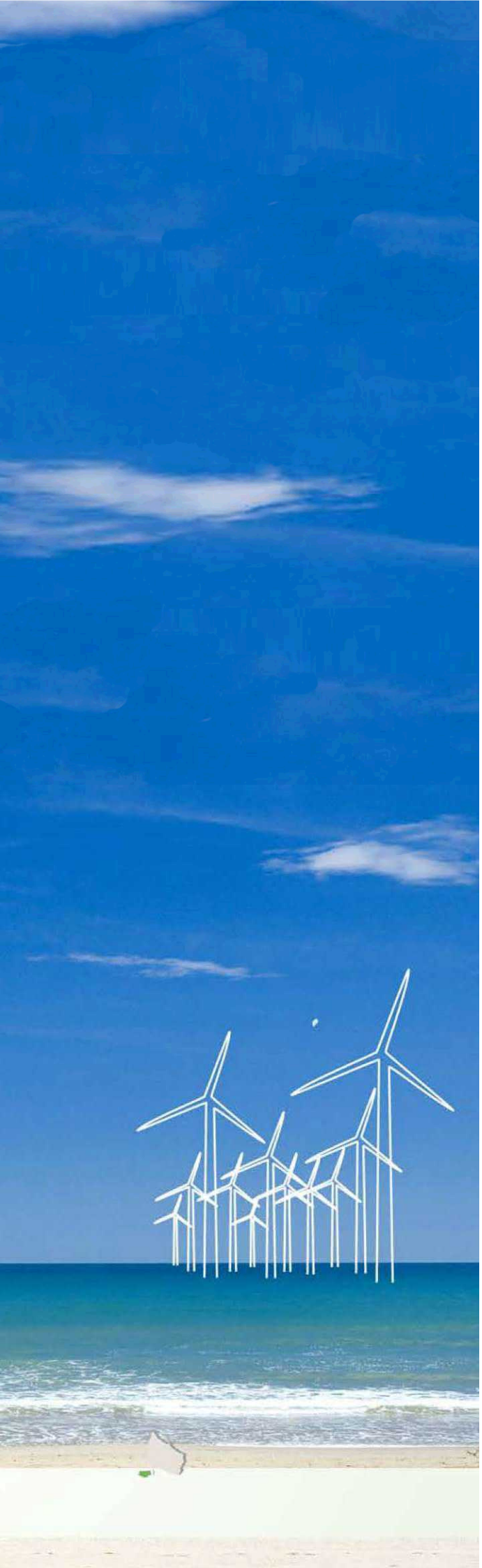

ENERGI STYRELSEN

Bornholm

Offshore Wind Farm

Environmental Statement

Part 0: Non-Technical Summary

April 2015

Colophon

Title: Bornholm Offshore Wind Farm. Environmental Statement.
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What is EIA?

EIA is an acronym for Environmental Impact Assessment.

Among other things, regulations for environmental impact assessments are intended to ensure that power production facilities at sea, which may be assumed to substantially impact the environment, can only be erected following a so-called Environmental Statement (ES). The goal of producing an ES is to provide the best possible foundation for both public debate and the final decision to implement the project. In the ES the direct and indirect impacts of the project on the environment are investigated, described and assessed. This includes impacts on:

- People, animal and plant life
- Soil, water, air, climate, and landscape
- Material goods and cultural heritage
- The synergy between these factors

The ES is published and provides basis for public debate. Based on the ES and the comments received during the public hearing The Danish Energy Agency (Energistyrelsen) evaluates whether the project is accepted with the described environmental impact and makes the final decision on the project's implementation.

Table of Contents

Part 0 Non-Technical Summary

This Environmental Statement for Bornholm Offshore Wind Farm consists of five parts:

- Part 0: Non-Technical Summary
- Part 1: Introduction and Background
- Part 2: The Marine Environment
- Part 3: The Onshore Environment
- Part 4: Summary and Conclusion.

This report the 'Non-Technical Summary' is Part 0 of the Environmental Statement for Bornholm Offshore Wind Farm. For additional details about the structure of the report in its entirety, please refer to the readers guide in Part 1 of the Environmental Statement: Introduction and Background.

Offshore Wind Farm (Photo: Energinet.dk).

1 Introduction

Like many other countries, Denmark has a significant energy policy challenge in terms of securing energy supply, while helping to reduce global warming by reducing emissions of greenhouse gasses.

To meet the challenge, on March 22, 2012, a broad political majority in the Danish parliament, Folketinget, passed an Energy Policy Agreement for the period 2012-2020.

The goal is that Denmark's entire energy supply (power, gas, heating) and transportation will be based on sustainable energy in 2050. The energy policy agreement will ensure that wind power will produce 50 percent of the total Danish power usage by 2020. As part of the implementation of the energy policy agreement it was decided that 450 MW offshore wind turbines divided into 6 nearshore wind farm areas must be erected before 2020.

On July 14, 2014 a large majority of the parties in Folketinget joined the government in a growth package agreement. As a result, the call for tenders for nearshore wind turbines was reduced from 450 MW to 350 MW.
The analyses and research which forms the basis of this Environmental Statement are based on the intention to establish a total of 450 MW nearshore wind turbines. Subsequently, it has been assessed that this reduction will not affect the assessments and conclusions of this Environmental Statement, because the goal of establishing a 50 MW offshore wind farm in the area covered in this Environmental Statement remains unchanged.

In November, 2012 the government and the parties to the agreement decided that research and calls for tender for erecting nearshore wind farms as well as planning for cable landfall and necessary improvements to the power grid on land must be completed for six areas for nearshore wind farms. The six areas are: Bornholm, Vesterhav Nord, Vesterhav Syd, Sæby, Sejerø Bugt and Smålandsfarvandet. In each area a maximum of 200 MW offshore wind turbines may be erected, however, in the Bornholm area the maximum is 50 MW. The locations of the areas are shown on Figure 1-1.

The call for tender for all six areas will be issued by the Danish Energy Agency (Energistyrelsen) and bids received for all areas will compete against each other. The expectation is not to establish nearshore wind farms erected to the maximum capacity allowed in all six areas, since only a total of 350 MW will be awarded.

In order to strengthen local ownership, the parties to the energy policy agreement have decided that an agreement (Køberetsordningen), which is in force for wind turbines on land, will also be in force for nearshore wind turbines. The agreement allows local citizens to by equity shares in a future wind turbine project thus own-

ing a part of any future profits. The developer of the wind farm is required to offer at least 20 % of the project for sale to local citizens.

Figure 1-1. Locations of the six nearshore wind farm project areas.

In addition, the Danish Loss of Value to Residential Properties Programme (Værditabsordningen) also covers the coastal wind turbines. This program allows for claims for compensation for loss of value on residential properties resulting from the erection of wind turbines. The amount of the loss is determined by the Valuation Authority (Taksationsmyndigheden) based on an individual assessment.

In order to establish the offshore wind farms permits are required which are dependent on completing so-called environmental impact assessments, including completing any necessary pre-investigation to form the basis of the environmental impact assessments.

The Danish Energy Agency (Energistyrelsen) is the permitting EIA authority and coordinates the government processing of the project. The Danish Energy Agency will grant the actual construction license for the offshore wind farm including the inter array cables and the submarine cables which deliver the power to shore and to the Danish power grid.

In January 2013, Energinet.dk, the Danish Transmission System Operator (TSO), was instructed by the Minister of Climate, Energy and Building to manage the preparation of Environmental Statements for the six nearshore wind farms preceding the issuance of calls for tender for construction and operation of the offshore wind farms. Energinet.dk is an independent public company owned by the Danish Minister of Climate, Energy and Building and with its own board of directors. Energinet.dk owns, operates, and expands the main power grid, which serves as the energy 'motorway'.

The environmental impact assessment was begun in June 2014 by issuing a call for ideas and suggestions from the public. Subsequently, input received from the public and the results of preliminary investigations have been processed and this environmental impact report presents the overall assessment.

2 Bornholm Offshore Wind Farm

The framework for the investigation of the project was given in the instructions from the Climate, Energy, and Building Ministry and accordingly investigations have been carried out based on 50 MW as the maximum production for Bornholm Offshore Wind Farm. The offshore wind farm must deliver this production no later than 2020.

The investigated area for Bornholm Offshore Wind Farm is show in Figure 2-1. The area is located at a distance of no less than 4 km from the coast south of Rønne.

Bornholm Offshore Wind Farm will be placed inside an investigated area measuring approximately 45 km². In this area, only an area measuring up to 11 km² will be used to erect the wind farm. The power which is produced by the offshore wind turbines will be delivered by export cables to shore on the coast southeast of Rønne.

The investigated area covers the area where the offshore turbines will be erected and the inter array cables between the wind turbines and the cable corridors for the export cables.

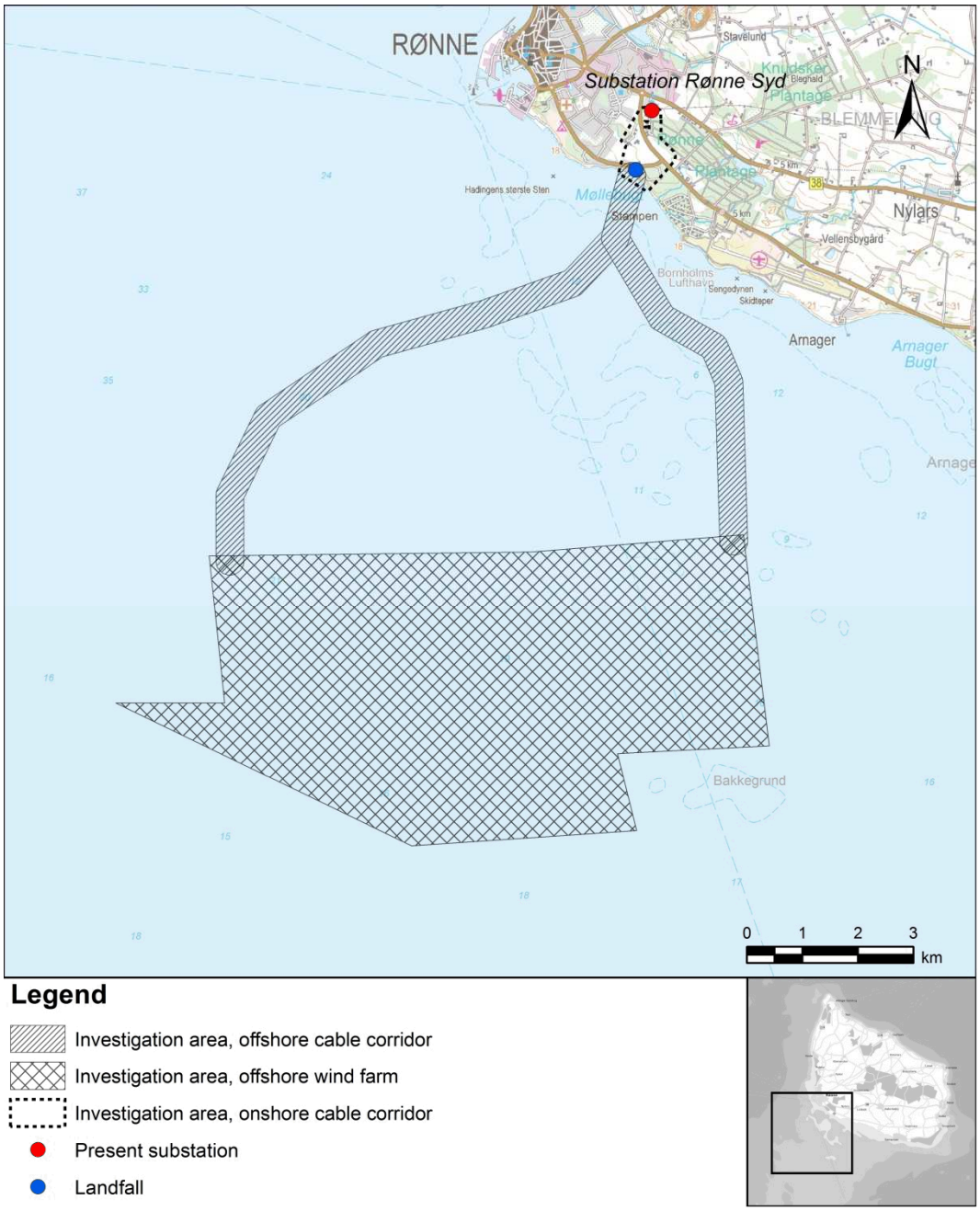

Figure 2-1. Investigated area for Bornholm Offshore Wind Farm.

The design of the offshore wind farm is not finalized, but will be decided by the future owner and developer of the offshore wind farm.

Construction of the export cable to shore which will ensure transportation of the power produced to the existing power grid onshore.

Figure 2-2. Main elements of the project, which are covered in the environmental impact assessment. (Photos: Energinet.dk).

2.1 Design of the Offshore Wind Farm

The future owner and developer of the offshore wind farm will be responsible for construction of the offshore wind farm. Accordingly, the design, wind turbine type, and foundation type will be determined by the future owner and developer taking into accounts the energy utilization in the area and the requirements of the Danish authorities among other things. Therefore, the final decisions regarding the size of the offshore wind farm (the maximum power production) and the number and type of wind turbines will depend on who is awarded the Danish Power Agency's EU-tender, which will be decided in 2016.

Accordingly at this time it is not known which type or size of wind turbine will be erected. One option is to erect many small turbines (e.g. up to 16 3MW wind turbines). Alternatively, fewer larger wind turbines (e.g. five 10 MW wind turbines) could be used. Finally, wind turbines between those two sizes could be used.

Table 2-1. Overview of wind turbine sizes (examples in the interval from 3 to 10 MW).

Wind Turbine Type, MW	Number of Offshore Wind Turbines	Rotor Diameter, m	Total Wind Turbine Height, m
3	16	112	137
6	8	154	179
10	5	190	220

Regardless of the size and design of the offshore wind turbines, the area required by the wind farm will be approximately the same. Larger wind turbines will require more space between the wind turbines than smaller wind turbines.

The offshore wind turbines consist of a round tower, with a rotor and a nacelle at the top. Three rotor blades are attached to the rotor and the nacelle contains a generator and a gear box, among other things.

The wind turbines begin producing power in light winds (3-5m/s). Maximum power production is reached in strong winds (12-14 m/s). To protect the wind turbine from overload, the wind turbine stops when the wind speed reaches gale force (24-25 m/s).

The site layout for the 50 MW offshore wind farm near Bornholm has not been chosen yet. Examples of possible site layouts for 3 MW, 6 MW and 10 MW offshore wind turbines respectively are shown in Figure 2-3.

The investigated area chosen is larger than the 11 km² and can potentially accommodate significantly more offshore wind turbines than a 50 MW wind farm. The offshore wind turbines must be placed together in one group inside the investigated area.

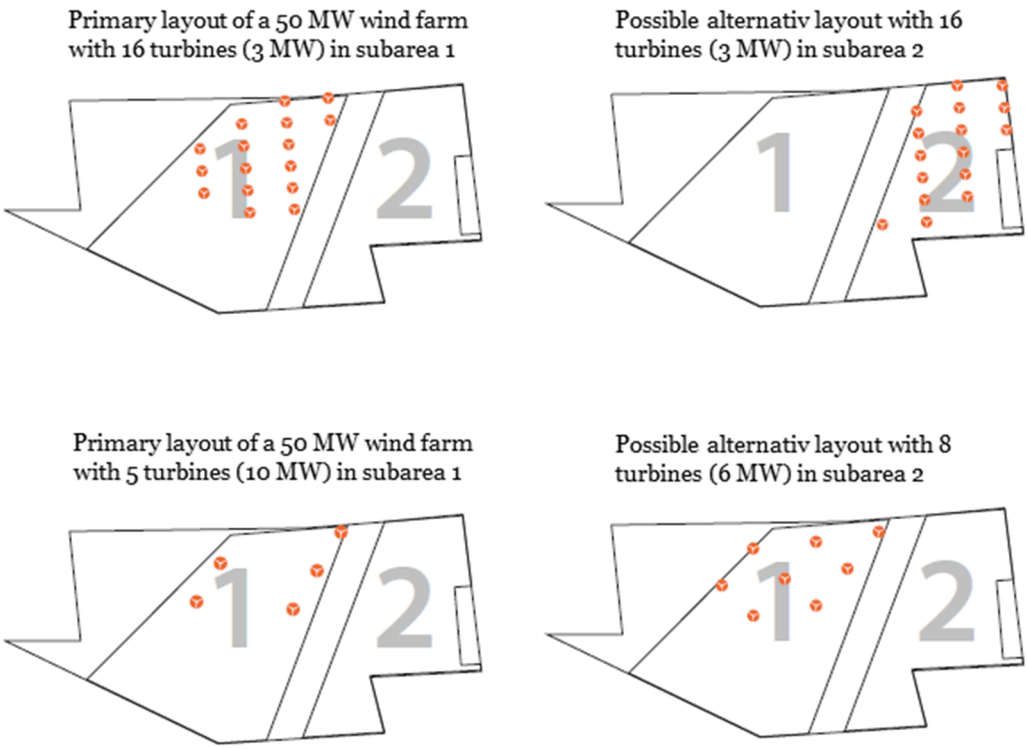

Figure 2-3. Examples of possible site layouts with a maximum capacity of 50 MW for 3 MW, 6 MW and 10 MW offshore wind turbines respectively.

2.2 Construction of offshore wind turbines and cable corridor

The wind turbine towers must be fastened to foundations on the seabed. Several types of foundations may be used and require different construction methods.

It is expected that the foundations used for the Bornholm offshore wind farm will be of one of the following types:

- A *monopile foundation* which is in the main a tube of steel which is driven into the seabed.
- A *gravity foundation* made of concrete and stays in place on the seabed due to the weight of the structure.
- A *jacket foundation* is a three or four legged steel structure which is typically used for large offshore wind turbines and deep waters.
- A *suction bucket foundation* consists of an upside down bucket-like structure which is attached to the seabed using a vacuum.

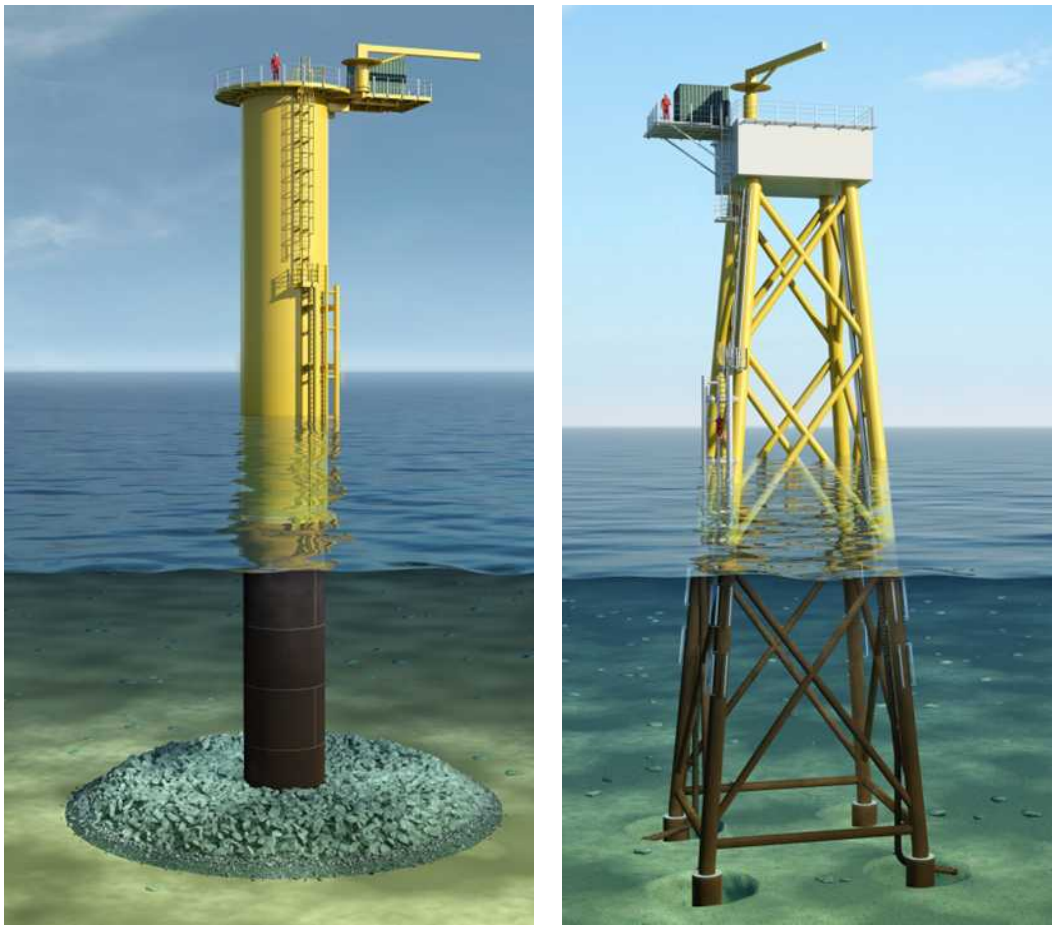

Figure 2-4. *Monopile of steel (left). Monopiles have been utilized for a large number of offshore wind Farms, including offshore wind farm Horns Rev 1, offshore wind farm Horns Rev 2 and Anholt Offshore Wind Farm (Drawing: Rambøll). Jacket foundations (right) have not been used in Danish offshore wind farm construction, but have been used by British offshore wind farms, among others. (Drawing: Rambøll).*

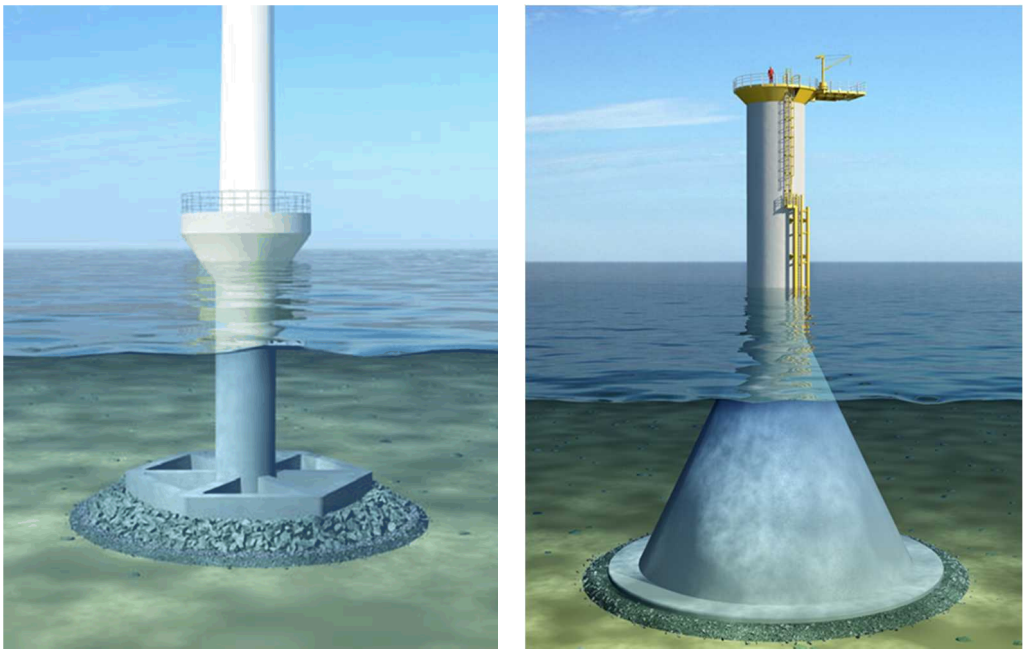

Figure 2-5. Gravity foundations have been used by a number of Danish offshore wind farms, including MidPart site, Nysted Offshore Wind Farm, Rødsand II and Sprogø Offshore Wind Farm. The figure shows outlines of two different types of gravity foundations with erosion control made of rocks. (Drawing: Rambøll).

Offshore wind turbine installation is typically carried out by one or more installation vessels. The wind turbine components are either transported from the port of discharge on barges or on the installation vessel itself. The large wind turbine components (tower, nacelle including rotor hub, and 3 rotor blades) are lifted into place one at a time using a crane on board the installation vessel. The installation is supported by a number of smaller supporting vessels carrying equipment and personnel.

Around the wind turbine foundations there is a risk that the ocean current will remove sediment from the seabed and leave large holes. To prevent this erosion a protective layer of rocks is placed around the foundations. The design of the erosion control depends upon the type of foundation.

The offshore wind turbines are connected by inter array cables and subsequently to export cables to shore and Substation Rønne Syd. All subsea cables will be buried in the seabed to prevent damage by fishing equipment, dragging anchors, etc.

Depending upon the seabed conditions the subsea cables will be jetted or ploughed into the seabed, or laid in a prepared trench at a depth of 1-1.5 m below the seabed depending on the method used. It may be necessary to cover the cables with rocks if the seabed conditions prevent laying the cables at the desired depth.

Figure 2-6. The use of suction bucket foundations is relatively recent. In Denmark this type of foundation has been used for the research mast at Offshore Wind Farm Horns Rev 2 and for a test wind turbine near Frederikshavn. Typically this type of foundation functions like a combination of a gravity foundation and a monopile foundation. (Photo: Aalborg University/Scanpix).

2.3 Decommissioning the Offshore Wind Farm

The lifespan of the offshore wind farm is estimated to be up to 30 years. A plan for removing the offshore wind farm is expected to be made two years before the end of the lifespan of the offshore wind turbines. The extent of the decommissioning is not known at this time but would be expected to include the following:

- Offshore wind turbines are removed completely.
- Foundations are removed wholly or partially to the level of the seabed.
- The inter array cables which connect the wind turbines are removed, or are left below the seabed and protected with a layer of rocks.
- Export cables between the offshore wind farm and the coast are left below the seabed level, or protected with a layer of rocks.
- Erosion control rock layers surrounding wind turbine foundations are left in place on the seabed.

In the case of the foundations, it is likely that monopiles and jacket foundations will be cut just below the seabed. Gravity foundations may possibly be left standing, since they may have acquired an important function as artificial reefs with rich plant and animal life during the operational phase. If foundations are left on the seabed after dismantling of the wind turbines they can constitute a risk for navigation or fishery. In that connection it is expected that the authorities will make requirements regarding navigational safety in the area. Suction bucket foundations can be removed immediately by increasing the pressure inside the bucket.

2.4 Investigated Alternatives

This Environmental Statement for Bornholm Offshore Wind Farm only covers the main proposal and the 0-alternative, which is the situation in which the offshore wind farm is not developed. Bornholm Offshore Wind Farm is located in one of the six total areas which were chosen for investigation and tender for nearshore wind farms and planning for landfall and onshore facilities according to the 2012 energy policy agreement.

Accordingly, the location and delineation of the investigated area for the offshore wind farm was decided politically. Based on this, no additional alternative locations beyond the six areas chosen by the political parties to the energy policy agreement will be assessed.

2.5 Time Table

Since the developer has not been chosen yet, a detailed time table for the project is currently unknown. The developer is expected to be chosen at the beginning of 2016 and immediately following that the planning will begin. Bornholm Offshore Wind Farm is expected to be ready and operational by 2020 at the latest. Construction of the offshore wind farm and the associated onshore facilities will be completed over a period of approximately two years. Figure 2-7 shows the overall time table for the project.

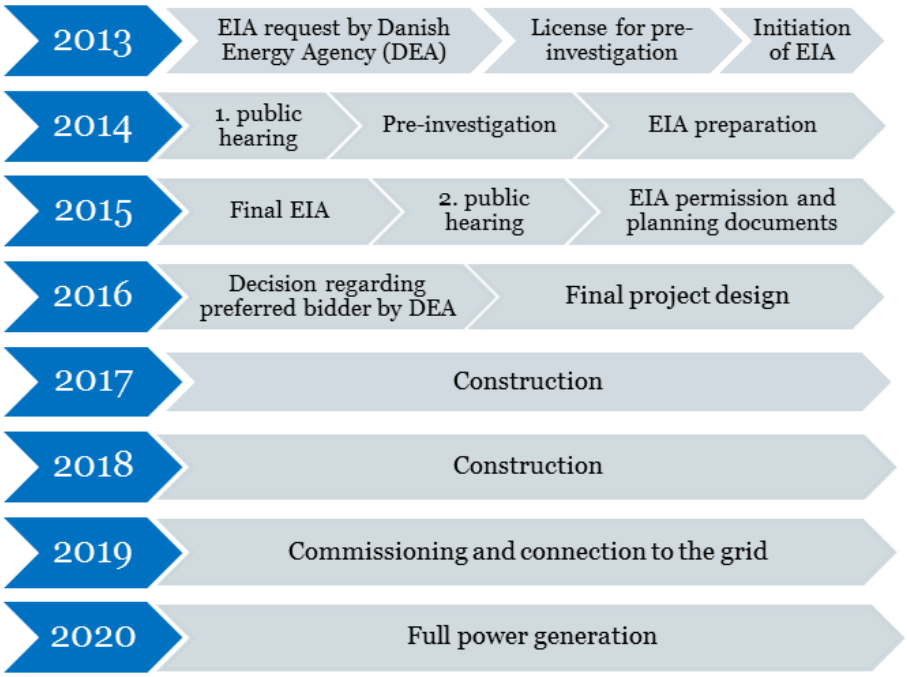

Figure 2-7. Overall table for the expected project sequence.

2.6 Environmental Impacts and the Environmental Impact Assessment as a Worst Case Scenario

The design of Bornholm Offshore Wind Farm is not yet firm and the choice of wind turbine type also remains to be made, since a defined construction project will not be available until the future owner and developer receives a construction license.

Accordingly, this Environmental Statement has been completed based on a 'worst case' scenario, meaning that assessments were made assuming the worst possible impacts within the technical limits of the project. Included in this environmental impact assessment are the impacts of a variety of site layouts, wind turbine types, foundations, and construction methods for the offshore wind farm. The purpose of investigating a number of differing project designs is to assess environmental impacts and requirements for construction of the final project. The future owner and developer of the offshore wind farm will choose the design of the offshore wind farm including choice of wind turbine size, type of foundation, etc. and may also choose to erect an offshore wind farm with a production of less than 50 MW.

Design and construction solutions which result in environmental impacts exceeding those described in this Environmental Statement are not permitted, as this assessment is considered the 'greatest impact assumed' – also known as 'worst case'.

3 Landscape and Visual Impacts

The coastal landscape surrounding the investigated area for Bornholm Offshore Wind Farm is described following the principles of a Danish method for describing landscapes which is called the 'Landscape Character Method' (Landskabskaraktermetoden). The description includes the existing landscape and cultural heritage conditions and the spatial and visual conditions, vulnerabilities, and character of each individual area. In order to assess the visual impact of the offshore wind farm the description is supplemented with visualizations of the offshore wind farm from several points on the coast and also from high points further inland by Aakirkeby and Almindingen. The visualizations have been completed showing clear weather, overcast/foggy weather, and finally night time darkness.

3.1 Landscape, Cultural Heritage and Visual Conditions

The Danish landscape shows clear evidence of how Denmark has developed geologically over time. Geologically, Bornholm is very interesting and a number of designated geological areas of national significance are found on the island.

The cliff profiles along the coast are important to understanding and teaching the geology of the creation of the landscape many millions of years ago.

The landscape of Southern Bornholm is a gently undulating, open agricultural landscape oriented towards the coast. The landscape also encompasses significant experiential values along the coast in the form of wide views of the sea and along the coast as well as landscapes where the round churches of Bornholm form part of the view.

The area surrounding Almindingen is particularly interesting because the landscape here shows the impact of bedrock faults on landscape creation and provides a very clear geological history today. This area is a very popular tourist attraction. The area is approximately 10 km. from the offshore wind farm. The southern part of Almindingen in the middle of Bornholm around the highest areas on the island is a nature conservation area.

For these reasons, the investigated area for the landscape impacts of the offshore wind turbines includes these landscapes inside a radius of approximately 15 km surrounding the offshore wind farm. The assessment particularly focuses on assessing the degree of impact upon the especially characteristic and experientially significant landscapes by the proposed nearshore wind turbines.

Figure 3-1. Bornholm's southern cliff coast viewed towards the west.

3.1.1 The Offshore Wind Farm

The great height of the offshore wind turbines means that they can be seen across a very large area. In this Environmental Statement the 3 MW, 6 MW or 10 MW wind turbines in the visualizations are shown with a total height of 137 m, 179 m and 220 m respectively. Figure 3-2 shows the onshore areas which are deemed to be inside the immediate and intermediate zones of the offshore wind farm respectively.

The offshore wind turbines will be particularly visible along the southern coast of Bornholm. The cliff coast between Rønne and Boderne is characteristic and comprises are particularly rich experiential coastal landscape. In addition to the scenic views of the sea and along the coast, the landscape tells an important geological creation story. The beach and the cliff generally define a landscape which is separate from the agricultural landscape further inland and where the forces of nature, wind and water are crucial to its appearance.

The impact will be presented during the entire operational phase and will affect landscapes encompassing national or local conservation interests across large parts of the investigated area. Inside the immediate zone the impact will be *moderate* to *major* and in the intermediate zone the impact will be *negligible* to *major*.

The assessment shows that the impacts of 3 MW, 6 MW, and 10 MW offshore wind turbines on the coastal landscape along the south facing and partially southeast facing coasts will be *major*. The impact diminishes the further inland the observer is, but will continue to affect the views which are particularly characteristic of the landscape northeast of Rønne and west of Aakirkeby. In scenic views at Almindingen, the offshore wind turbines will be visible and a part of the views which are attractions in the area. However, the great distance to the off-

shore wind farm means that that wind farm will be a minor element in the landscape and in the view according to this assessment.

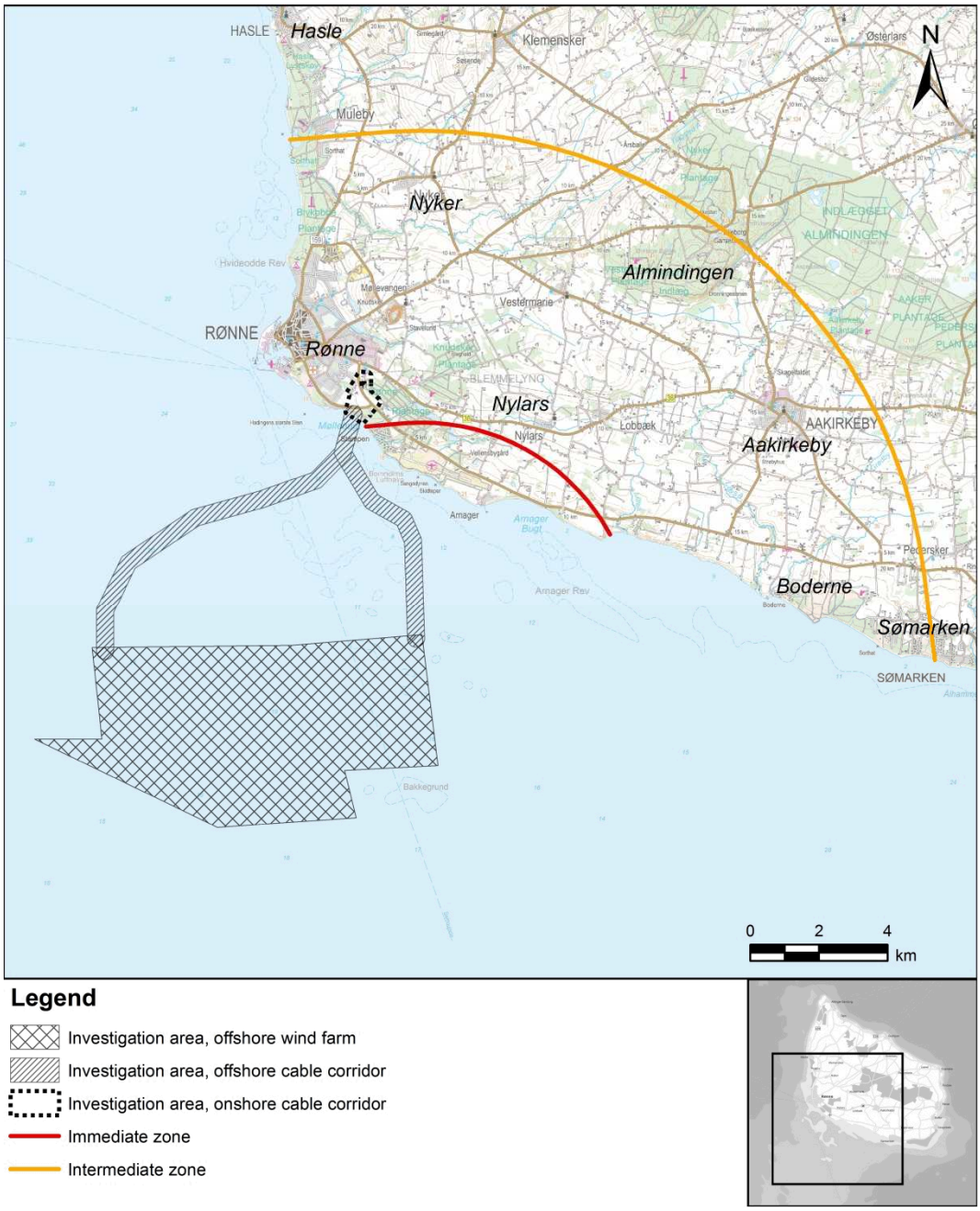

Figure 3-2. The location of the offshore wind farm and the limits of the immediate and intermediate zone.

The visual impact of a site layout with 3 MW, 6 MW or 10 MW offshore wind turbines respectively as seen from the beach at Arnager southeast of Rønne is shown in Figure 3-3.

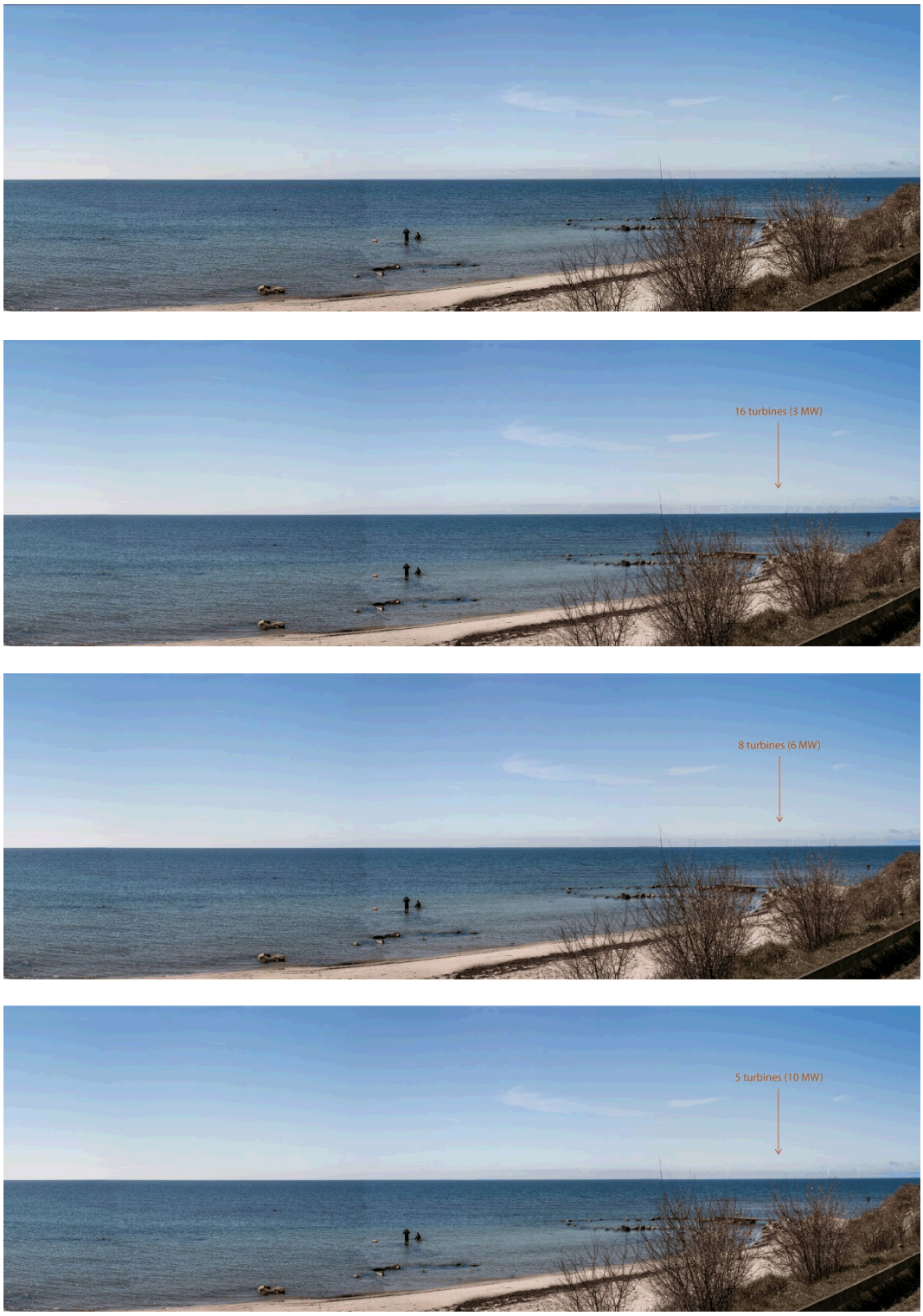

Figure 3-3. *The view from Arnager along the coast line and over the sea is completely undisturbed today. The top image shows the existing conditions and below follows views including 3 MW, 6 MW and 10 MW offshore wind turbines respectively in a site layout with two rows.*

Selected visualizations have been reproduced in this part of the report as examples. It is emphasized that the images have been reduced significantly from their original size (A3) and that in this report they are only intended to provide a general impression and should not be construed as showing accurate visual impact. In Part 3 of the Environmental Statement and in a separate report more examples are given of visualizations of the wind turbines from other viewpoints in clear weather, foggy weather, at dusk, and in the dark of night.

Due to the statutorily required warning lighting of the offshore wind turbines, the visual impact will also be present at dusk, at night and in poor weather, during which one will be able to see the blinking lights on the wind turbines. The lighting at night will consist of red lights attached to the nacelle of the offshore wind turbines. The lights will flash at regular intervals. During the day the same lighting as at night will be used on wind turbines at a height lower than 150 m, while lighting on wind turbines over a height of 150 m (e.g. 10 MW wind turbines) will be different. For wind turbines over 150 m an intensive white blinking light must lit during the day. Furthermore the wind turbines will be marked with yellow flashing light for navigation and the lowest part of the foundations will be painted yellow. The visualization below illustrates a situation in which the lights are 'on' but the visualization cannot illustrate the effect of the blinking itself. The blinking of the lights is assumed to accentuate the visual impact somewhat.

The lighting means that the landscape will also be impacted during the night.

Figure 3-4. View from Arnager with overcast weather approximately 6.2 km from the closest 10 MW offshore wind turbine. The five offshore wind turbines are erected in two rows.

Figure 3-5. View from Arnager at night approximately 6.2 km from the closest 10 MW wind turbine. The five offshore wind turbines are erected in two rows.

4 Population and Health

Construction and operation of an offshore wind farm may impact the people who use the area for recreational and outdoor activities.

4.1 Emissions and Noise

There will be noise during the construction. In particular, noise from driving monopile foundations into the seabed warrants attention. This activity can result in short term noise impacts above the recommended limits for construction during the night. It takes approximately six hours to drive a monopile into the seabed. Since this noise impact is very limited and of short duration, it is not expected to produce significant noise impact. If other types of foundations are used, no noise exceeding the noise level guidelines is expected.

Substations emit noise and this noise will be constant around the clock, however, the noise level from the new facilities will conform to the current limits for industrial noise of 35-40 dB(A) during the night at the nearest neighbouring residential property.

Operational noise - including low frequency noise - from the offshore wind farm is within the limits at the coast, in some places with a substantial margin even.

As such, there will be no significant impact on the population due to noise and also no impact on health.

4.2 Fishing

Construction and operation of the offshore wind farm may impact fishing in the area. Fishery and unauthorized access will be prohibited in the construction area during the construction phase. Once the facility has been completed fishing with nets and other passive equipment is expected to be allowed both at the offshore wind farm and in the cable corridors, and thus no economic loss is expected for this type of fishing. Fishing with trawling equipment is expected to be banned in the offshore wind farm as well as the cable corridors.

Fishing is relatively limited at Rønne Banke including in the investigated area because the seabed makes fishing with trawling equipment impossible. A few vessels periodically fish using hooks, long lines or nets inside the investigated area or between the investigated area and the shore.

There is no fishing using trawl in the investigated area or in the cable corridors, and accordingly no negative consequences for this type of fishing are predicted.

5 Plant and Animal Life

The plant and animal life has been investigated and assessed. Relevant nature interests include conditions for fish, marine mammals, and birds among others. The investigated offshore area is located in a part of the Baltic Sea which has abundant bird life and the area also features good conditions for populations of several species of fish.

Particularly relevant are those species and habitats which are covered by international wildlife conservation interests (so-called Annex IV-species and Natura 2000 areas). Since harbour porpoises are so-called Annex IV-species and on the designation basis for Natura 2000 areas in the North Sea, the harbour porpoises are both treated under section 5.1 about international nature protection and section 5.2 about the marine environment. The same applies for bats, which are also Annex IV-species and are also treated in section 5.1 about international nature protection and section 5.2 about the marine environment.

The descriptions and assessments of conditions related to plant and animal life are partially based on existing knowledge and partially on a number of field surveys carried out in connection with the project.

5.1 International Nature Conservation

Natura 2000 is the name of the international ecological network of a number of natural areas in the EU, the so-called habitat areas and bird conservation areas. These areas are chosen based on the Habitat Directive and the Bird Directive. For each Natura 2000 area there is a list of species and habitats which are conserved in that particular area. The purpose of the Natura 2000 network is to ensure favourable conservation status for those species and habitats which are conserved objectives of the individual Natura 2000 areas.

Annex IV of the Habitat Directive contains a list of specific animal and plant species which the member countries are committed to protect in general both inside and outside Natura 2000 areas. These species are called Annex IV-species.

5.1.1 Natura 2000 Areas

The investigated area does not cover any Natura 2000 areas directly, but as shown in Figure 5-1, there are a few Natura 2000 areas near by the investigated area. The closest Natura 2000- area is Area No. 212: Bakkebrædt and Bakkegrund, which is located at offshore less than 100 m southeast of the investigated area for the Offshore Wind Farm.

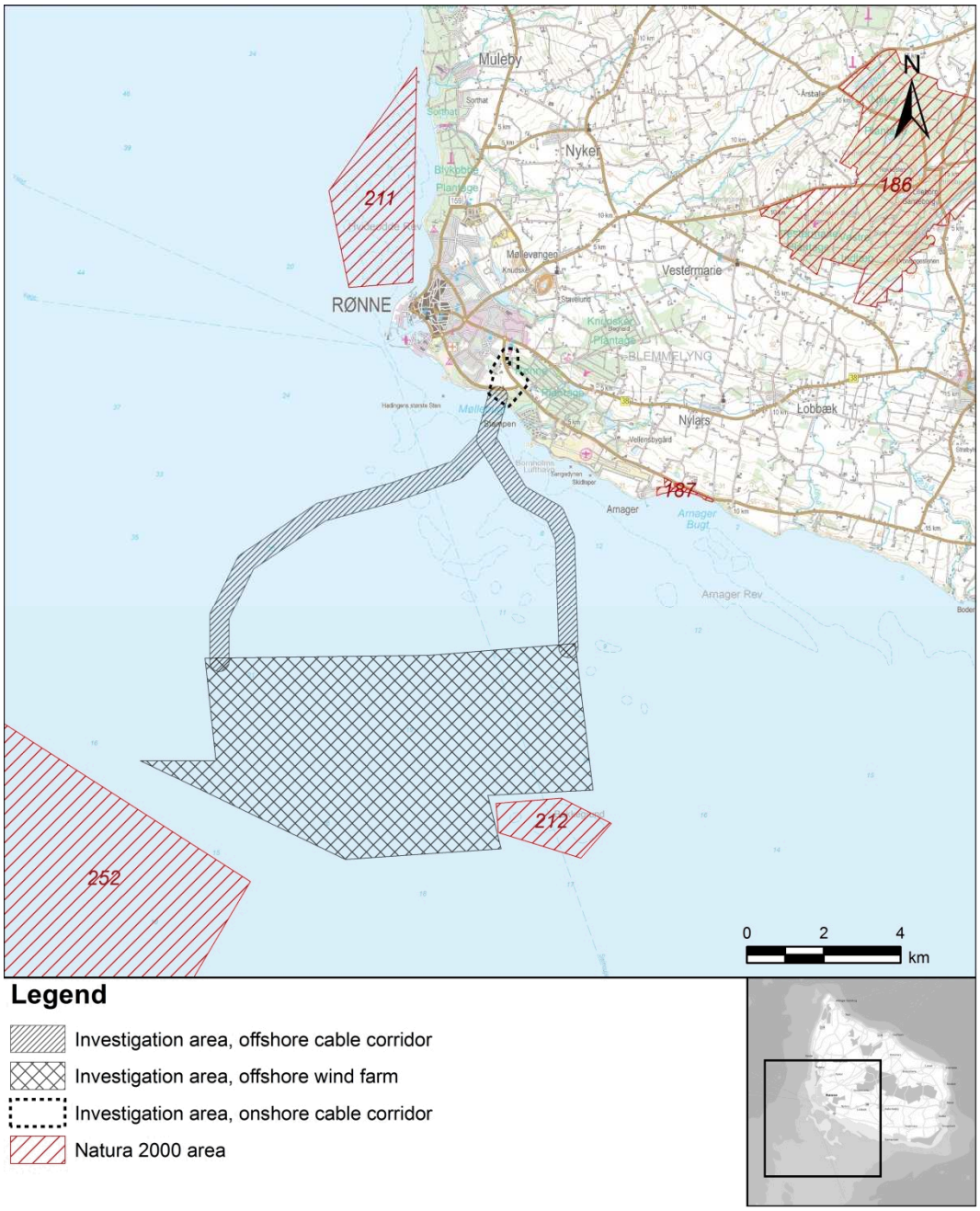

Figure 5-1. The investigated area for Bornholm Offshore Wind Farm and the nearest Natura 2000 areas.

Impacts on the habitat types listed on the designation basis for the nearest habitat areas will be caused by sediment dispersal first and foremost, since no construction is being carried out inside the actual habitat areas. No significant impact upon the Natura 2000 areas is expected, since no matter where in the investigated area the offshore wind turbines are located, the sediment dispersal caused by construction will be limited to a very small part of the Natura 2000 area and the impact will be short term.

The species listed on the designation basis for the nearest habitat areas which are relevant to the impact assessment for the offshore wind farm, are seals (harbour seal and grey seal) as well as harbour porpoises. The closest habitat areas where these species are listed on the designation basis, are located more than 45 km from the investigated area. Due to the distance, the project is not expected to result in any major impacts on the seals and harbour porpoises in these areas.

Impacts on birds that are listed on the designation basis for bird conservation areas near Bornholm Offshore Wind Farm include among others the risk of collision with the offshore wind turbines. This may potentially impact bird conservation areas at a great distance from the offshore wind farm. Based on an examination of bird conservation areas in a radius of 150 km from the investigated area for Bornholm Offshore Wind Farm an assessment of which bird species may potentially breed in the investigated area for the offshore wind farm as well as which bird species may migrate and overwinter inside the investigated area.

As far as breeding birds are concerned, only guillemot and razorbill are relevant, while the red-throated diver, black-throated diver and guillemot are relevant as overwintering birds. Relevant migrating birds include the greater white-fronted goose, barnacle goose, dark-bellied brent goose, eurasian widgeon, northern pintail, european honey buzzard, western marsh harrier, rough-legged buzzard, common kestrel, common crane and eurasian sparrow hawk. However, the overall assessment is that there is no risk of major impacts on breeding birds, overwintering birds, or migrating birds listed on the designation bases for the nearby bird conservation areas.

According to the legislation, impacts on Natura 2000 areas must also be assessed in connection with other projects. It is only relevant for migrating cranes, and thus a more specific Natura 2000 impact assessment for this species has been produced. It is concluded in the Natura 2000 impact assessment that Bornholm Offshore Wind Farm neither by itself nor in combination with other projects will harm or affect the preservation objectives for migrating cranes, stated in the designation basis for nearby Natura 2000 areas.

5.1.2 Annex IV-species

In accordance with the habitat regulations, damage or destruction of the breeding and staging areas of the Annex IV-species caused by the project must be prevented.

Based on the results of field surveys conducted in 2014, existing knowledge about Annex IV-species within and near the investigated area, as well as knowledge of the expected impacts of the project, the assessment has been limited to include the following species: harbour porpoises and bats.

The assessment concludes that if a number of mitigation measures are implemented the ecological functions of the Annex IV-species' breeding and staging areas will not be impacted by the construction, operation, and decommissioning of Bornholm Offshore Wind Farm.

5.2 Current and Wave Conditions

Current and wave conditions are some of the most crucial conditions of life in the ocean. The offshore wind turbine foundations will provide some resistance to the current in the area, but model calculations show that the impacts on both wave and current conditions will be very limited.

5.3 Sediment

During the construction phase, it is possible that there may be an impact on the seabed caused by the construction of the offshore wind turbine foundations and inter array cables. This may result in spilling and dispersion of sediment from the seabed. The impact of the sediment and the resulting impact on e.g. the light conditions at the seabed due to elevated sedimentation levels in the sea water are expected to lead to a minor impact on the seabed morphology and sediment conditions in the area.

5.4 Seabed Animal and Plant Life

The wind turbine foundations and the protective layer of rocks (erosion protection) around the foundations will take up space on the seabed. Both will function as so-called artificial reefs where species that do not live in on the soft areas of the seabed can live on the rocks.

Because the seabed consists of sand, rocks, and mixed materials the animal life on the seabed is characterized by species which are especially connected to this type of environment. Species such as marine worms, crustaceans, and molluscs are dominant. Vegetation in the wind turbine area is very sparse and only found where the seabed is a mix of sand and rocks.

Only *negligible* impacts on the seabed conditions will be caused and since only a very small part of the seabed will be covered by wind turbine foundations and the impact of sediment is very limited, the total impact on the animal and plant life of the seabed will be *negligible* to *minor*.

5.5 Fish

The seabed conditions also determine which fish are able to live in the area. Many fish need specific seabed types especially flatfish. Species which are abundant, ecologically very significant, and/or important for the fishing industry are called

'keystone species'. Keystone species in the area surrounding the investigated area include among others: cod, flounder, plaice, herring, sprat, and salmon.

During the construction phase there will be shorter periods of physical disturbance of the seabed, including dispersal of sediment. Because of the short term nature of construction and the relatively low increase in concentration and small area affected there will be no impact on fish.

In connection with construction, underwater noise from driving monopile foundations may have a short term impact on the fish community. Based on the planned number of wind turbine foundations the total period of pile driving noise will be very limited meaning less than 100 hours during the first half of the construction phase. This fact combined with the good opportunities fish have to leave the construction area means that the noise from pile driving will result in only a *minor* impact on fish.

Construction of the offshore wind turbine foundations will replace the naturally occurring seabed with a new environment in the form of concrete, rock beds, and steel. The foundation and the erosion control will function as so-called artificial reefs. The impact on fish and the fish community may potentially be positive, but is estimated to be low since hard bottom areas already occur in the area and the erosion control and wind turbine foundations will not significantly alter the extent of this sea bed type. Thus, the assessment of the overall impact is that the impact on fish will be *negligible*.

Surrounding the inter array cables between the wind turbines and around the export cables an electromagnetic field will be created. The intensity of the field will quickly decline with increasing distance to the cables, and it is estimated that it will not impact the ability of fish to navigate.

5.6 Marine Mammals

Harbour porpoise is the most common species of whale in Denmark and can be seen year round in Danish waters. There are very few harbour porpoises in and around Rønne Banke and in addition harbour porpoise activity has only been measured during the June-October period. The few harbour porpoises at Rønne Banke are most likely members of a larger population in the Kattegat, the Belts (Bælthavet), Oeresund and the western part of the Baltic Sea. At present, no good estimate of the size of that population is available.

Harbour seal is the most commonly found seal species in Denmark. It is found mainly in coastal waters where food such as fish, squid, and crustaceans are abundant. This species is listed in Annexes II and V of the Habitat Directive, however, it is not a part of the designation basis for any habitat areas near the investigated area. The closest habitat where harbour seal is on the designation basis

is H126: Saltholm and surround waters which are located 120 km northwest of the investigated area.

Grey seal is listed in the designation basis for Habitat Area No. 210 Ertholmene which is located approximately 45 km from the investigated area. It is estimated that the investigated area for the offshore wind farm is of limited significance to the population of grey seal in the Baltic Sea, particularly when compared to areas in the central part of the Baltic Sea where the core area of the population is located.

If a monopile foundation type is chosen, the pile driving will produce very loud noise which can inflict both temporary and permanent hearing damage on marine mammals which are in the immediate vicinity of the source of the noise. In addition, the noise may cause behavioural changes particularly in harbour porpoises. Thus, it will be necessary to scare the marine mammals away from the area before pile driving begins.

In relation to the worst case scenario used in the ES to describe the noise distribution it is necessary to further reduce the noise to secure that no harbour porpoises contract permanent hearing damage.

If the marine mammals are scared away from the area prior to pile driving and it is secured that the noise will be reduced, so that no permanent hearing damage is inflicted on the marine mammals, the assessment shows that the noise impact on marine mammals will be minor.

5.7 Birds

The Baltic Sea is an important area for waterfowl that either live in the area permanently, use the area as a resting area, or passes through during migration.

5.7.1 Staging Birds

Staging birds either live permanently in the area or stage for a longer or shorter period of time. Migratory birds all stop to develop their fat depots so they can complete the long migration to and from their breeding areas.

The staging birds in the investigated area for Bornholm Offshore Wind Farm were counted from airplanes. Among the observed species were: long tail ducks, divers, and auks.

An offshore wind farm can negatively impact staging birds, because of changes to or loss of habitat and by disturbing or displacing birds from the area. When the offshore wind turbines have been erected and the offshore wind farm is in operation, the impact on long-tailed ducks due to the displacement effect is estimated to be *moderate*. The impact on divers and auks due to the displacement effect is

estimated to be *minor*. For all other species of staging birds the impact is estimated to be *negligible*.

By minimizing the offshore wind farm area, e.g. by erecting few but powerful wind turbines instead of many wind turbines with lower output, the impact on birds during operations can be mitigated.

Figure 5-2. Long-tailed duck is one of the bird species which are registered in the investigated area for Bornholm Offshore Wind Farm (Photo: Stefan Pfützke, www.green-lens.de).

5.7.2 Migratory Birds

Migratory birds perform directional migrations between a breeding area and the areas where the birds live during the rest of the year. The most important migratory birds in the investigated area for Bornholm Offshore Wind Farm belong to the following groups: ducks, raptors, cranes and sea birds.

Depending on the sensitivity of the species and the migration routes of the birds the barrier effect and collision risk may negatively impact birds. The assessment indicates that the species in the area which are most vulnerable to the barrier effect and collision risk associated with the wind turbines are: greater white-throated goose, barnacle goose, and dark-bellied brent goose, eurasian widgeon, northern pintail, european honey buzzard, western marsh harrier, eurasian sparrow hawk, rough-legged buzzard, common kestrel, red-throated diver, black-throated diver, eider, scoter, little gull and common crane.

According to the assessment, 12 bird species in all will experience minor impact from the collision risk and barrier effect created by the construction of Bornholm Offshore Wind Farm.

5.8 Migrating Bats

The description of bats in the investigation area is based on a literature review and additional site specific investigations of bats along the coast and at sea.

It is assessed that migrations of bats in the area are very irregular and only occur during the night at low wind speeds. Based on this existing knowledge the degree of impact is considered *minor*.

An investigation of migrating bats will be carried out during spring in order to investigate, if high numbers of bats pass the area.

6 Other Environmental Concerns

In addition to the plant and animal life, there are a number of other areas in which the environment may be impacted by the project.

6.1 Air Quality and Climate

The emission of airborne pollutants during the construction phase is relatively small and will not result in adverse effects.

During the operational phase the power production from the offshore wind farm will replace the equivalent power production from power plants that use fossil fuels. This will result in an annual reduction of approximately 40,000 tons CO_2, and also a reduction in the emission of acidic gasses, primarily nitrogen (NO_x). During the expected operational phase off the offshore wind farm of up to 30 years, the greenhouse gas emissions from power plants will be reduced by approximately 1 million ton CO_2 with the construction of a 50 MW offshore wind farm. The annual savings is equal to the CO_2 emissions of approximately 4,000 people based on emissions of 7.9 tons CO_2 per inhabitant in 2012.This is equal to approximately 0.1 percent of annual Danish CO_2 emissions.

6.2 Archaeological Cultural Heritage

There are no areas with potential for occurrence of Stone Age sites in the investigation area at sea. A few objects of archeologic importance have been identified, probably wrecks or wreckage.

If the final plant affects any objects or areas of potential archeologic importance or later added areas/locations they can be inspected or further investigated prior to the construction work in order to determine the actual culture-heritage potential, and mitigation measures can be implemented. A marine-archaeological feasibility study can be conducted according to the Museum Act and must be approved by the Danish Agency for Culture. Thus it is secured that the archeologic cultural heritage is not harmed.

6.3 Radar and Radio Links

There are no radio links which could be impacted by the offshore wind farm.

However, the presence of the offshore wind farm will disturb signals from radars used for a variety of purposes. Radar signals have a certain range depending on which objects are being observed (e.g. air planes or ships).

The military radar facility at Rytterknægten will experience *minor* impact during the construction phase and a *moderate* impact during the operational phase. The impact is due to the close proximity of the radar facility to Bornholm Offshore Wind Farm. The impact will be in the form of reflections, blocking, and echoing of the radar signal which will result in air planes or ships 'disappearing' or appearing in the wrong place on the radar when they are in or near the offshore wind farm. The two military early detection surface radars at Nexø and Hammeren will not be affected by the offshore wind farm. A detailed assessment of the offshore turbines' impact on the radars and potential mitigation measures must be completed in connection with the approval of the final project. A detailed assessment must be made of the offshore wind farm impact from radars and potential mitigation in connection with approval of the final project.

The navigation system at Bornholm Airport will experience a *minor* impact during the construction phase and a *moderate* impact during the operational phase.

Bornholm Offshore Wind Farm will also impact the radar of the Danish Meteorological Institute which is located at Rytterknægten, causing data to be hard to interpret which may result in errors in weather forecasts for the region. The weather radar will only be affected during the operational phase if tall wind turbines are chosen such as the 10 MW wind turbines because the radar only operates at heights above 183.5 m in the project area. The extent of the impact of the wind turbines on the weather radar is uncertain, but in a worst case scenario the impact will be *moderate*.

The impact on radar systems used for civilian vessels are expected to be *negligible* during the construction phase since only a few construction vessels are expected to be in the wind turbine area which may disturb the radar systems. During the operational phase, ship radars will be affected by the offshore wind turbines however, because radar is not the only navigation option available to the ships, but rather a supplement, the impact of the offshore wind farm is estimated to be *minor*.

6.4 Aviation

A small part of the investigated area falls within the approach plan of Bornholm Airport and due to safety requirements no objects which penetrate the approach slope may be placed there.

Erection of offshore wind turbines in this area will most likely be problematic. The reason is that the offshore wind turbines will function as aviation obstacles, which are expected to imply significant challenges in relation to maintaining the aviation security. This may have influence on the airport capacity.

Given the above, aviation to and from Bornholm Airport will be *moderately* impacted if wind turbines in the offshore wind farm as well as construction vessels such as cranes are placed inside the approach plan of Bornholm Airport. This impact will be present during the construction phase as well the operational and decommissioning phases and mitigation measures will be required to ensure aviation safety by the airport.

The offshore wind farm is located in an area where small civilian aircraft are flown quite a lot, especially during the summer. In normal conditions, this will not be a problem, since small civilian aircraft are only permitted to fly in good visibility so that the pilot can see objects. However, if the weather should change during a flight and visibility decreases, the risk of collision increases. Civilian aircraft will experience a *minor* impact due to the numerous flights with small aircraft over the investigated area for the offshore wind farm. Because civilian aviation is permitted as low as an altitude of 150 m above ground, 10 MW Offshore wind turbines with a total height of 220 m and construction vessels such as cranes will increase the risk of collision for the low altitude flights.

Search and rescue efforts will be very likely to involve flying rescue helicopters at low altitude and if that is necessary helicopters will have to fly in between the offshore wind turbines.

For these reasons, the offshore wind farm will impact the safety of search and rescue work inside the offshore wind farm area during the operational phase and especially during bad weather. The impact will be *minor* because it will be in a very small area, and the number of flights in the offshore wind farm area is expected to be minimal.

6.5 Navigation

The majority of the traffic around Bornholm consists of merchant and passenger vessels and to a lesser extent fishing vessels and recreational watercraft. Only a small number of the most used sailing routes pass through the offshore wind farm. In the area closest to the planned offshore windfarm, the most prevalent vessels are larger merchant vessels. The existence of the offshore wind farm will require that some traffic is rerouted to avoid passing through the offshore wind farm.

The risk of collision with the offshore wind turbines by ships under power as well as by drifting ships has been calculated. The collision risk is low and therefore the

impact on navigation is expected to be *minor*. Various risk mitigation measures such as marking of the offshore wind farm will be performed.

6.6 Commercial Fishing

As is the case nationally, the number of fishing vessels harboured on Bornholm has been clearly declining throughout the last 10 years from about 150 vessels in the early 2.000s to the current level of about 80 vessels.

In addition to commercial fishing vessels, there are a number of part time commercial fishing vessels, and their number has also been reduced markedly during the same period. There are about 20 part time commercial fishing vessels left. Because the part time fishing vessels are primarily small vessels with relatively low levels of activity, their part of the total catch amounts to just a few percent.

Fishing with trawl is the most important form of fishing in the western Baltic Sea and accounts for 84 per cent of the volume and 75 percent of the value of the total Danish catch in the area. However, the fishing is relatively poor at Rønne Banke including in the investigated area because rocks and an uneven seabed makes fishing with trawl impossible.

Overall the impact on fishing will be *negligible* to *minor*.

7 Cumulative Impacts

The cumulative impacts are the enhanced environmental impacts that result from several facilities and activities being present in the same area where each facility and activity impacts the environment in similar ways.

The purpose of including cumulative impacts is to assess the overall environmental impact of the current project as it relates to the environmental carrying capacity of the area. The assessment of cumulative effects must take into account existing facilities as well as future land use and activities based on permits that have been granted and plans that have been passed.

7.1 The Marine Environment

There may be cumulative impacts on birds. Among other things, the existing and planned offshore wind farms in the area contribute.

When assessing the cumulative impacts on staging birds, Bornholm Offshore Wind Farm has been assessed in conjunction with the following offshore wind farms: Kriegers Flak (Danish Part), Baltic II, Wikinger and Arkona-Becken Südost. For staging birds there will be *moderate* cumulative impacts on long-tailed duck, guillemot, razorbill and *minor* cumulative impacts on divers.

When assessing the cumulative impacts on migrating birds, Bornholm Offshore Wind Farm has been assessed in conjunction with Kriegers Flak, which is located in the western part of the Baltic Sea. The assessment shows a *minor* cumulative impact on cranes due to collision risk.

8 Mitigation Measures

An important purpose of an environmental impact assessment is to point to solutions, so that substantial negative environmental impacts caused by the current project may be reduced, compensated for, or completely avoided. Such solutions are called mitigation measures and can be implemented both before and during the construction phase and during the operational phase.

During the construction permitting process, requirements will be identified as to the framework of the project, which mitigation measures must be implemented to potentially lessen or avoid possible environmental impacts including whether certain environmental features must be monitored during construction and operations.

If the offshore wind farm is licensed, the license will contain specific requirements for the construction and for the final facilities, e.g. noise impacts.

8.1 The Marine Environment

The impact on long-tailed ducks has been assessed based on a worst case scenario in which the offshore wind turbines are placed in the location in the investigated area where they would impact this species the most. It is recommended to consider mitigation measures for long-tailed duck during the operation phase by choosing a location of the offshore wind turbines within the investigation area, which will have less impact on long-tailed duck than the assessed impact of the worst case scenario.

Driving monopile foundations for the offshore wind turbines into the seabed generates extremely loud noises, which are capable of causing both temporary and permanent hearing loss in marine mammals which are in the immediate vicinity of the source of the noise. In addition, the noise may cause behavioural changes particularly in harbour porpoises. This necessitates scaring marine mammals away from the area before pile driving begins. In relation to the worst case scenario used in the ES to describe the noise distribution it is necessary to further reduce the noise to secure that no harbour porpoises contract permanent hearing damage with the assumptions given for the worst case scenario. Implementing this mitigation measure will change the assessment so that the total environmental impact will be *minor*. At present it is not possible to decide whether the described noise reduction demands an active reduction by taking various physical measures to reduce the noise distribution. Among other things it depends on the size of the foundations and the hammer being used during the construction of the wind farm.

Bats will be *moderately* impacted as a result of the increased risk of collision during the operation phase of Bornholm Offshore Wind Farm. This assessment is based on a precautionary principle. A monitoring program will be worked out by the developer of the wind farm in order to identify the extent of the bat migration in spring through the marine investigation area. The monitoring program must be carried out and reported before the initiation of the construction work and must be approved by the relevant authorities before initiation.

The two military radar systems at Rytterknægten and Naviair's civilian radar system at Bornholm Airport are expect to be *moderately* impacted by Bornholm Offshore Wind Farm. Impacts on radar systems are unavoidable and it will be necessary to implement mitigation measures. Such mitigation measures must be agreed upon and coordinated with the Danish Military and responsible authorities. Once mitigation measures have been implemented the impact on radar systems is expected to be *minor*.

Mitigation measures will be necessary to reduce the impact on civilian aviation during approach to Bornholm Airport. Since the offshore wind turbines do not need to be erected throughout the investigated area to reach 50 MW productions, another possible mitigation measure must not be erected at any offshore wind turbines inside the area covered by the approach plan at Bornholm Airport.

9 Conclusion

An assessment of the environmental impacts of construction, operation, and decommissioning of Bornholm Offshore Wind Farm has been completed.

A minor part of the investigation area for Bornholm Offshore Wind Farm is located within the approach plan of Bornholm Airport. The erection of offshore wind turbines in this area will most probably be a problem and prompt a demand for a comprehensive risk assessment of the aviation security. This is caused by the offshores wind turbines functioning as aviation obstacles, assessed to cause considerable problems in relation to maintaining the airport security. This can influence the airport capacity and the airport approach plan.

Based on the assessed impact on the approach to Bornholm Airport it is assessed that a project adjustment is needed to reduce the area of erection of offshores wind turbines.

The final area where offshore wind turbines can be erected is displayed in Figure 9.1. To the North West it is also marked, that erection of wind turbines is not possible. This is due to cables through the investigation area, to which a certain respect distance must be kept and thus it is assessed that there is a limited potential for erecting wind turbines in the north-westerly part of the investigation area.

The final area where offshore wind turbines can be erected is shown in Figure 9.1.

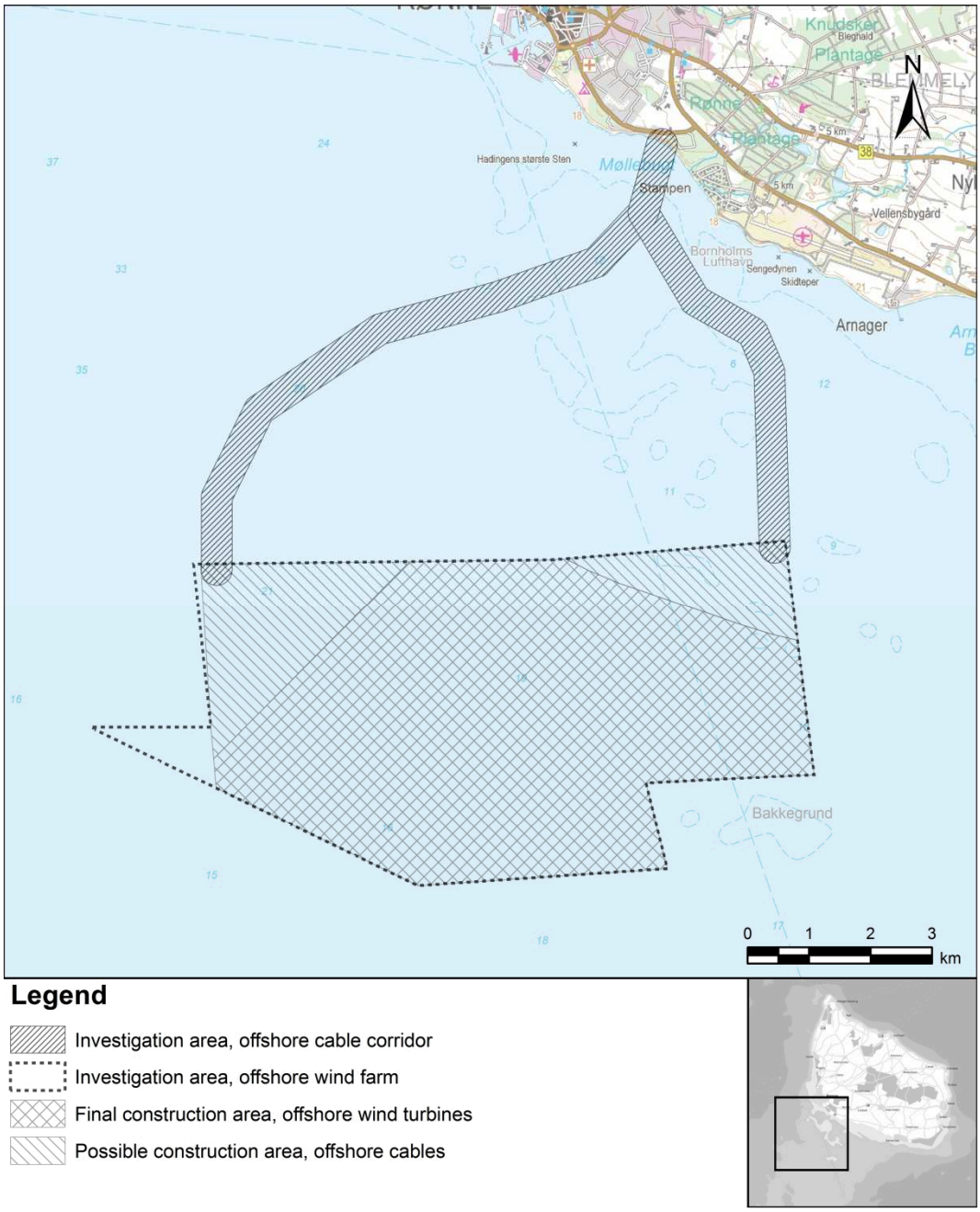

Figure 9 1. Final construction area for offshore wind turbines.

The other impacts are primarily related to construction phase activities. The impacts are primarily temporary and can be characterized as *negligible* or *minor*.

However, during construction offshore, driving monopile foundations into the seabed, should this type of foundation be chosen, will result in *major* noise impact in particular for harbour porpoises who may suffer permanent as well as temporary hearing loss. This necessitates scaring the animals away from the area at the beginning of the construction phase. In relation to the worst case scenario

used in the ES to describe the noise distribution it is necessary to further reduce the noise to secure that no harbour porpoises contract permanent hearing damage with the assumptions given for the worst case scenario.

The offshore wind turbines will have a *major* visual impact along the coast and in several places inland over the lifespan of the wind farm. Solutions that may reduce the impact should be considered, among other things, the site layout may be adjusted by erecting larger but fewer wind offshore wind turbines, rather than many offshore wind turbines with lower production.

A few sea bird species will be *moderately* impacted during the operational phase. In addition, a *moderate* impact on the population as it experiences the landscape and recreational value of the area near the offshore wind farm is expected. It is possible to mitigate the moderate impacts to varying degrees.

For the remainder of the environmental and natural areas the assessment shows that impacts will be *minor* or *negligible*.

By completing the project long term reductions in CO_2 emissions are ensured and the project will contribute to reaching the energy policy goal of improving the climate.