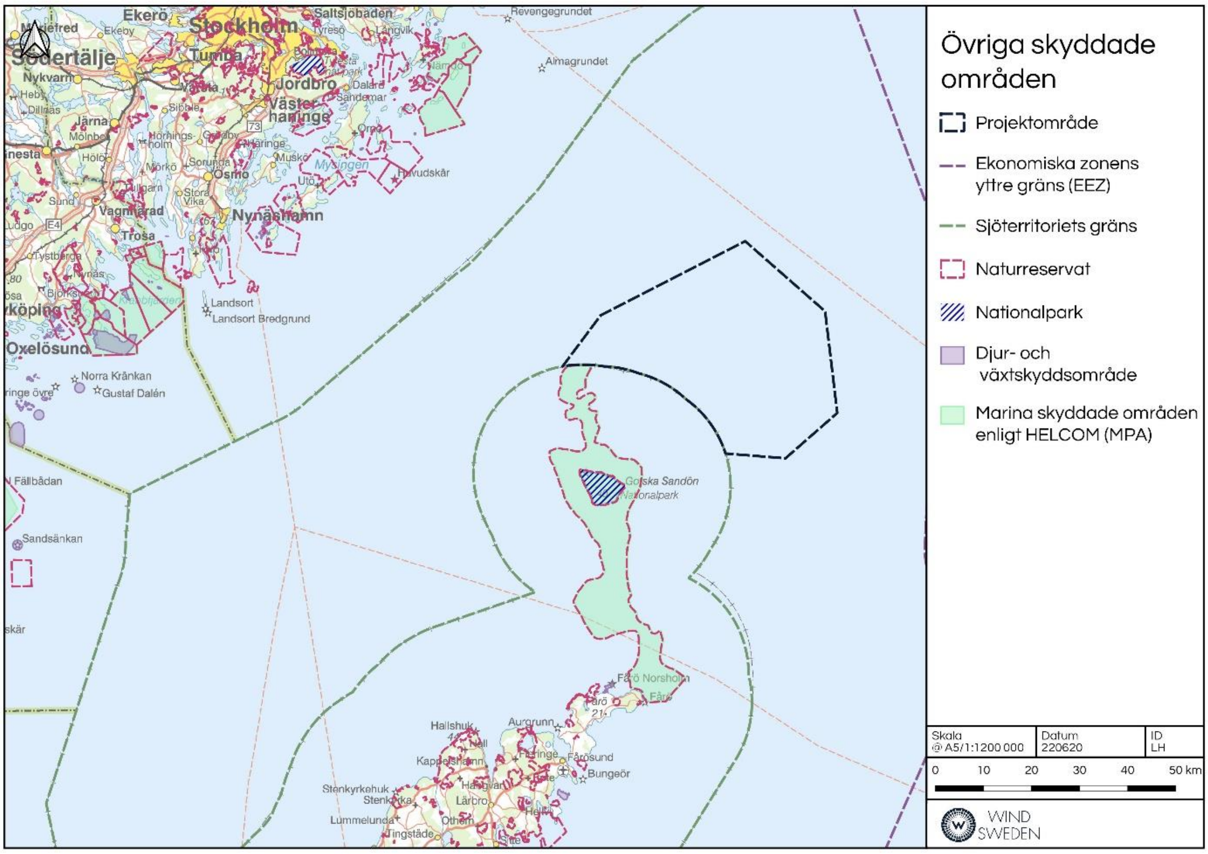


Figure 26. Other protected areas in the vicinity of the wind power development Skidbladner. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Naturreservat – Nature reserve; Nationalpark – National Park; Djur- och växtskyddsområde – Fauna and flora protected area; MPA – Marine Protected area.

4.9 Natural environment

The Baltic Sea's brackish water conditions give it specific conditions with a mixture of both fresh and salt water species. The sea is species-poor and therefore especially sensitive as the marine ecosystem is easily impacted if one species disappears. It is especially sensitive if one of the key species disappears which can lead to major changes in the ecosystem's foundations(Baltic Eye, 2022). Habitats in the Baltic Sea are driven by four main factors: salinity, oxygen content, light and seabed conditions.

The composition of the ecosystem is also influenced by factors such as currents, winds, waves, temperature and seabed substrate.

4.9.1 Demersal plants and animals

The depth of the project area varies between approx .14 m and 197 m in the deepest areas. The seabeds consist predominantly of hard clay and mud, see Figure 19. According to data from the SGI, post-glacial clay, muddy clay and clay-mud and glacial clay are present. In places there are also areas of moraine, postglacial silt and postglacial sand and gravel.

According to information from Sweden's environmental goals,(Sveriges miljömål, 2022)the project area largely includes oxygen-poor seabeds which provide poor conditions for many organisms, see Figure 21.

The photic zone, i.e., the depth to which light penetrates into the water, is around 30 m below the surface at open sea in winter. The limited light conditions means that in the deep parts of the project area there is no life at all.

At that depth and soft seabeds below 20 m depth, there are widespread areas of silt-rich seabeds. The silt consists of organic material from plants and animals which form a blanket over the seabed.

The deep seabeds are home to a variety of animals such as the Baltic Sea mussel, blue mussels, white marlin, scorpion fish and various types of flatfish and eels.

The location specific environment and seabed conditions within the project area have not yet been investigated, rather investigations of the seabed conditions will be conducted as part of the further work on an Environmental Impact Assessment, see Chapter 8.

4.9.2 Marine mammals

The Baltic Sea is home to marine mammals such as porpoises, common seals, grey seals and ringed seals.

Porpoises

A Baltic Sea population of porpoises lives in the Baltic Sea moving between southern Skåne and the North Gulf of Bothnia and one of the most important areas for porpoises is found in Hanö Bay. The species is on the Red List and classes as vulnerable (VU) according to the species data bank's national red list. A study carried out by the SAMBAH project estimated the number of porpoises in the Baltic Sea population at 500(SAMBAH, 2016), see Figure 27.

Modelling has identified areas worth protecting for porpoises in the Baltic Sea(Carlström, J & Carlén, I, 2016), see Figure 28. In this Figure it can be seen that the project area is not within the area of particular importance for the Baltic Sea population during the summer breeding period or in its zone of consideration (Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022).

The porpoises use other areas of the Baltic Sea during different periods of the year. Between March-May and February-April, two coastal areas around Gotland are important areas for porpoises. Based on a combination of acoustic investigation (SAMBAH project) and Kernel density[5]from older investigations, the presence of porpoises in the project area is low (Havs- och vattenmyndigheten, 2018).

[5] A method of estimating probability density on a limited amount of data.

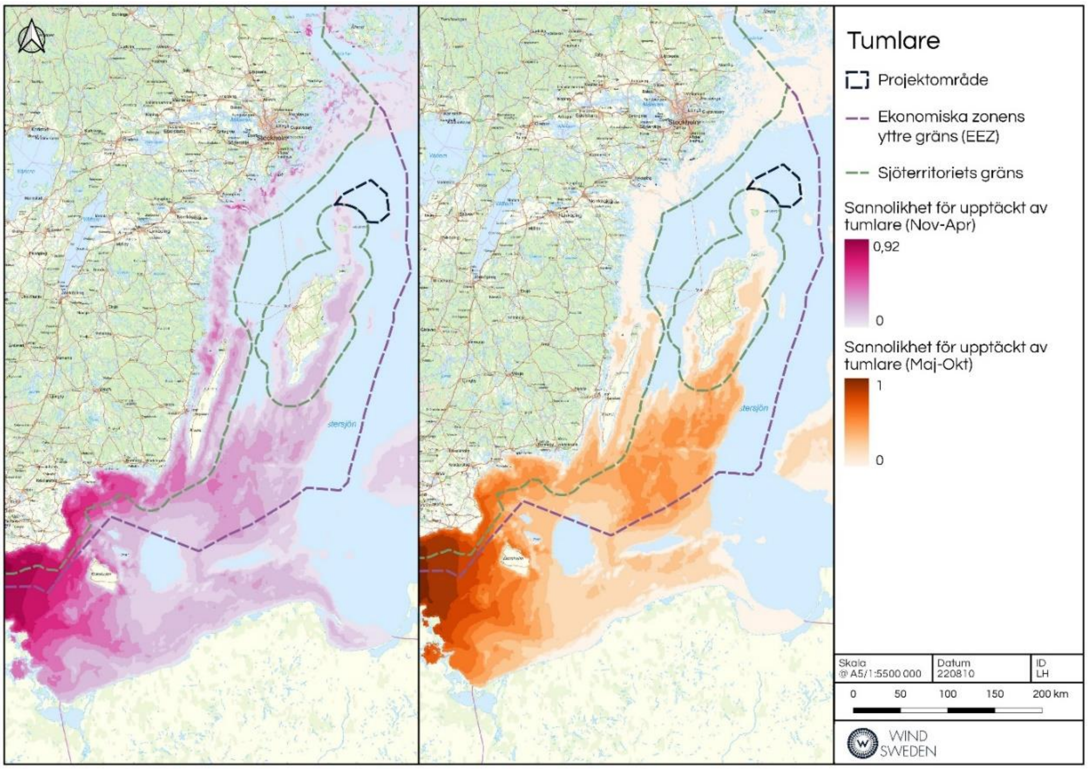


Figure 27. The probability of finding porpoises in the Baltic Sea at different times of year (HELCOM, 2016 & HELCOM, 2017). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Sannolikhet för upptäkt av tumlare (Nov-Apr) – Probability for harbour porpoise presence (Nov – Apr); Sannolikhet för upptäkt av tumlare (Maj-Okt) - Probability for harbour porpoise presence (May – Oct).

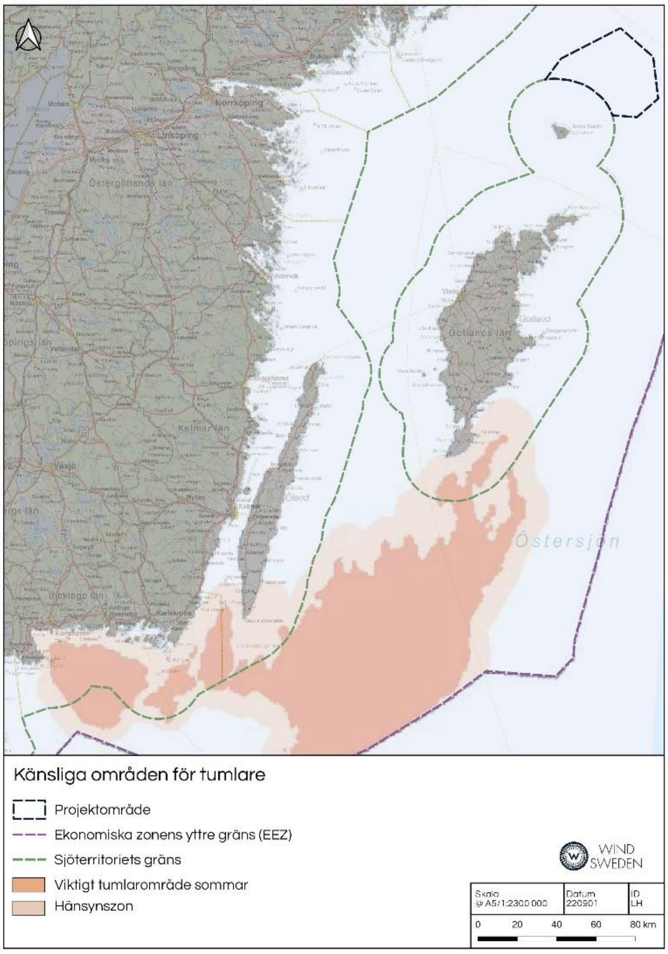


Figure 28. Sensitive areas for Baltic Sea porpoises (Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Viktigt tumlareområde sommar – Important areas for harbour porpoise, summer; Hänsynzon – Consideration areas.

Seals

The grey seal is the most common seal in Sweden and is mostly found in the Baltic Sea. There are estimated to be between 37,000 and 50,000 grey seals in the Baltic Sea. Areas with grey seals are found from the Falsterbo peninsula in Skåne to Haparanda in North Bothnia with the majority of grey seals being found in the archipelagos of Stockholm and Södermanland, though there are also large population in the Sea of Bothnia and North Kvarken as well as along the south coast. The grey seal is listed as of least concern according to the Swedish Red List. The greatest threat to grey seals is climate change which reduces the pack ice in the Baltic Sea, environmental pollutants and by-catch in commercial fishing (Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022). Based on the national environmental monitoring programme of seal colonies, the occurrence of seals in the project area is low(Havs- och vattenmyndigheten, 2018).

The number of ringed seals is estimated at 22,000 animals (Havs- och vattenmyndigheten, 2019b)and most of them are found in the Gulf of Bothnia. The ringed seal is considered of least concern in the Swedish Red List. Based on the national environmental monitoring programme of seal colonies, there are no ringed seals in the project area (Havs- och vattenmyndigheten, 2018).

Common seals are predominantly found along the west coast but also in the Baltic Sea, in the Kalmar Sound. The population in the Kalmar Sound is classed as vulnerable (VU) in the red list. In 2005, it was estimated to be maximum 477 animals. Based on the national environmental monitoring programme of seal colonies, no common seals are found in the project area(Havs- och vattenmyndigheten, 2018).

4.9.3 Fish

A variety of fresh and salt water fish species are found in the Baltic Sea. The number of fish species in the Baltic Sea is around 80(Baltic Eye, 2022). Cod, haddock, herring and sprats are among the species found in the Baltic Sea. One of the key species in the Baltic Sea is cod.

According to data evidence from HELCOM there is no cod spawning within the project area (HELCOM, 2021)and the presence of cod is considered low within the project area and the occurrence of spawning areas for the main species for commercial fishing is assessed as low (Havs- och vattenmyndigheten, 2018). The presence of herring and sprats in the project area is rather higher than for cod and sprats are believed to spawn within the project area (HELCOM, 2021).

A survey of the occurrence of different fish species will be conducted together with the Environmental Impact Assessment, see Chapter 8.

4.9.4 Birds

Various bird species are found in different marine areas in different ways during the year depending on whether they are overwintering, resting or foraging. There are often migration routes near the coast. The bird species found in the Baltic Sea during summer and/or winter can be divided into three groups based on the type of food they consume. The Baltic Sea's bird species can be broadly divided into three groups: those which live on plants in shallow water, those that feed on fish and other animals in the body of water and those which eat mussels and other seabed animals(Larsson, 2012). Fish-eating birds can in turn be divided into two groups: flying birds which look for and capture their food on or near to the surface such as terns and gulls, and those which mainly swim and deep dive for fish such as ducks, guillemots, skuas, dippers and cormorants. The bird types which mostly eat seabed plants are for example, eider, velvet scoter, common scoter and long-tailed ducks

Together with the project "*Marina skyddsvärden runt Gotland och Öland"* led by the Gotland County Administrative Board in 2018, the Administrative Board produced a report (Larsson, 2018)with the aim of summarising and interpreting the bird distribution and use of the offshore banks as well as sea and coastal areas around Gotland and Öland. Several sea birds overwinter in the coastal areas around Gotland and the Gotska Sandön such as long-tailed ducks, black guillemots, razorbills and others.

The closest breeding grounds for eider and lesser black-backed gulls is found on the Gotska Sandön southwest of the project area.

The project summary lists a number of areas which should be high priority for protection of long-tailed ducks and black guillemots. The project area doesn't cover any of these areas but they lie closer to the coast in shallower waters than the planned wind farm.

The occurrence of overwintering sea birds within the planned project area is low(Havs- och vattenmyndigheten, 2018)and according to documents from HELCOM, no red list bird species are found in the project area.

A survey of the occurrence of birds will be conducted together with the Environmental Impact Assessment, see Chapter8.

4.9.5 Bats

19 different species of bat can be found in Sweden, of which 12 are red-listed(Artdatabanken, 2022). All of the 19 species are strictly protected and bat surveys are therefore required for all types of development which may have an impact. Sweden has a long tradition of mapping the occurrence of bats and development of wind power has increased knowledge of bats in the context of the surveys conducted(de Jong, Gyltje Blank, Ebenhard, & Ahlén, 2020). Several bat species are found on Gotland.

Bats fly over sea only in relatively light winds, rarely at wind speeds above 10m/s. Most activity takes place at wind speeds below 5 m/s. However, it varies between species. Larger species tolerate stronger winds but all bats prefer light winds. In addition, very good weather is required for foraging at sea and intensive and prolonged foraging usually takes place in calm or very light winds when waves are insignificant or there is still water. These are the same conditions in which insects thrive in large quantities higher up around wind turbines (Ahlén, Bach, J. Baagø, & Pettersson, 2007). At sea, most bats fly at heights lower than 40 m and they like to use wind turbines as resting sites.

A survey of the occurrence of bats will be conducted together with the Environmental Impact Assessment, see Chapter 8.

4.10 Fishing

Commercial fishing takes place along the coast and offshore. From this, fishing can be categorised into a number of groups including pelagic and demersal species(Bergenius, o.a., 2018). Since there is predominantly oxygen-free seabed in the project area (see Chapter4.6.3) the fishing in the area concerns pelagic fishing.

In recent years, Swedish fishing in the Baltic Sea has mostly been focused on herring and sprat (Havs- och vattenmyndigheten, 2022d).

There is no identified national interest for commercial fishing within the project area for Skidbladner. The nearest area identified is located approx. 11 km south of the project area’s limit. Within the area, the presence of fishing vessels is restricted, as illustrated below in Figure 29 .

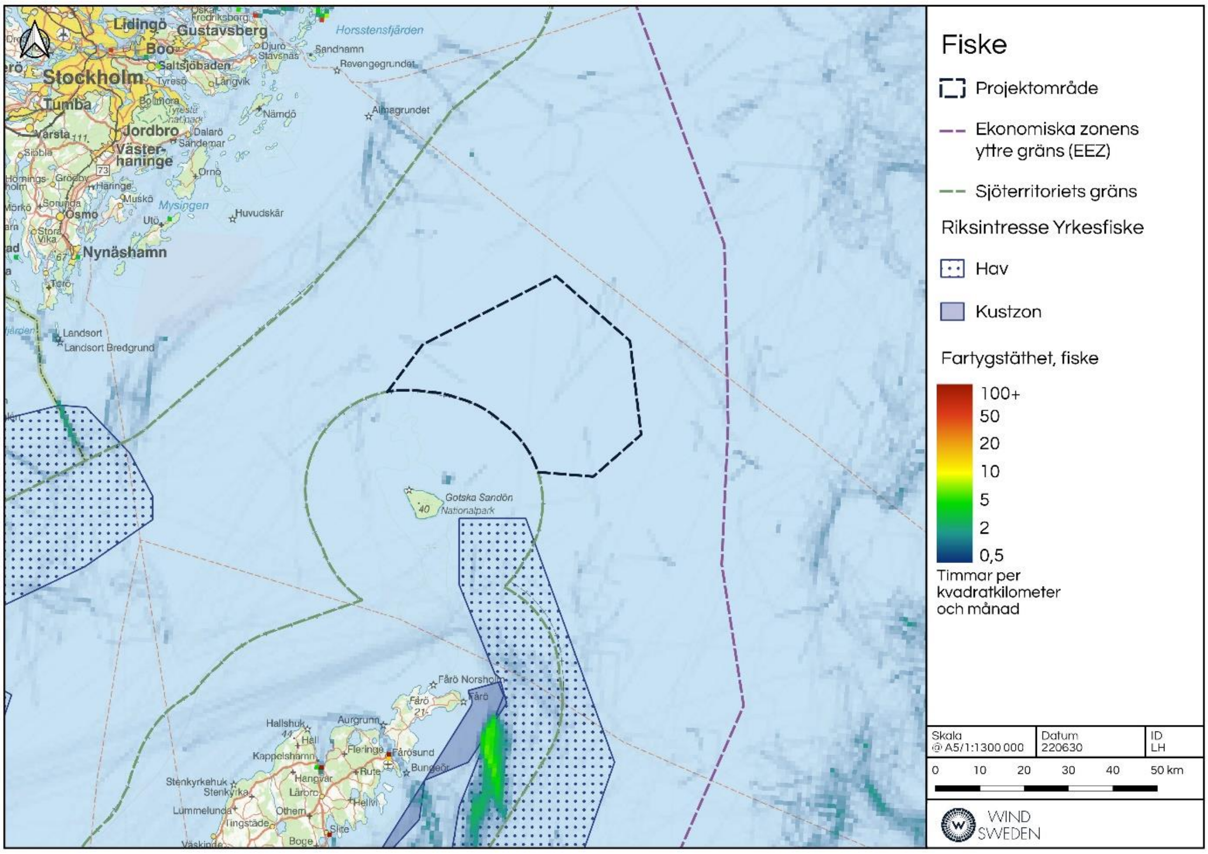


Figure 29. Vessel density for commercial fishing in the project area and vicinity 2020 (EMODnet, 2022b). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Riksintresse Yrkesfiske – National interest for commercial fishing; Hav – Open sea; Kustzon – Coastline.

4.11 Marine culture value

A search for known cultural-historical remains has been carried out in the Swedish National Heritage Board's database (Riksantikvarieämbetet, 2022), see Figure 30, which showed known remains within the project area.

Table11 Known cultural historical remains in the project area.(Riksantikvarieämbetet, 2022)

Remains number	Type of re-mains	Description	Antiquarian as-sessment	Con-firmed in the field	Position
L1934:4203	Vessel/boat remains	Galeas from Visby, sank 25/10/1925 (28)	No antiquarian as-sessment	No	(SWEREF 99 TM N, E) N 6510970.379, E 765314.661

Section 2 Chapter 1 § p. 8 Cultural Environment Act (1988:950) states that shipwrecks constitute ancient monuments provided that the sinking occurred before 1850. A shipwreck from 1850 or later may be declared an ancient monument by the County Administrative Board if there are special reasons relating to its cultural and historical value(Riksantikvarieämbetet, 2014).

Swedish jurisdiction[6]can apply in the whole of the Swedish marine territory, i.e., in both the area known as inner waters and territorial waters. The law on Sweden's marine territory (1966:374), states that territorial water extend 12 M (around 22 km) from the baseline. Within this area the Cultural Environment Act applies in its entirety. In addition, the UN's Convention on the Law of the Sea of 1982, gives coastal states the right to establish a so-called contiguous zone outside of the territorial waters. This zone, also calculated from the baseline, can be up to 24 nautical miles (M) wide. The coastal states which have established such a zone have the right to protect archaeological and historical finds and remains found inside this limit. Such a zone was established in Sweden in 2017, Law (2017:1272) on the Swedish territorial waters and maritime zones.

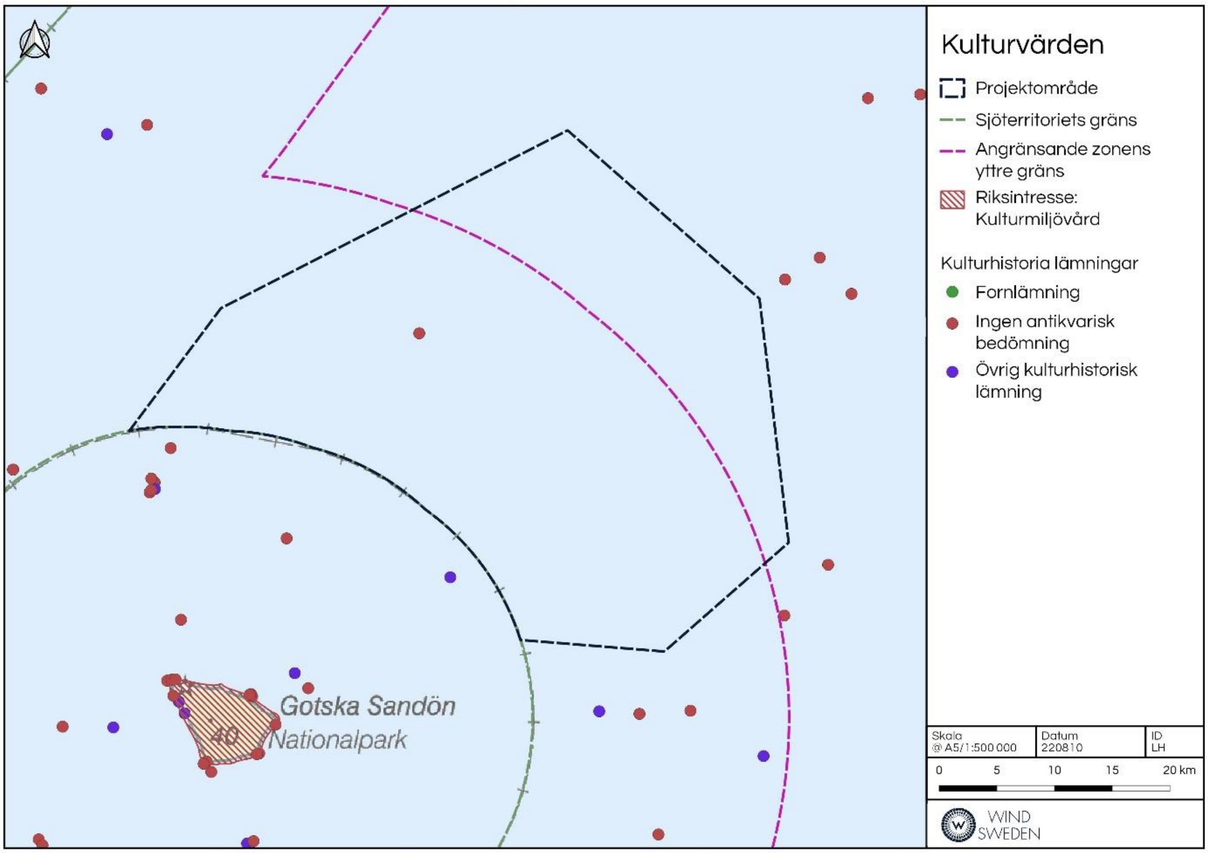


Figure 30. Cultural value within and near the project area. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Kulturmiljövård – Culture heritage protected area; Kulturhistoria lämningar – Culture heritage remains; Förlämningar – Remains; Ingen antikvarisk bedömning - No anti-quarian assessment; Övrig kulturhistorisk lämning – Various cultural heritage remains.

Before a large area of the ocean or a sea ca be exploited, the affected seabeds are surveyed with regard to existing water depth, presence of flora and fauna, seabed conditions and more. Along with these surveys, a search for remains can also be conducted. The most suitable method is sonar mapping (Side Scan Sonar) from a boat. The County Administrative Board can decide that such a survey is required under the Law on Cultural Monuments (KML) but this can also be done within the framework of an Environmental Impact Assessment (EIA),(Riksantikvarieämbetet, 2017).

[6]Jurisdiction or judicial power, to administer justice and to judge. The jurisdiction is limited to a geographic area or to certain people or a certain subject matter.

4.12 Outdoor recreation and leisure

An offshore wind farm may have a certain impact on outdoor recreation and leisure. The impact may consist on physical intrusion and encroachment on areas of high value for outdoor recreation and leisure. The farm also changes the landscape and a changed value of experience from the surrounding areas. How the value of experiences changes depends on the individual's opinion of offshore wind power and isn't always considered negatively.

The nearest area for active outdoor recreation covers the whole of Gotland including the Gotska sandön and surrounding waters which are adjacent to the project area, see Figure 31. On the mainland in the coastal areas and Stockholm archipelago, there are national interest areas for outdoor recreation. National interest for outdoor recreation is also found on the Gotska sandön approx. 22 km south west of the limit of the project area, see Figure 31.

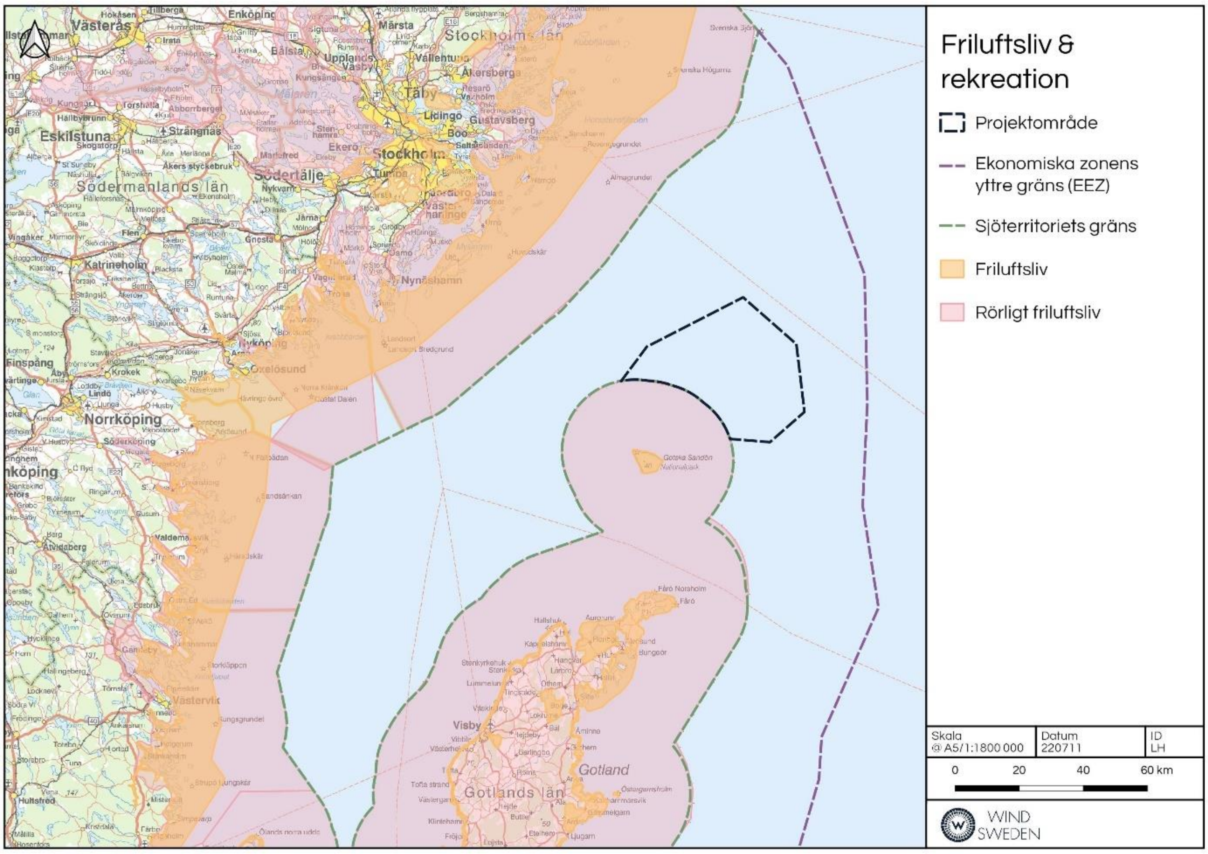


Figure 31. Overview of the national interest for outdoor recreation and activities. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders.

4.13 Landscape

Due to their size and constant movement of the rotor bales, wind turbines have a visually dominant impact on the landscape. Developments are towards even taller wind turbines which are visible across a wide area. Wind farm developments change the landscape and affect people's experiences of their surroundings and local identity. Certain landscapes may be especially sensitive to wind power, while wind turbines may add value to other landscapes (Boverket, 2009). The planned wind power development Skidbladner will involve the landscape changes from an undisturbed horizon to a horizon with a man-made development.

The experience of the landscape is largely subjective, driven by individual experiences, knowledge, attitude and use of the landscape. Visualisation is an important part of determining the impact on the landscape in the forthcoming EIA.

4.13.1 Obstruction marking

Aviation Obstruction Lighting

The wind turbines will be fitted with obstruction markings in accordance with the Swedish Transport Agency's regulations and general guidance on marking objects which may pose a danger to aviation, currently TSFS 2020:88. Current regulations include the following: A wind turbine over 150 m above land or sea level (including rotors) must be painted white and equipped with a high intensity white flashing light at the top of the motor housing (nacelle). If the nacelle is over 150 m above sea level, the tower must also be marked with at least three low intensity lights from half way up to the nacelle. In a wind farm, the wind turbines at the edge of the farm must be marked as above as a minimum. Other wind turbines within the wind farm will be painted white and as a minimum equipped with low intensity lights on the turbine's highest fixed point.

The white lights must be illuminated to maximum strength during daytime. During this time the maximum intensity for the high intensity lights is 100,000 candela (cd). At dusk the light strength can be reduced to 20,000 cd and during hours of darkness, the regulations permit a reduction to 2,000 cd i.e., 2% of the daytime light intensity.

Marine Obstruction Lighting

Offshore wind turbines must be equipped with maritime safety devices, such as obstruction lights. This is in accordance with international recommendations from the marine organisation International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), *Guideline -G1162*. In addition, this is regulated at a national level in *Transportstyrelsens föreskrifter och allmänna råd om utmärkning till sjöss med sjösäkerhetsanordningar (SSA)*, TSFS 2017:66.

The wind farms design, size and location will determine which type and how many safety devices are required. Markings are categorised in two groups, Significant Peripheral Structures (SPS) and Intermediate Peripheral Structures (IPS). These markings are placed on the wind turbine tower, usually 6-15 m above surface level.

For the example design B for the project, an obstruction lighting analysis has been conducted to see how obstruction lighting appears for aviation and marine traffic since this impacts how the development will be experienced, see Figure 32.

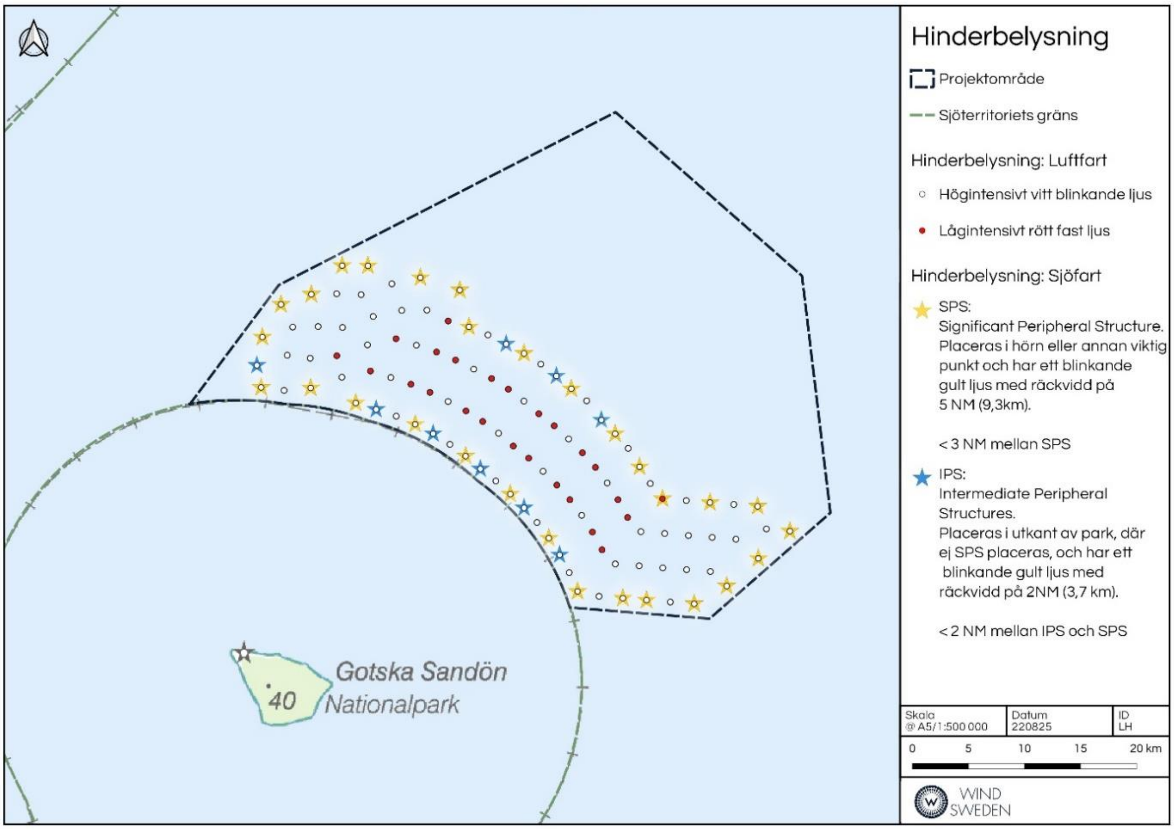


Figure 32. Proposals for how the obstruction lighting may look for the example design B with 111 turbines for both aviation and marine traffic. Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders; Hinderbelysning: Luftfart – Obstacle lighting: Aviation; High intensity white flashing light; Lågintensivt rött fast ljus - Low-intensity red solid light.

4.13.2 Visibility

The visibility of the example design of Skidbladner has been analysed with the aid of a sightline analysis. This analysis shows the theoretical distance from which the wind turbines can be seen from the sea surface before they disappear under the horizon due to the curvature of the earth. Figure 33shows how far it is theoretically possible to see the tops of the blades in their highest position (the blue and purple line) as well as the obstruction lighting for aviation (at hub height for example designs A and B, orange line) at the sea surface in perfect visibility considering the curvature of the earth. The blue line shows the maximum total height which is envisaged for the project (360m) and the purple and orange line show how it theoretically appears based on the dimensions of the example designs.

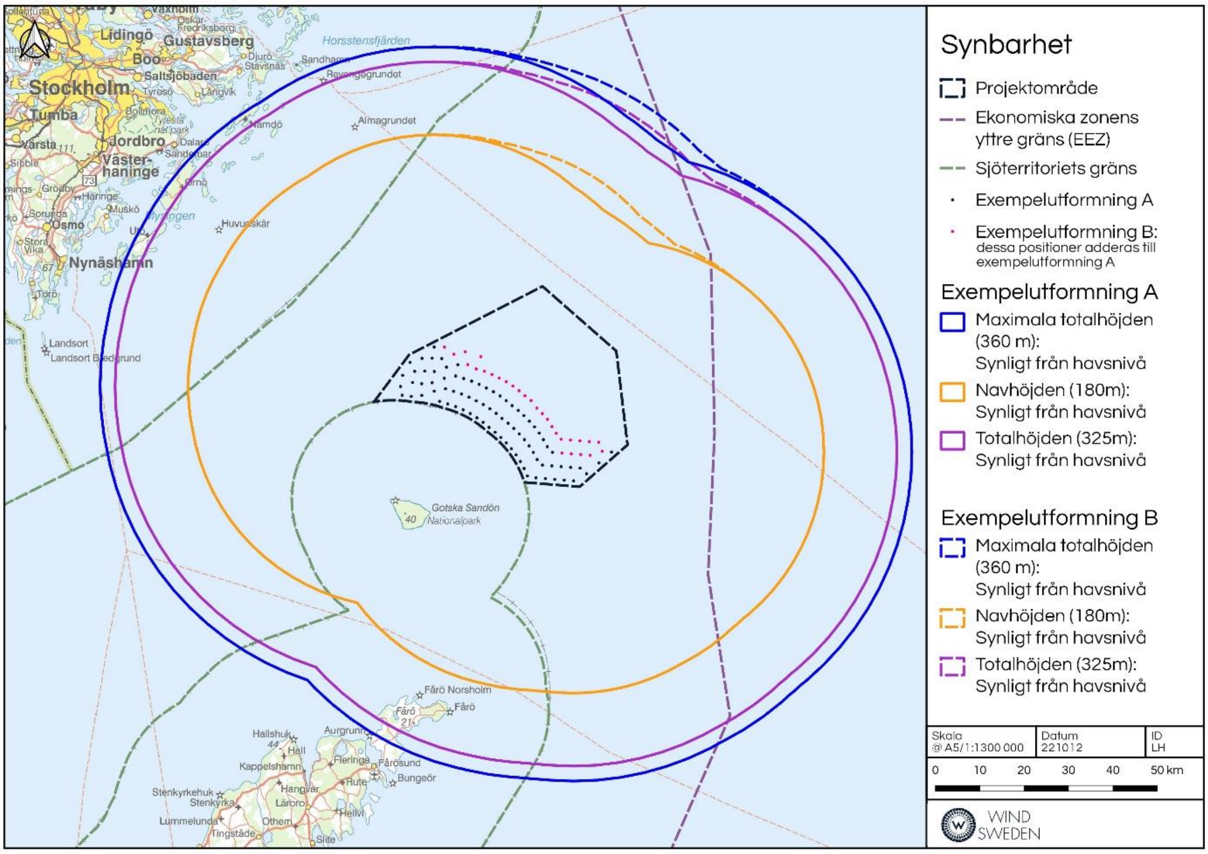


Figure 33. The lines show the distance the wind turbines are still visible from the sea surface for the example designs A and B (Chapter3.2.1). The blue and purple line shows from how far away the top of the blades in their highest position are visible and the orange shows from how far away the obstruction lighting is visible from the sea surface for aviation (hub height). Projektområde – Project area; Ekonomiska zonens yttre gräns (EEZ) – Exclusive economic zone (EEZ); Sjöterritoriets gräns – Territorial waters boarders.

5 IMPACT FACTORS

The environmental impact and individual and public interest differ across the three project phases: construction phase, operation phase and decommissioning phase, in terms of both scope and time. Some of the impact factors are not relevant to all parts of the project phases. These impact factors can, in turn, lead to the impact and environmental effects reviewed in Chapter 7below.

An important aspect when looking at the impact of an activity is the duration of the impact and severity of the specific impact for the respective species' population. An impact for a long period of time, for example 30-40 years of operation, is considered more significant for population development than a temporary impact for 1-2 years unless the latter is very large (Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022).

*Table12 Table of possible impact factors in the three project phases Large **X**: high impact, small x: low impact, no x: no impact.*

Impact factors	Construction phase	Operational phase	Decommissioning phase
WIND FARM, MEASURING STATIONS, OSS AND INTERNAL CABLE NETWORK			
Sound (underwater sound, operational sound, noise)	X	x	X
Turbidity	X	x	X
Landscape	x	X	x
Increase traffic (vessels)	X	x	X
Collision risk	x	X	x
Habitat loss	x	x	x
New habitats	x	X	
Electromagnetic field	x	X	
Climate (emissions to the air)	X	x	X
Shadows		X	

*Table13 Possible impact factors of downstream activities for the three project phases for export cable. Large **X**: high impact, small x: low impact, no x: no impact.*

Impact factors	Construction phase	Operational phase	Decommissioning phase
ACCOMPANYING ACTIVITIES - EXPORT CABLE			
Sound (underwater sound, op-erational sound, noise)	x		x
Turbidity	X		X
Increase traffic (vessels)	X		X
Habitat loss	x	x	x
New habitats	x	X	
Electromagnetic field		X	
Climate (emissions to the air)	x		x

5.1 Sound, underwater sound, operational sound, noise

During the three project phases, different types of noise will occur but the greatest impact of noise will be in the construction phase. The groups of species most impacted by the predominantly high intensity submarine noise are fish and marine mammals (Vindval, 2022). The vessels used during all three phases for construction, operation and decommissioning also emit noise.

Noise is also emitted by the site surveys conducted during the planning phase as surveys and data collection are conducted to apply for and receive the required permits and to identify the final design of the wind farm.

In the construction phase, anchoring the floating foundations and substations emits noise as well as the construction of the internal cable network. The scope of the noise depends on the final choice of anchoring method.

In the operational phase, the wind turbines emit a swishing noise created when the rotor blades cut through the air. The scope of the noise depends on the rotor blades' size and design, the rotation speed and the surrounding wind conditions. The motor housing itself also emits a sound. The wind turbine's rotation also gives rise to a low frequency noise which is the consequence of vibrations in the tower or noise from the motor housing. The noise varied with the wind speed.

In the decommissioning phase, the scope of the noise emitted is similar to the construction phase.

5.2 Turbidity

Due to the anchoring of foundations and substations, installation of cables and decommissioning of the wind farm, some disturbance of sediment can occur. The scope of the turbidity depends on the choice of anchoring method, type of seabed substrate, salinity, water temperature and the areas currents(Naturvårdsverket, 2009).

In the operational phase, the chains anchoring the wind turbines may cause some disturbance and distribution of sediment. The scope of turbidity in the operational phase depends on changes in water conditions and anchoring method.

The effect of turbidity is also related to the occurrence of any pollutants in the seabed sediment.

5.3 Landscape

In the construction and decommissioning phases, vessels will be seen in the wind farm area, as well as the transport route used to transport to and from the shore. In the operational phase, the wind turbines will visibly change the landscape, which varies with the total height of the wind turbines and the distance from the beholder to the various turbines.

5.4 Increased shipping

There will be increased shipping during the three different phases. The increase will be greatest during the construction and decommissioning phases. In the operational phase, service vessels will travel between land and the wind farm.

5.5 Collision risk

The wind farm and its substations and wind turbines create a collision risk for vessels, birds and bats.

5.6 Habitat loss

Some habitat loss will occur in the construction and decommissioning phases. Habitat loss will be both temporary and permanent. The extent of this depends on the anchoring method and choice of method for laying cables.

5.7 New habitats

New habitats will arise within the wind farm in the operational phase in the form of hard surfaces. These new habitats consist of the anchorages fixing the wind turbines to the seabed, cable protection on the seabed, substations and the wind turbine floating foundations.

5.8 Electromagnetic field

In the operational phase an electromagnetic field will be created by the internal cable network. The electromagnetic field is formed by the generation and transmission of electricity. The electromagnetic impact decreases with distance from the cables.

5.9 Climate, emissions to the air

During all three phases there will be increased emissions to the air from the vessels and machines used. The greatest increase will be in the construction and decommissioning phase as many work boats and machines will be used. The amount of emissions can be regulated through choice of fuel.

In operation, the wind farm will contribute to renewable and emission-free electricity which will replace other electricity produced from fossil fuels.

5.10 Shadows

In the operational phase there will be both fixed and mobile shadows from the wind turbine’s tower and rotor blade. The scope of the shadows depends on the position of the sun in relation to the wind turbine and varies throughout the day. The scope of the shadow also depends on the weather and is lower when it is cloudy. The intensity of the shadow is reduced with distance from the tower. At most, the shadows will penetrate to a depth corresponding to the photic zone, i.e., the depth to which sunlight penetrates below the surface, approx. 30m.

6 PROTECTIVE MEASURES

In all three phases of establishing an offshore wind farm disturbances and impacts on the surrounding area can arise. The impact can be both direct and indirect and varies in nature and scope depending on the phase of the development. The conditions in the relevant area also determine the scope of environmental impact(Havs- och Vattenmyndigheten, 2022c).

During the introductory work in the authorisation process for an offshore wind farm a comprehensive location survey is conducted with the aim of finding the optimal site for the development. The location survey takes into consideration to conflicting interests and existing natural values as well as the presence of sensitive species. This survey is a protective measure in itself, since it considers the environmental sensitivity on the basis of existing evidence.

In addition, technical solutions in respect of the choice of foundation and construction methods create different scopes of environmental impact.

In order to reduce the negative impact, a number of protective methods and precautions can be used. This may involve technical solutions or regulating the time of year or day when certain types of work can be carried out.

To reduce the negative impact on fish spawning, sensitive periods of time can be avoided and the same can be done to adapt the time of the work to porpoise mating and calving periods. Times when certain work can be conducted can be regulated in the conditions of authorisation.

In the event the construction period causes extensive underwater noise, noise protecting methods can be used in the form of bubble curtains or hydro sound dampers (HSD) or a combination of these. A so-called ramp- up can also be used, where the pile driving intensity is gradually increased allowing fish and porpoises to the opportunity to leave the area before the noise increases (Naturvårdsverket, 2012).

Sediment dispersal can occur with anchoring and decommissioning of the floating foundations. Sediment dispersal depends on the mooring method as well as the character of the seabed and presence of any environmental pollutants. Sediment dispersal can also occur due to the laying and removal of the external cable network. Sediment dispersal shouldn't occur in the important fish breeding areas in breeding season. Should there be a risk of comprehensive turbidity there are methods to reduce the dispersal.

Use of vessels in the construction phase can be planned in such a way that the number of transports is reduced and thus minimised.

The applications for establishing the Skidbladner wind farm will include proposals for appropriate protective measure adapted to the scope and conditions of the activity seeking authorisation.

Following receipt of a permit, a control program will be established and conducted to facilitate the final design of measures to reduce the negative impact on the environment.

7 POTENTIAL ENVIRONMENTAL IMPACTS

Impact and environmental effects occur in the three different phases of establishing a wind farm. The scope of the impact differs between the three phases in terms of time and space. The scope of environmental effects also depends on the choice of technical solutions, protective measures and working methods for mooring and construction.

The planned wind farm will be constructed in the deeper parts of the Baltic Sea with oxygen-poor seabeds and both flora and fauna are generally poorer in deep environments than shallow. Marine species which live in the deep hard seabeds are especially lacking in the Baltic Sea due to the low salt content. According to the report *Ekologisk hållbar vindkraft i Östersjön,* it is good from a sustainability perspective that wind farms tend to be built in areas with deep water as a wind farm sited in a deep area causes less disturbance to the benthic environment. The report also includes an assessment of the oxygen-free areas which are the most suitable locations to build floating wind power in the Baltic Sea from an environmental perspective(Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022).

Below is an overview of the impact on various interests as initially assessed based on existing information. Under the relevant heading, only those factors are described that are initially considered to have a potential impact on the respective interest, others are omitted. The impact of the activity will be investigated within the framework of the forthcoming EIA and a more thorough description and assessment of the environmental effects will also be conducted within this. The statement below includes the different technical alternatives being investigated for consideration. The forthcoming environmental impact assessment will be based on a worst-case scenario for each technical alternative investigated.

The environmental effect of accompanying activities and the export cable are difficult to assess currently, since the placement, dimensions and laying method are not yet determined. A cable will be laid on or in the seabed and may have some environmental impact, mostly for a limited time during the construction phase. The marine environment may be affected by the dispersal of sediment and in some cases, there may be a risk of environmental pollutants being released. Where an assessment can be made, from existing knowledge and experience, this is described under the relevant heading below.

7.1 National interest

The national interest for natural value is found in a very limited part of the project area under Chapter 3 EC. This part won’t be installed with wind turbines due to the shallow depth which is not suitable for floating wind turbines. The project area is adjacent to a national interest for defence, a naval training area and a national interest shipping lane. These are initially considered not to be affected by the establishment of a wind farm within the project area. None of aviation’s MSAs will be affected by the proposed wind farm. The wind turbines will be marked with obstruction lighting as described in Chapter4.13.1.

The project area is adjacent to a national interest for active outdoor recreation according to Chapter 4 EC. Establishment of a wind farm is initially judged as not impacting the opportunity of exercising this national interest. However, the area’s landscape value should be highlighted in the forthcoming landscape analysis.

7.2 Protected areas

The project area is adjacent to the Natura 2000 area, Gotska Sandön – Salvorev. In the northern part of the Natura 2000 area there are sandbanks (1110) and reefs (1170) which are among the priority protected values for the area. One of the negative impact factors listed in the conservation plan concerning these sandbanks and reefs is swell from boats which can impact the zoning of reefs and banks. Changes to currents and circulation can also impact these reefs and banks.

The impact on currents from floating wind turbines is limited as only the mooring chains make contact with the seabed in deep water, as with the internal cable network. In a comparison of fixed and floating foundation, the impact of seabed currents and waves was much lower for floating foundations (Farr, Ruttenberg, K. Walter, Wang, & White, 2021).

During the establishment, operation and decommissioning of the wind farm, vessel traffic will be limited or avoided entirely in the area with protected banks and reefs. These measures can avoid a negative impact.

Some turbidity may occur in the construction and decommissioning phases. Turbidity occurs with construction and lifting of the seabed anchors which moor the wind turbines to the seabed. According to data from the nearest measuring buoy at Huvudskär Ost the average speed at 90 m depth was 10.6m/s. Data concerns measurements from a 20-year period, see Chapter 4.6.1.

7.3 Natural environment

7.3.1 Demersal plants and animals

The project area is located mostly within an area of great depth, below the photic zone. Only approx. 0.6% of the project area is shallower than 30 m. No floating wind turbines or OSSs will be placed in the shallow area. Around 90 % of the project area consists of oxygen-poor seabeds which create poor conditions for rich biological seabed life. The seabeds predominantly consist of clay of different hardness. The depth of visibility is limited and the penetration of the sun to the deepest parts is zero.

Some physical disturbance may arise during the construction phase due to the turbine and substation mooring work and cable laying. The disturbance consists of turbidity, noise and the impact on the seabed substrate. Turbidity may arise in the construction phase and can spread to a limited area around the substations, anchors and cables. Any impact on the immediate vicinity may also be seen through some coverage of seabeds in connection with mooring and cable laying as well as construction of substations. The impact on the different existing species depends on their normal exposure to turbidity. After construction, the seabeds will be recolonised relatively comprehensively, as any coverage is judged to be limited(Sveriges Lantbruksuniversitet, 2020). Some disturbance of seabed-living animals may occur due to the noise of construction works.

In the operational phase, hard surfaces from the different parts of the wind farm can lead to the establishment of species which live on hard seabeds. The low frequency noise emitted during the operational phase is not judged to have a negative impact on seabed life(Vindval, 2022). The impact of the electromagnetic field from cables, is judged to be non-existent during the operational phase. According to existing studies, there is no evidence that this magnetic field should have a negative impact on organisms at population level(Vindval, 2022).

In the decommissioning phase, physical disturbances will arise corresponding to those in the construction phase.

A final assessment of the impact on seabed plants and animals in the different phases will be conducted following the forthcoming investigations and EIA.

The methodology for laying export cables is still unclear but the cables will need to be laid either on or in the seabed which will cause turbidity. The extent of the turbidity and how far the particles spread depends on the actual seabed substrate, current conditions and the choice of laying method. The smaller the particles on the seabed, such as clay, the greater the turbidity. Smaller particles spread further than the is the same measure is carried out on a sand or stone seabed. The size of the particles determines the length of time before they settle on the seabed again and therefore the spread and thickness of the subsequent sediment deposits. Some coverage of the seabed may also occur. New habitats may arise if the cable is laid on the seabed and protected with stones or blocks.

7.3.2 Marine mammals

In the construction phase, along with the arising high noise, there may be a risk of negative impacts on porpoises and seals. Sudden, high noises can lead to behavioural changes and hearing damage should the animals be in the vicinity of the construction area. If protective measures are taken and particular attention is paid to important times of year for porpoises, these negative risks can be avoided.

In the operational phase, the wind farm can have a positive effect on seals and porpoises where the establishment leads to a greater occurrence of hard seabed species and fish, The noise emitted during operation does not appear to adversely affect either seals or porpoises(Vindval, 2022). Altogether the impact during the operational phase is judged as low (Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022).

In the decommissioning phase, the effects are judged to correspond to those during the construction phase.

A final assessment of the impact on marine mammals in the different phases will be conducted following the forthcoming investigations and the EIA.

The export cable will be laid by a cable laying vessel which will generate noise from the vessel and the equipment used for laying on the seabed. As cable laying is judged to be quite quick and the total time the vessel will be in a specific area is limited, the impact from noise related to the presence of vessels is initially judged to be low.

7.3.3 Fish

In the construction phase, underwater noise will arise due to the laying of cables and mooring foundations and construction of substations. The size of the disturbance depends on which mooring and construction methods are chosen. Increased presence of boats and work vessels will also generate noise. This noise may cause escape responses in fish(Vindval, 2012). Fish may also be negatively impacted by turbidity and the suspended material which occurs with work on soft seabeds. The size of the disturbance depends on the nature of the seabed, current speeds, mooring and construction methods, protective measures and the amount and species of fish present in the area at the time. Which time of the year work is carried out is also a decisive factor in the impact on fish.

The noise emitted by the wind turbines in the operational phase arises when the rotors spin. This noise does not appear to adversely affect fish to the extent that it would inhibit fish behaviour (Vindval, 2022). If more species of hard seabed species arise on the structures of the wind farm, this could lead to a positive impact on fish. Studies of cod show that their presence increases near wind farms which is probably due to the increased availability of food and possibly protection. Regulation of commercial fishing often occurs with the establishment of wind farms which also brings about areas of sea where fish are protected from commercial fishing. During the operational phase, no significant negative impact on fish is expected as the effects of the addition of artificial facilities bring about several positive effects. Studies around Lillgrund wind farm showed that the site attracted fish to the area and that any negative effects of the cables and noise was insignificant(Bergström, Sundqvist, & Bergström, 2012). It is noted, however, that these results were based on a wind farm with fixed seabed foundations.

During the decommissioning phase, an impact corresponding to that in the construction phase may arise.

A final assessment of the impact on fish in the different phases will be conducted following the forthcoming investigations and EIA.

The impact factors on fish from the export cable may arise in connection with laying as turbidity and noise may arise. In relation to the operational phase, the main impact is the generation of electromagnetic fields in the vicinity of the cables. An electromagnetic field is generated around the export cable as it is around the internal cable network.

7.3.4 Birds

The impact on birds in the construction phase is considered to be low. In relation to the wind farm's total life span, the period of time is relatively short. However, consideration must be paid to birds during the important breeding season.

During the operational phase, the establishment of an offshore wind farm can cause a loss of habitat and displacement of birds. The farm's presence can also cause barrier effects for migratory and foraging birds. When birds have to detour around wind farms, there is greater energy loss. Offshore wind farms can also create a collision risk for birds if they fly too close to the rotor blade(Isæus, Beltrán, Stensland Isæus, C Öhman, & Andresson-Li, 2022).

The impact on birds in the decommissioning phase is judged to correspond to that of the construction phase.

A study of the presence of birds will be carried out within the framework of the forthcoming EIA.

7.3.5 Bats

If there are migrating or hunting bats in the project area, they may be affected by the establishment of a wind farm.

To determine the impact on bats which may occur during the three different project phases, a survey of the presence of bats will be conducted within the framework of the forthcoming EIA.

7.4 Fishing

The project area does not include any identified national interest for commercial fishing and the nearest identified area for this is situation approx. 11 km south of the project areas outer limit. According to known information about the area, even the presence of fishing vessels is limited, see Figure 29.

During the construction and decommissioning phase, the accessibility of the area for fishing will be limited.

Any pelagic fishing currently carried out in the project area may need to be restricted during the operational phase in the area where turbines, substations and moorings will be located. Since pelagic fishing and angling do not impact the seabed cables, some fishing can continue to take place within the project area.

Based on currently available information, the impact on commercial fishing will not be significant. Through dialogue with commercial fishing during the consultation process, the impact on commercial fishing will be further investigated for the different phases of the project.

The export cable will be laid either on or in the seabed and thus protected from the impact of commercial fishing. Depending on the fishing methods used within the area of the export cable, some impact on commercial fishing may arise within a very limited area.

7.5 Marine culture value

In connection with the forthcoming investigations ahead of the EIA, a marine archaeological survey will be conducted. If this survey reveals the presence of remains this will be handled according to current legislation, alternatively these areas will be exempted from any establishment which may adversely affect the marine cultural value.

For the export cable, a similar study as for the wind farm will be conducted.

7.6 Outdoor recreation and leisure

In the construction phase, some impact may arise due to the transports to the project area. The amount of vessel traffic will increase and disturbance from that will depend on the time of year. In general, there is more vessel traffic at sea due to outdoor recreation and increased boating activities. During the construction phase there may be barriers and safety distances preventing recreational boats from visiting the area.

In the operational phase the wind farm will be accessible to visitors in recreational boats.

During the decommissioning phase, an impact corresponding to that in the construction phase may arise.

7.7 Landscape

Experience of the landscape is largely subjective, driven by individual experiences, knowledge, attitude and use of the landscape. The lie of sight analysis presented in Figure 33 shows the theoretical visibility at sea level in respect of obstruction lighting and the highest point of the rotor blades. Obstacle lighting and wind turbines will be visible from the Gotska sandön and Huvudskär. From Fårö and the outer islands of the Stockholm archipelago parts of the rotor blades will be visible.

The planned wind power development Skidbladner will involve the landscape changes from an undisturbed horizon to a horizon with a mobile, man-made development. Of course, visibility will be high for recreational boats passing close to the wind farm.

Visualisation and animations are an important part of determining the impact on the landscape in the forthcoming EIA.

7.8 Cumulative effects

Cumulative effects means those effects which arise when the impact from several sources interact with each other. For the assessment of cumulative effects, already licensed activities within and around the project area as well as the wind farm’s accompanying activities are included. Licensed and current activities include shipping, wind power and commercial fishing. The current environmental status of the represented or surrounding body of water will also be included in the assessment.

Which phase of the project other wind power projects in the vicinity are at is also of importance in assessing the cumulative effects, as well as when the accompanying activities will be carried out in relation to the construction of the wind farm. If two close farms carry out turbidity and/or noise creating work in the construction or decommissioning phase at the same time, the cumulative effects will be greater than if they are at different phases of their respective projects. As far as is reasonable based on the phase of the projects, the cumulative effects of planned wind power projects in the vicinity will be assessed in the forthcoming EIA.

Preventative protective measures reduce the risk of extensive cumulative effects. Even the soundscape can be affected if there are two close wind farms which must also be included in the assessment.

The cumulative effects on fish, birds and commercial fishing during the operational phase will be surveyed in the forthcoming surveys and investigations conducted in connection with the EIA.

Cumulative effects with regards the export cable will be considered in the forthcoming EIA.

8 PLANNED INVESTIGATIONS

Comprehensive investigations and surveys will be conducted to establish the evidence required to complete an EIA for the project. The investigations and surveys currently planned are described below.

8.1 Seabed investigations

Seabed investigations will be conducted for the project area. The aim is to gather information on the conditions for establishing a wind farm in the area. The evidence will then be used to determine the design of the wind farm and what is appropriate for the area.

In addition, the evidence will be used to determine the topography and sediment conditions of the seabed. Sediment samples can be taken to establish the grain size, composition and oxygen content of the seabed in order to map out the area. This can then be used to assess the conditions for seabed vegetation and fauna. The survey will also form the basis of a survey of the marine archaeology and any presence of ordnance.

8.2 Natural environment

To map the natural environment within the project area, investigations of seabed flora and fauna, fish and invertebrates, marine mammals, birds and bats must be conducted. With the aid of this information, an assessment can then be made of the possibility of life and any risk of spreading environmental hazardous substances.

8.3 Cultural heritage

To map remains within the project area, marine geological surveys must be conducted. Evidence from the geophysical investigations can also be used as evidence for this survey.

8.4 Other surveys

Other surveys and investigations which may be relevant are listed below:

- Noise survey
- Fishing survey (Commercial fishing)
- Aviation and shipping risk analysis
- Landscape analysis
- Natura 2000 survey
- Survey of any cumulative effects
- Survey of the impact of environmental quality standards
- Visualisations and animations
- Meteorological investigation
- Investigate the water quality in the area (lack of oxygen in the area?)
- Survey of presence of remaining ordnance, UXO, in the area
- Current modelling and distribution calculations
- Weather measurements, including wind and waves

9 RISKS AND SAFETY

There are risks in establishing a large-scale offshore wind-farm which involve high safety requirements. Safety is therefore prioritised across all phases. The different risks which can arise can be categorised into different groups such as risk to human health and environmental risk.

Risk to human health can occur in connection to work which emits high noise, handling electrical equipment or heavy lifting. The environmental risks which can occur include the negative impact which can arise from establishing an offshore wind farm. This can include oil or other chemical release, distribution of seabed sediment and high levels of submarine noise which can impact marine life. In addition to these risks, the project area will be investigated for ammunition and other ordnance which may cause a specific risk. This will be mapped in the geophysical investigations.

Risks related to the location of the area with regards to shipping may arise.

10 LOCAL BENEFIT

10.1 Socio-economic benefits

The benefit of wind power is about much more than just energy and the environment. There is the possibility of positive effects both within business and civil society. For example, the socio-economic benefit in the form of employment opportunities, high levels of education and the resulting increased attractiveness. Therefore, it is important that decision makers see the whole picture and have the opportunity to evaluate all the benefits which can arise in relation to intrusion and protective measures. The cost-benefit balance for different target groups/bodies is an important aspect to consider in decision making.

10.1.1 Employment

Employment may be created within the wind power branch from two main areas. Construction of wind power strengthens the manufacturing industry and creates jobs. Interaction between the different parts, for example by sharing skills between companies, is strengthened if the domestic wind power market develops well. Offshore wind power has been shown to be more labour intensive than onshore wind power. This applies throughout the life cycle i.e., planning, construction and installation as well as operation and maintenance. In addition to increased demand for goods and services within the region of the wind power development, this creates a direct increase in the number of employment opportunities.

10.1.2 Technical learning

Supporting offshore wind power creates a positive dissemination of technical learning. As the market for offshore wind is international, the knowledge gained by constructing offshore wind farms can be shared between and within countries. On a global level, Sweden can help other countries to reduce their emissions by sharing knowledge on renewable electricity production. In the long term as market players learn more about the technology, costs also decrease which in turn contributes to greater socio-economic stability.

10.1.3 Infrastructure

Often, infrastructure is expanded and improved in areas where wind power is established. New roads, port expansion, electricity grid and fibre arranged in conjunction with the development bring positive external effect such as increased communication and transport opportunities in the local community(Blom, Eriksson, Hillman, & Zandén Kjellén, 2020).

10.1.4 Calculations

The socio-economic calculation is based on a wind farm close to shore with a total of 50 wind turbines and an output of 10MW.

Planning phase

A positive annual financial contribution is made to the local and regional community as a whole, a large share of which is also passed onto the state. At the local level, this depends on how many people live in the municipality (tax base) during the planning phase. If planning takes seven years, this would give an overall effect of around 43 Mkr in total and approx. 10.8 Mkr to the local community. The annual overall employment effect during planning in the report's calculations is 14 full time jobs when direct and indirect jobs are included.

Construction

The opportunities for the local community to benefit from revenue during construction are, in our view, significant as 'accompanying works' covered by the supplier's commitment must take place on site and should be deliverable by existing and start-up businesses - such as electrical work, security and, not least, continual boat servicing. If preliminary work/construction were to last three years, this would have a total impact of just over 100 million SEK, of which just over 25 million SEK would be directed to the local community. The annual overall employment effect during preliminary work in the report's calculations is 95 full time jobs when direct and indirect jobs are included.

Operation and maintenance

As the facilities for operation and maintenance must be nearby to be able to implement measure quickly while maintaining continuous service, the opportunity for the local community to benefit from the social values created is very large. Several sources expect as much as 90 % of the total value for operation and maintenance to benefit the local area. This means that people affected probably live in the local community, that the boat service is always accessible, that monitoring is continuous. We calculate he annual overall employment effect with regards operation and maintenance as 62 full time jobs when direct and indirect jobs are included(IUC Sverige AB, 2020).

11 SCHEDULE

Consultation will be conducted between autumn 2022 and spring 2023. After that the investigations and surveys which will form the basis of the environmental assessment as part of the forthcoming EIA will begin.

Preliminary content of the Environmental Impact Assessment

On conclusion of the consultation process, an environmental impact assessment (EIA) will be carried out as a part of the environmental assessment process. The EIA forms a central document in which all environmental aspects are analysed and assessed, both direct and indirect environmental consequences during construction, operation and decommissioning. In addition, the EIA will contain data on the site location, design, scope and other properties which may be significant for the environmental assessment. To prevent, hinder and counter negative environmental effects of the activity, the planned measures to be applied will be presented in the EIA.

Below is a summary list of content proposed for inclusion in the EIA.

- Non-technical summary
- Introduction and background
- Location
    - Alternative location and implementation
    - Zero option
- National maritime plan
    - What this looks like for the project area
- Environmental quality standards

- Geology
    - Types of sediment and sediment processes
    - Presence of hazardous substance in sediment
    - Diffusion models
- Underwater noise generated by the activity
- Impact on current conditions caused by the activity
- Any impact from electromagnetic radiation
- Potential impact on types of nature and species identified in the nearby Natura 2000 area
- Current description of the marine biology within the project area
    - Indirect and direct impact on existing species such as fish, birds and marine mammals.
- Impact on conflicting interests such as commercial fishing and outdoor recreation
- Cumulative environmental impact of other activities
- Protective and precautionary measures to minimise negative environmental impact
- Proposed content of the control programme
- Choice of technique and method for preliminary investigations and civil engineering works
- Restoration after decommissioning
- Schedule
    - For the project
    - Any time restrictions during ecologically sensitive periods

In addition to the above, the EIA will include the consultation report and technical description. The layout of the forthcoming EIA is proposed to follow the same structure as this consultation document.

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