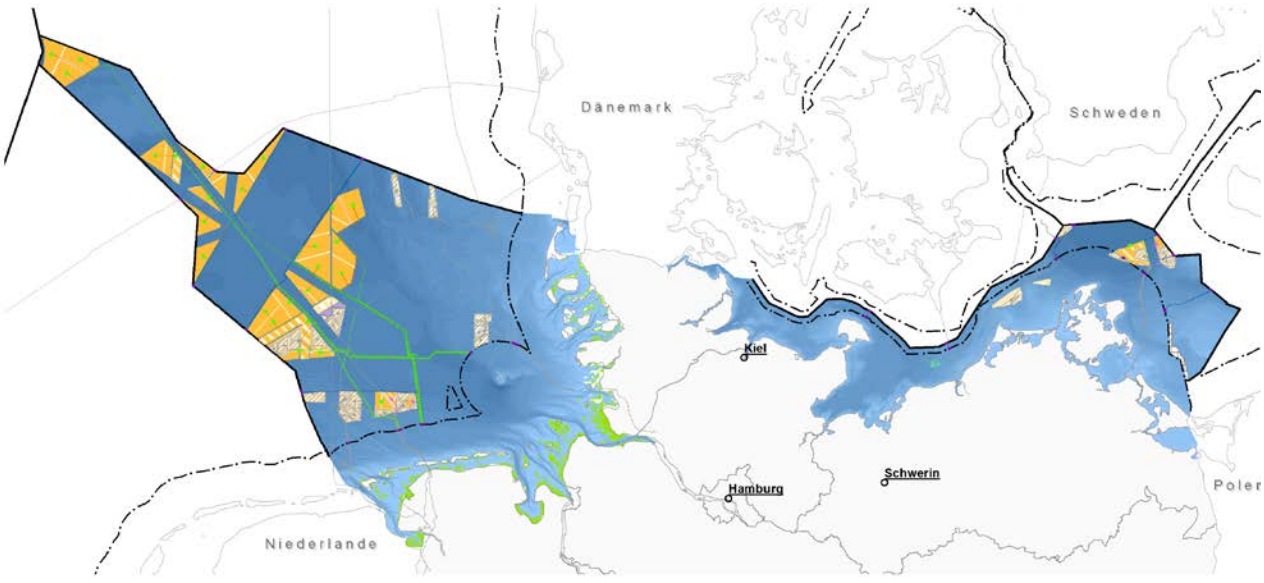
BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

Environmental Report: North Sea Draft Site Development Plan

- unofficial translation -



Hamburg, 1 July 2022

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List of abbreviations

AWI	Alfred Wegener Institute for Polar and Marine Research
EEZ	Exclusive Economic Zone
BfN	Federal Agency for Nature Conservation
BMUB	Federal Ministry for the Environment, Nature Conservation, Construction and Nuclear Safety
BNatSchG	Act on Nature Conservation and Landscape Management (Federal Nature Conservation Act)
FNA	Bundesnetzagentur (Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway)
BSH	Federal Maritime and Hydrographic Agency
F&E	Research and development
SDP	Site development plan
FFH	Flora Fauna Habitat
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
FFH-IA	Compatibility assessment in accordance with Art. 6, para. 3 FFH Directive and Sec. 34 BNatSchG
ICES	International Council for the Exploration of the Sea
IfAÖ	Institute for Applied Ecosystem Research
IOW	Leibniz Institute for Baltic Sea Research, Warnemünde
IUCN	International Union for Conservation of Nature and Natural Resources (World Conservation Union)
K	Kelvin
LRT	Habitat type according to FFH Directive
MARPOL	International Convention for the Prevention of Pollution from Ships
MSFD	Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in marine environmental policy (Marine Strategy Framework Directive)
NCA	Nature conservation area
NN	Normal zero
OSPAR	Oslo-Paris Agreement
OWF	Offshore wind farm
PSU	Practical Salinity Units
ROP 2021	Maritime spatial plan of the EEZ (dated 19 August 2021)
SCANS	Small Cetacean Abundance in the North Sea and Adjacent Waters
SEL	Sound exposure level
SPA	Special Protected Area
SPEC	Species of European Conservation Concern
StUK4	Standard “Investigation of impacts of offshore wind turbines”.
SEA	Strategic environmental assessment
SEA DIRECTIVE	Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the environmental impacts of certain plans and programmes (SEA Directive)

UBA	Umweltbundesamt (Federal Environment Agency)
Environmental Impact Assessment Act	Environmental Impact Assessment Act
EIA	Environmental Impact Assessment
Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive)
WT	Wind turbine
WindSeeG	Offshore Wind Energy Act (WindSeeG)

***Preliminary remarks**: This environmental report, like the underlying scope (published on 30 June 2022), the Strategic Environmental Assessment and the draft Site Development Plan (SDP), is based on the Federal Government's draft bill of a second law to update the Offshore Wind Energy Act and other regulations (BT-Drs. 20/1634 of 2 May 2022, hereinafter: **WindSeeG-E**).*

The draft law contains updates that are relevant for the designations in the SDP as well as for reviews and assessments within the framework of the Strategic Environmental Assessment.

The final version of the new WindSeeG is expected for the period of finalisation of the SDP (3rd and 4th quarter 2022). Therefore, the final environmental reports published with the final SDP will also be able to take into consideration all legal changes in the WindSeeG – in addition to the SDP itself – until its expected publication in early 2023.

1 Introduction

A Strategic Environmental Assessment (SEA) is carried out as part of the revision and update of the SDP. This environmental report documents the result of the SEA for the EEZ of the North Sea.

1.1 Legal basis and tasks of the environmental assessment

According to Sec.s 4et seq. WindSeeG-E, the BSH prepares an SDP in agreement with the Federal Network Agency (BNetzA) and in coordination with the Federal Agency for Nature Conservation (BfN), the Directorate-General for Waterways and Shipping (GDWS) and the coastal states. The SDP was last updated in 2020.

The renewed revision was initiated on 17 December 2021.

When the SDP was prepared, a detailed environmental assessment was carried out in accordance with the Environmental Impact Assessment Act (UVPG)[1], in what is termed the Strategic Environmental Assessment (SEA). The environmental reports were published together with the SDP on 28 June 2019. The implementation of an SEA with the preparation of an environmental report is based on Sec. 35, para. 1, No. 1 UVPG in conjunction with Appendix 5, No. 1.17 UVPG because site development plans are subject to the SEA obligation within the meaning of Sec. 5 WindSeeG. In principle, this also applies if the SDP is updated or amended.

In the context of the revision initiated on 17 December 2021, in order to implement the statutory expansion targets for offshore wind energy, which have been defined since October 2021 by the coalition agreement and subsequently enshrined in the draft bill for the amendment of the WindSeeG (Sec. 1, para. 2 WindSeeG-E), areas and sites that go beyond SDP 2020 and were therefore not included in the SEA carried out in previous preparation, update, and revision procedure of the SDP are designated.

Unlike the last revision of the SDP, the completion of the revision procedure for maritime spatial planning means that an up-to-date maritime spatial plan is now available: The maritime spatial plan for the German EEZ of the North Sea and Baltic Sea (ROP)[2], which came into force on 1 September 2021. As part of the maritime spatial planning revision procedure, a comprehensive SEA was carried out and an environmental report was prepared for each of the

[1] Environmental Impact Assessment Act (UVPG) in the version published on 18 March 2021 (Federal Law Gazette I p. 540) last amended by Art. 14 AufbauhilfeG 2021 of 10 September 2021 (Federal Law Gazette I p. 4147).

[2] Ordinance on Spatial Planning in the German Exclusive Economic Zone in the North Sea and the Baltic Sea of 19 August 2021, Federal Law Gazette p. 3886.

German EEZs in the North Sea and the Baltic Sea. The revision of the SDP will essentially build on the designations of the maritime spatial planning for offshore wind energy and subsea cables and pipelines and develop them in terms of sectoral planning.

Against this background, the SEA for the revision of the SDP will also be largely based on the results of the SEA carried out in the maritime spatial planning revision procedure. According to Sec. 5, para. 3, sentences 5–7 WindSeeG-E, it must be determined at which stage certain environmental assessments are to be focussed in order to avoid multiple assessments in multi-stage planning and approval processes. The nature and extent of the environmental impacts and technical requirements as well as the content and subject matter of the site development plan shall be taken into account. The environmental assessment shall be limited to additional or other significant impacts on the environment as well as to necessary updates and elaborations.

In accordance with Sec. 72, para. 1 WindSeeG-E, the assessment of the environmental impact of offshore wind turbines or other energy production installations according to the provisions of the UVPG on the basis of an SEA already carried out according to Sec.s 5 to 12 WindSeeG-E for the site development plan or the site investigation shall be limited to additional or other significant impacts on the environment as well as to any necessary updates and elaborations.

Accordingly, the SEA to be carried out in the procedure for the update and revision of the SDP is to be limited to additional or other significant environmental impacts and to necessary updates and elaborations compared with the SEA for ROP 2021 (in this respect, in accordance with Sec. 5, para. 3, sentences 5–7 WindSeeG-E) and compared with more recent results from site investigations or from SDP 2020 (in this respect, in accordance with Sec. 72, para. 1 WindSeeG-E).

Accordingly, the SEA for the revision of the SDP is also based on the environmental reports for the preparation and revision of the SDP from 2019 and 2020. Insofar as new knowledge on existing designations is available and relevant, this will also be taken into consideration.

In the following, the scope of the assessment is therefore limited to additional or other significant environmental impacts as well as to necessary updates and elaborations.

In accordance with Art. 1 of Directive 2001/42/EC on the assessment of the impacts on the environment of certain plans and programmes on the environment (SEA Directive)[3], the SEA Directive aims to ensure a high level of environmental protection in order to promote sustainable development and to contribute to the proper integration of environmental considerations into the preparation and adoption of plans well in advance of the actual planning of projects.

The SEA has the task of identifying the likely significant impacts on the environment of implementing the plan, describing them at an early stage in an environmental report, and assessing them. It serves as an effective environmental precaution according to the applicable laws and is implemented according to consistent principles, and with public participation. In accordance with Sec. 2, para. 1 UVPG, the following protected assets are to be considered:

- Population & human health, in particular human health,
- Fauna, flora, and biodiversity,
- Space, soil, water, air, climate, and seascape,

[3] Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the environmental impacts of certain plans and programmes (OJ L 197 p. 30).

- Cultural heritage and other material assets as well as
- the interrelationships between the aforementioned protected assets.

The main document of the Strategic Environmental Assessment is this Environmental Report. It identifies, describes, and assesses the likely significant impacts that the implementation of the SDP will have on the environment and possible alternative planning options, taking into consideration the essential purposes of the plan.

As part of the assessment of the impacts on the protected assets within the meaning of Sec. 2, para. 1 UVPG, the SEA also included the nature conservation law assessments for statutory biotope, site, and species protection in accordance with Sec. 30, 34, and 44 BNatSchG. The special provisions of Sec. 72, para. 2 WindSeeG-E (for marine biotopes) and Sec. 5, para. 3, No. 5 WindSeeG-E were also taken into consideration.

1.2 Brief description of the content and most important objectives of the Site Development Plan

According to Sec. 4, para. 1 WindSeeG, the purpose of the SDP is to make offshore grid planning designations for the exclusive economic zone (EEZ) of the Federal Republic of Germany.

Sec. 4, para. 2 WindSeeG-E stipulates that for the development of offshore wind turbines and the offshore grid connections required for this purpose, the SDP shall make designations with the objective of

- achieving the (now increased) expansion targets according to Sec. 1, para. 2, sentence 1 WindSeeG-E,
- expanding power generation from offshore wind turbines in a spatially ordered and space-saving manner, and
- ensuring an orderly and efficient use and utilisation of offshore grid connection, and planning, erecting, commissioning, and using offshore grid connection cables in parallel with the development of power generation from offshore wind turbines.

According to the legal mandate of Sec. 5, para. 1 WindSeeG-E, the SDP contains designations for the period as of 2026 for the German EEZ and, subject to the following provisions, for the territorial sea:

1. areas; in the territorial sea, areas may be designated only if the competent federal state has designated the areas as a possible subject of the Site Development Plan,
2. sites in the areas designated according to Number 1; in the territorial sea, sites can be designated only if the competent federal state has identified the sites as a possible subject of the site development plan
3. the chronological order in which the designated sites are to be put out to tender according to Sec.s 2, 4, and 5 of Part 3, including the designation of the respective calendar years, and whether the area is to be centrally pre-screened,
4. the calendar years including the quarter in the respective calendar year in which the surcharged offshore wind turbines and the corresponding offshore grid connection are to be commissioned on the specified sites as well as the quarters in the respective calendar year in which the cable of the inner park cabling of the subsidised offshore wind turbines is to be connected to the converter or transformer platform,
5. the expected generation capacity of offshore wind turbines to be installed in the designated areas and on the designated sites,

6. locations of converter platforms, collector platforms and, where possible, substations,
7. routes or route corridors for offshore grid connecting cables,
8. locations at which the offshore grid connecting cables cross the boundary between the exclusive economic zone and the territorial sea
9. corridors for cross-border electricity lines,
10. corridors for possible connections between the installations mentioned in points 1, 2, 6, 7, and 9, and
11. Standard technical principles and planning principles

For areas in the German EEZ and in the territorial sea, the SDP may designate available grid connection capacities on existing offshore grid connections or on offshore grid connections to be completed in the following years; these may be allocated to pilot offshore wind turbines according to Sec. 95, para. 2 WindSeeG-E. The SDP may make spatial designations for the construction of pilot offshore wind turbines in areas and designate the technical conditions of the offshore grid connections and resulting technical requirements for the grid connection of pilot offshore wind turbines.

In accordance with Sec. 5, para. 2a WindSeeG, the SDP may designate areas for other forms of energy generation outside of areas.

In accordance with Sec. 3, No. 8 WindSeeG-E, an area for other forms of energy generation is an area outside of areas on which offshore wind turbines and plants for other forms of energy generation, each of which is not connected to the grid, can be installed in spatial coherence and which is subject to the approval procedure according to Sec. 2 of the Maritime Facilities Act. According to Sec. 4, para. 3, sentence 1 WindSeeG-E, the objective of these designations is to enable the practical testing and implementation of innovative concepts for energy generation not connected to the grid in a spatially ordered and land-saving manner.

In the context of the SEA, a “classic” offshore wind farm is assumed based on the findings to date with regard to electricity generation within the areas for other forms of energy generation. Impacts on the environment going beyond this are highly dependent on the respective type of use and should therefore be comprehensively examined at the approval level. In this respect, the SEA for the areas for other forms of energy generation is carried out in the same way as the assessment of sites for offshore wind energy.

1.3 Relationship with other relevant plans, programmes, and projects

The SDP is related to other plans and programmes within the Exclusive Economic Zone (EEZ) and adjacent areas, in particular in the territorial sea, as well as to plans and projects at upstream and downstream planning and licensing levels. Detailed information can be found in the scope for the current SEA dated 30 June 2022 to which reference is made here.

1.4 Presentation and consideration of the environmental conservation objectives

The update and revision of the SDP and the implementation of the SEA will be carried out with due consideration for the environmental conservation objectives. These provide information on the state of the environment to be aimed for (environmental quality objectives). The environmental conservation objectives can be derived from an overall view of the international, European union, and national conventions and regulations that deal with marine environmental protection and based on which the Federal Republic of Germany has committed itself to certain principles and objectives.

These are explained in detail in the scope for the current SEA. Please refer to the statements in Chapter 3 of the scope of 30 June 2022.

The environmental reports on ROP 2021 contain a description of how compliance with the aforementioned relevant international, EU, and national regulations and recommendations is checked and implemented, and which designations are made or which measures are taken. Should there be a need for updating or changes in this respect in the context of the revision of the SDP, a supplementary presentation will be made in this environmental report.

1.5 Methodology of the Strategic Environmental Assessment

When carrying out the Strategic Environmental Assessment, various approaches to the planning status can be considered within the framework of the methodology. This Environmental Report builds on the methodology used in the Strategic Environmental Assessments of SDP 2019 and SDP 2020.

The methodology is based primarily on the designations of the plan to be examined. Within the framework of this SEA, it is determined, described, and evaluated for each of the designations whether the designations have likely significant impacts on the protected assets concerned. In accordance with Sec. 1, para. 4 UVPG in conjunction with Sec. 40, para. 3 UVPG, in the environmental report the competent authority provisionally assesses the environmental impacts of the designations with regard to effective environmental precautions in accordance with applicable laws. According to the special legal standard of Sec. 5, para. 3, sentence 1, No. 2 WindSeeG, the designations may not pose a threat to the marine environment. In addition, the provisions of Sec. 5, para. 3, sentence 1, No. 5 WindSeeG-E (protected areas) and Sec. 72, para. 2 WindSeeG (marine biotopes) must be observed in particular.

The subject of the environmental report corresponds to the designations of the SDP as listed in Sec. 5, para. 1 and 2a WindSeeG (see 1.2).

The methodology of the Strategic Environmental Assessment is comprehensively explained in the scope for the current SEA. Reference is made at this point to the defined scope of 30 June 2022.

Area of investigation

The SUP area of investigation covers the German EEZ of the North Sea (Figure 1). It should be noted that the data availability within the EEZ of the North Sea for the region up to Shipping Route 10 is considerably better than for the area north-west of Shipping Route 10 because of the available project-related monitoring data.

For the area north-west of Shipping Route 10, the SDP makes statements on possible routes, route corridors, or gates for interconnectors. Based on the available sediment data and findings from monitoring for the “Doggerbank” protected area, it is also possible to describe and assess the environmental status and potential impacts on the environment in this area.

The adjacent territorial sea and the adjacent areas of the neighbouring states are not directly the subject of this plan; however, they are considered as part of the cumulative and transboundary consideration of this SEA where necessary.

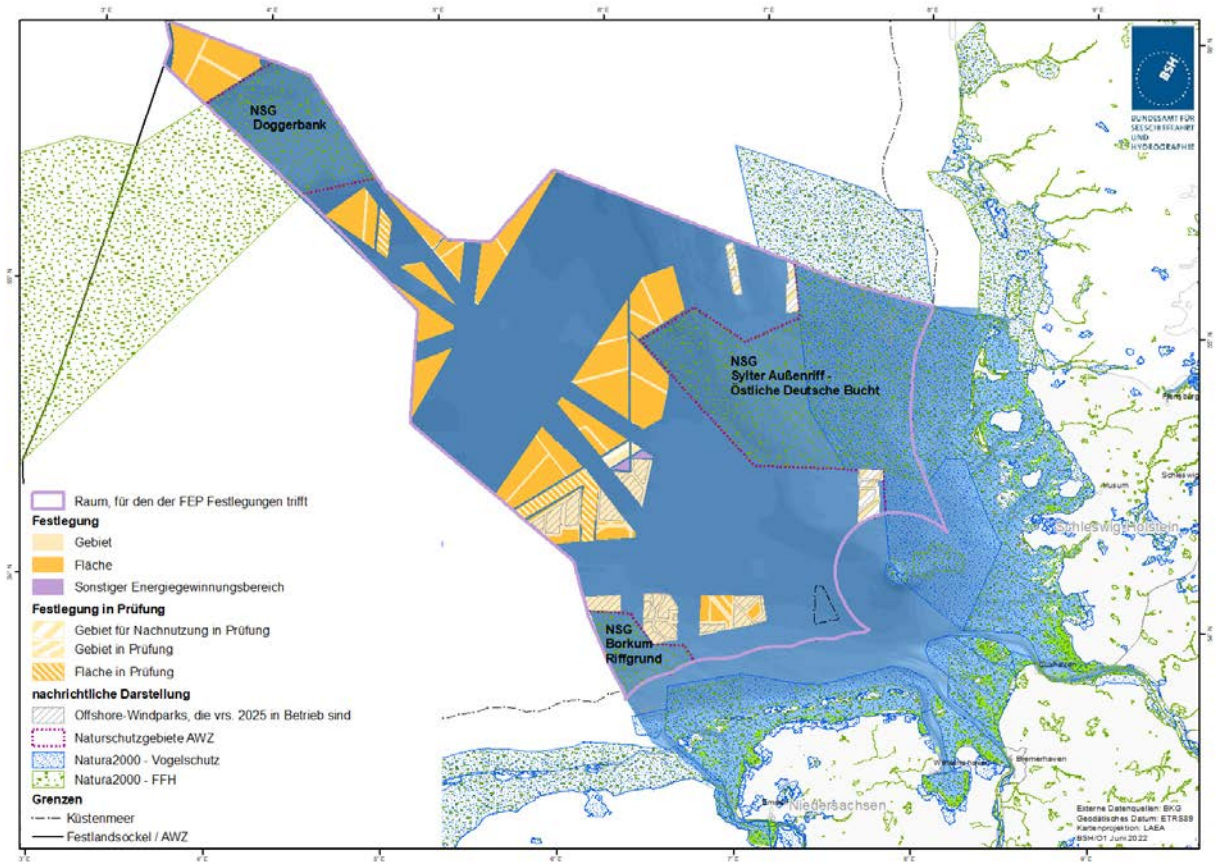

Figure 1: Delimitation of the area of investigation for the SEA of the site development plan – in this case, the EEZ of the North Sea.

1.6 Data sources and indications of difficulties in compiling the documents

With regard to the data and knowledge bases for the SEA, please refer to Chapter 5 of the scope for the current SEA dated 30 June 2022.

Indications of difficulties in compiling the documents

Indications of difficulties arising when compiling the data (e.g. as technical gaps or lack of knowledge) are to be presented according to Sec. 40, para. 2, No. 7 UVPG. There are still gaps in knowledge in places, especially with regard to the following points:

- Long-term effects from the operation of offshore wind farms
- Effects of shipping on individual protected assets
- Effects of research activities
- Data for assessing the environmental status of the various protected assets for the area of the outer EEZ
- Cumulative effects

In principle, forecasts on the development of the living marine environment after implementation of the SEA for ROP 2021 remain subject to certain uncertainties. There is often a lack of long-term data series or analytical methods (e.g. for the intersection of extensive information on biotic and abiotic factors) in order to better understand complex interactions of the marine ecosystem.

In particular, there is a lack of detailed area-wide sediment and biotope mapping outside the nature conservation areas of the EEZ. As a result, there is a lack of a scientific basis on which to assess the impacts of the possible use of strictly protected biotope structures. Currently, a sediment and biotope mapping with a spatial focus on the nature conservation areas is being carried out on behalf of the BfN and in cooperation with the BSH, research and university institutions, and an environmental agency.

Furthermore, there are no scientific assessment criteria for some protected assets, both with regard to the assessment of their status and with regard to the impacts of anthropogenic activities on the development of the living marine environment, to allow cumulative effects to be considered in both temporal and spatial terms.

Various R&D studies on assessment approaches, including for underwater noise, are currently being developed on behalf of the BSH. These projects are being used for continuous refinement of a consistent, quality-assured basis of information on the marine environment for assessment of possible impacts of offshore installations.

The environmental report will also list specific information gaps or difficulties in compiling the documents for the individual protected assets.

2 Description and assessment of the environmental status

According to Sec. 40, para. 2, number 3 UVPG, the environmental report includes a description of the characteristics of the environment and the current environmental status in the area of investigation of the SEA. The description of the current state of the environment is required in order to be able to forecast its change upon implementation of the plan. The subject of the inventory are the protected assets listed in Sec. 2, para. 1, sentence 2, Nos. 1 to 4 UVPG as well as interrelationships between them. The information is presented in a problem-oriented fashion. The focus is thus on possible existing impacts, environmental elements requiring special protection, and on the protected assets that will be most affected by the implementation of the plan. In spatial terms, the description of the environment is oriented towards the respective environmental impacts of the plan.

In accordance with Sec. 5, para. 3, sentence 7 WindSeeG-E, the environmental assessment is to be limited to additional or other significant impacts on the environment as well as to necessary updates and elaborations. Within the framework of the present SEA, it was examined in detail whether there are any updates or elaborations with regard to the state of the environment. Insofar as no updates or elaborations are required in comparison with the environmental reports on ROP 2021, for the respective protected assets, please refer to the corresponding statements in Chapter 2 of the North Sea Environmental Report on ROP 2021.

2.1 Space

For the protected asset space (Sec. 2, para. 1, No. 3 UVPG), the consumption of land must be considered in particular. Land economy is therefore also reflected in the guidelines and principles of ROP 2021.

The basis for the designations of the draft SDP are the increased statutory expansion targets from Sec. 1, para. 2, sentence 1 WindSeeG-E, which envisage an achievement of 30 GW by 2030, 45 GW by 2035, and 70 GW by 2045. Against the background of the limited availability of land in the German EEZ of the North Sea and Baltic Sea, it must be taken into consideration when designating the expected generation capacity that these expansion targets can be achieved as far as possible with the space available. In order to achieve the statutory expansion targets, it is therefore imperative that the area available for offshore wind energy are developed sparingly.

A land-saving development is achieved by designating the expected generation capacity on the sites. As part of the revision of the SDP, the output on individual sites was increased considerably compared with the designations of SDP 2020 in order to achieve efficient land use with regard to the increased expansion targets. Furthermore, this can be ensured by bundling subsea cables as much as possible in the sense of parallel routing as well as routing them parallel to existing structures and built facilities (Sec. 6.4 Draft SDP). On the other hand, an efficient use of land can be achieved by designating standard technical principles (Sec. 5, para. 1, sentence 1, No. 11 WindSeeG-E) such as the use of more efficient grid connection technologies (Chapter 5 Draft SDP), which can greatly reduce the number of grid connection systems required.

Another aspect of sustainable and efficient use of land resources is the obligation to deconstruct installations, submarine cables, and the like after the end of their operating life so that these sites are available for subsequent use (Chapter 6.1.5 Draft SDP).

2.2 Soil

With regard to the description and assessment of the status of the protected asset soil, please refer to the statements in Chapter 2.2 of the North Sea

Environmental Report on ROP 2021. Compared with the SEA for ROP 2021, updates for the protected asset soil arise only for the data situation/data availability.

With regard to the data availability on sediment distribution on the soil, there is updated information from the Sediment Mapping in the EEZ project of the BSH, which is being carried out in cooperation with the BfN. Here, the level of knowledge has increased compared with ROP 2021. The current data availability of the – compared with existing maps (e.g. BSH/IOW, 2012) – more detailed maps is shown in Figure 2..

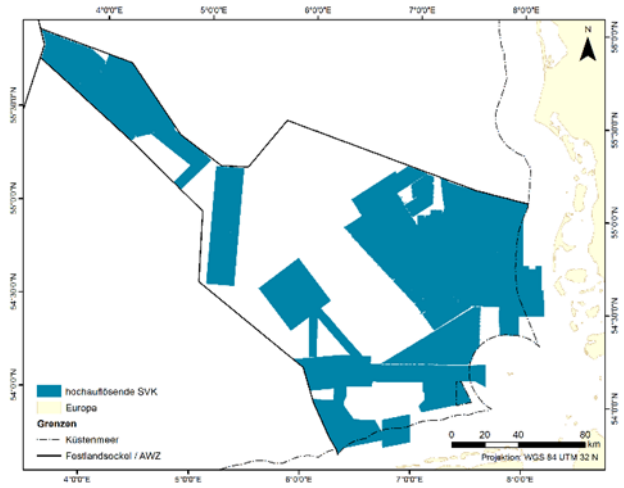

Figure 2: Detailed sediment distribution maps scale 1:10,000 (current data availability).

The updated data sources essentially confirm the status description and assessment in Chapter 2.2.2 of the North Sea Environmental Report on ROP 2021.

Only in the area of the North-western region of the German EEZ in the “Doggerbank” nature conservation area and the adjacent Areas N-17 and N-19 are there indications of coarse sandy and gravelly areas in the current investigations. Potential species-rich gravel, coarse sand and shell can therefore not be completely ruled out in these areas at present.

2.3 Water

With regard to the description and– of the status of the protected asset water, please refer to the statements in Chapter 2.3 of the North Sea Environmental Report on ROP 2021. Any updates or elaborations of the status description are not apparent compared with the SEA for ROP 2021.

2.4 Plankton

With regard to the description and– of the status the protected asset plankton, please refer to the statements in Chapter 2.4 of the North Sea Environmental Report on ROP 2021. Any updates or elaborations of the status description are not apparent compared with the SEA for ROP 2021.

2.5 Biotopes

With regard to the data availability and description of the status of the protected asset biotopes, please refer to the statements in Chapter 2.5 of the North Sea Environmental Report on ROP 2021. Compared with the SEA for ROP 2021, only necessary updates or elaborations are to be presented.

Within the framework of the revised SDP, which is published according to the WindSeeG-E, the following standard for assessing the compatibility of the designations with legally protected biotopes results from Sec. 72, para. 2 WindSeeG-E: Sec. 30, para. 2, sentence 1 BNatSchG shall be applied to projects under the WindSeeG with the proviso that a significant adverse effect on biotopes within the meaning of Sec. 30, para. 2, sentence 1 BNatSchG shall be avoided as far as possible.

A consideration of the potential occurrence and potential adverse effect on legally protected biotopes in the areas, sites, and platform sites as well as the routes of the subsea cables is provided in Chapter 4.14.

2.6 Benthos

With regard to the description and assessment of the status of the protected asset benthos, please refer to the statements in Chapter 2.6 of the North Sea Environmental Report on ROP 2021. Compared with the SEA for ROP 2021, only necessary updates or elaborations are to be presented. The assessment of the status described there is confirmed and selectively supplemented by the findings from recent literature and newly collected data described below.

Areas N-6 through N-13

Current investigations are available from the preliminary site investigations for further sites in Areas N-6 and N-7. The investigations in Sites N-6.6, N-6.7, and N-7.2 essentially confirmed the information provided in the environmental report on ROP 2021 with regard to the species inventory and the dominance structure of the benthic communities as well as the occurrence of species of burrowing soil mega-fauna (BIOCONSULT 2022A, B, IFAÖ 2021).

In addition, modelled data on the distribution of deep burrowing mega-fauna in the German sector of the North Sea are available in GUTOW et al. (2020). The distribution foci described there correspond well with the information in the environmental report on ROP 2021. The stock assessments made there are thus still valid.

Areas N-14 to N-18 and N-20

Parts of areas N-14, N-15, N-16, N-17, N-18, and N-20 are also core areas of occurrence of burrowing ground mega-fauna species according to GUTOW et al. (2020). Modelling confirms that parts of Sites N-16.1 and N-16.2 belong to the range of *Nephrops norvegicus*. However, in Areas N-17, N-18, and N-20, the deep burrowing mega-fauna is predominantly represented by the tadpole *Echiurus echiurus* according to GUTOW et al. (2020). The deep-digging crab species do not have a distribution focus there. Areas N-14 and N-15 are not core areas for deep burrowing mega-fauna (GUTOW et al. 2020). According to the assessments in the environmental report on ROP 2021, the benthos is therefore of average importance in these areas and of above-average importance in areas and sites with significant occurrences of deep burrowing crayfish species.

Areas N-21 and N-22

Little benthic data are currently available for Areas N-21 and N-22 under consideration and for a possible extension of Area N-11 (Fig.1 of the draft SDP). Because of the location, the findings for Sites N-6 to N-10 are likely to be largely transferable to these sites. According to PESCH et al. (2008), the areas lie in the transitional area between the *Nucula nitidosa* community and the *Amphiura filiformis* community, both of which are among the most widespread communities in the German EEZ. Consequently, an average importance of the sites for the protected asset benthos can be assumed. In contrast, the local occurrence of deep burrowing crayfish species (as modelled by GUTOW et al. (2020) for the sites) would have an above-average importance.

Area N-19

For Area N-19, supplementary information is available from IOW & AWI (2017) compared with the environmental report on ROP 2021. The benthic community of the slope descending to the Northwest is thus clearly different from the com-

munity of the actual sandbank in the "Doggerbank" nature conservation area. The community of Area N-19 is dominated by short-lived polychaete species. However, character species also include the tadpole *Echiurus echiurus* (which is one of the deep-digging bottom megafauna species) as well as the sand-dwelling anthozoan *Halcampa chrysanthenum* and the mussel species *Abra prismatica*. In addition, mainly young individuals of the long-lived black clam *Arctica islandica* are regularly found here (IOW & AWI 2017). Overall, the species diversity in this area is similar to that on the "Doggerbank".

The results of these investigations confirm the assessment in the environmental report of ROP 2021 that the benthos in this area is of above-average importance for the German EEZ. The community of the Central North Sea occurring there remains restricted to the area of Area N-19 within the German EEZ but is relatively widespread in sea areas of neighbouring states.

2.7 Fish

With regard to the description and assessment of the status of the protected asset fish, please refer to the statements in Chapter 2.7 of the North Sea Environmental Report on ROP 2021. Compared with the SEA for ROP 2021, only updates or elaborations are to be presented.

For Areas N-6 to N-8, recent results from site investigations of Sites N-7.2 (campaign in autumn 2019, spring and autumn 2020) as well as N-6.6 and N-6.7 (autumn 2020, spring and autumn 2021) confirm a fish community characteristic of the North Sea with a stable species and dominance structure (BIOCONSULT 2022A, B, IFAÖ 2021). Species of the central fish community (DANNHEIM et al. 2014a) represent the largest proportion in terms of biodiversity. Individual species of the coastal community diversify the fish fauna. For specially protected species, the sites tend to be of below-average importance compared with the North Sea as a whole (cf THIEL et al. 2013).

Because of similar geological and hydrographic environmental conditions, the results of Areas N-6 to N-8 can also be used as a basis for areas N-21 and N-22 under consideration as well as for a possible extension of Area N-11 (Fig.1 of the draft SDP).

In Areas N-14 to N-18, no environmental impact assessments have taken place to date. The literature shows that the areas in the "Doggerbank" area generally have low fish species diversity (RAMBO et al. 2017). The distribution centres of specially protected species also do not overlap with the designations for sites for offshore wind energy (PROBST et al. 2021).

2.8 Marine mammals

With regard to the description and assessment of the status of the protected asset marine mammals, please refer to the statements in Chapter 2.8 of the North Sea Environmental Report on ROP 2021. Compared with the SEA for ROP 2021, only updates or elaborations are to be presented.

The assessment of the status in the context of the SEA for ROP 2021 is thereby confirmed also taking into consideration newly collected data in the context of site investigations, monitoring of the construction and operation phase of offshore wind farms, and monitoring of nature conservation areas.

The following is a brief summary of current findings.

Harbour porpoise

The most recent data from the monitoring of nature conservation areas on behalf of the BfN showed an abundance of 44,380 harbour porpoises (95% CI: 33,103–59,109) in spring (northern EEZ, including the main concentration area or the "Sylt Outer Reef – Eastern German Bight" nature conservation areas and "Doggerbank" nature conservation areas, Areas A, B, C, D, E) and 25,480 (95% CI: 17,855–35,986) in summer (north-eastern and south-eastern EEZ, including

the main concentration area and the “Borkum Reef Ground” nature conservation area) for the year 2020 (NACHTSHEIM et al., 2021a). Data from the monitoring of nature conservation areas confirm the trend that a shift of the stock has occurred throughout the North Sea towards the English Channel (HAMMOND et al, 2021). The trend can also be observed in the German EEZ from the “Sylt Outer Reef – Eastern German Bight” nature conservation area to the “Borkum Reef Ground” nature conservation area (NACHTSHEIM et al. 2021b).

Areas N-1, N-2, and N-3

As part of the monitoring of the cluster “North of Borkum”, which comprises Areas N-1, N-2, and N-3, lower densities tended to be observed during the years of investigation from 2013 to 2019 (IFAÖ et al., 2021a). The distribution and abundance of harbour porpoise within the three areas continues to show a gradient with increasing densities from east to west. The current findings thus fit into the overall picture that emerges from the monitoring of nature conservation areas and from research projects.

Areas N-4 and N-5

The investigations carried out as part of the monitoring of the two wind farms “Dan Tysk” and “Sandbank” in Area N-5 did not reveal any change in the distribution and abundance or in the use of the habitat by harbour porpoises even taking into consideration the shipping traffic associated with the supply of the wind farms (BioConsult and IfAÖ, 2020).

The long-term investigations of the offshore wind farm “Butendiek” have confirmed the trend observed by Nachtsheim et al. (2021b). The results from the monitoring of the “Butendiek” wind farm confirm that despite the population shift observed across the North Sea, Area N-5 is still of high importance for the harbour porpoise (BioConsult, 2020). For Area N-4, there are no new findings related to the North Sea Environmental Report on ROP 2021.

Areas N-6 through N-20

For Areas N-14 to N-19, please refer to the statements in Chapter 2.8 of the North Sea Environmental Report on ROP 2021. No new findings regarding these areas have emerged. For Areas N-6 to N-13, current findings are presented below. These areas (Zone 3) are also designated as next for offshore wind development by the determinations of the current SDP:

The final report from the joint monitoring of the construction and operation phases of the three neighbouring offshore wind farms “BARD Offshore 1”, “Veja Mate”, and “Deutsche Bucht” for the period 2014–2021 provides a good overview to characterise the occurrence of the harbour porpoise in this area of the German EEZ, especially in Areas N-6 to N-9 (PGU, 2021). The long-term cluster investigations also provide the opportunity to assess interannual and seasonal variability over several years as well as effects from the operation of the wind farms.

The digital survey for the years 2014 to 2021 shows that this area of the EEZ has a rather low

occurrence compared with the western and southern areas of the German EEZ. Densities usually remain below 1 ind./km². There is also a strong seasonality with higher occurrence in winter and spring. Deviating from this pattern, only for the year 2020 was a higher density recorded in the summer months in the central area of the German EEZ than in the winter and spring of the same year (PGU, 2021).

The irregular and low calf numbers observed in this area of the German EEZ in 2008–2020 still do not indicate a particular importance of the areas for the reproduction of the species.

The most recent report from the investigations of the "East of Austerngrund" cluster with the offshore wind farms "Global Tech 1", "EnBWHohe-See", and "Albatros" (IFAÖ et al., 2021b) also shows a clear inter- and interannual variability in the detection period 2015–2020 with tendentially higher detection rates in winter and summer than in autumn and spring. Overall, the results confirm a stable distribution pattern and abundance.

Results from recent site investigations covering large parts of Areas N-6 to N-13 confirm the usual distribution patterns and abundance for this area of the German EEZ as well as the interannual and seasonal variability of occurrence (IfaÖ et al., 2021b).

Areas N-6 to N-12 are considered to be of medium importance for the harbour porpoise, whilst area N-13 is also of medium, and seasonally even high, importance for the harbour porpoise. Thus, there are no new assessments compared to the North Sea Environmental Report to ROP 2021.

Areas N-21 and N-22

Areas N-21 and N-22, which are under review, are new in the draft of the current SDP. Current and comprehensive findings on these areas are available from the site investigations of Sites N-6.6, N-6.7, and N-7.2 as well as from the environmental monitoring of the wind farms "Bard Offshore", "Deutsche Bucht", "Veja Mate", "EnBW He Dreiht", "Global Tech 1", "Albatros", and "EnBW Hohe See". The above findings for Areas N-6 to N-10 are thus also valid for Areas N-21 and N-22. The statements on the areas under examination – N-21 and N-22 – apply accordingly to a possible extension of Area N-11 (Fig.1 of the draft SDP).

Seals and grey seals

The most recent aerial census in 2021 showed 26,838 harbour seals in the Wadden Sea and on Heligoland, which is a continuation of the stabilising trend since 2012 (GALATIUS et al, 2021).

The number of grey seals detected during aerial surveys in 2020/2021 is 9,069 animals, which is an increase of 13%/year over the last five years (BRASSEUR et al, 2021).

Thus, stable to increasing population figures are available for both seal species. The importance of the individual sites for seals is considered low to medium. Because of the distribution of seals in offshore areas (GILLES et al. 2007,HERR et al. 2009), the importance of the sites decreases with increasing distance from the coast.

2.9 Seabirds and resting birds

With regard to the status description and status assessment of the protected asset seabirds and resting birds, please refer to the statements in Chapter 2.9 of the North Sea Environmental Report on ROP 2021. Compared with the SEA for ROP 2021, only updates or elaborations are to be presented.

In addition, for Areas N-6 and N-7 as well as for the areas in Zone 3 (N-9 to N-13), current investigations are now available within the framework of the preliminary site investigation. These investigations confirm the already known species composition, its spatial distribution, and the seasonality of the seabird species found there. In general, the occurrences of all species show strong intra- and interannual fluctuations. To this end, for most species, there is a tendency for higher individual densities in the area of Areas N-

10 to N-13 than in the area of Areas N-6 to N-9 during the study period August 2018 to June 2021 (BIOCONSULT SH, IBL UMWELTPLANUNG & IFAÖ 2021a, b, c, d).

More recent investigations will be carried out on the designated areas in Zones 4 and 5 (N-14 to N-20), and the considerations from the environmental report on ROP 2021 will be reviewed in the context of the downstream assessment levels.

For Areas N-21 and N-22 under consideration as well as for a possible extension of Area N-11, the findings for Sites N-6 to N-11 are transferable to these areas because of their location. After designating the sites, more recent investigations will also be carried out for these sites, and the considerations from the environmental report on ROP 2021 will be reviewed as part of the downstream assessment levels.

In the meantime, an updated version of the "European Red List of Birds" is available; this contains only one list for Europe and no longer distinguishes between continental Europe (EU) and the area of the 27 member states (EU27) (BIRDLIFE INTERNATIONAL 2021). Thus, only the black-throated diver, the Northern fulmar, and the kittiwake are now listed as vulnerable (VU) with the black-throated diver newly classified in this category. The common scoter is no longer classified as vulnerable (VU), but rather only as least concern (LC). However, these minor changes do not lead to any change in the overall assessment of the criterion conservation status for the areas under consideration. Table 1 summarises the classification of the most common resting bird species in the EEZ into current national and international threat categories.

Compared with the North Sea Environmental Report on ROP 2021, there have been no changes in the state of knowledge on the occurrence and distribution of species in the area under consideration and on the status assessment. According to current knowledge, the assessments in the North Sea Environmental Report on ROP 2021 remain valid.

Table 1: Assignment of the most important seabird and resting bird species of the German EEZ in the North Sea to the current national and international endangerment categories.
Definition according to IUCN: LC = least concern; NT = near-threatened; VU = vulnerable; EN = endangered; CR = critically endangered (BIRDLIFE INTERNATIONAL 2021). Definition according to SPEC: SPEC 1 = European species in need of global protective measures (i.e. classified as "Critically Endangered", "Endangered", "Vulnerable", "Near Threatened", or "Data Deficient" on a global scale) SPEC 2 = Species WITH, SPEC 3 = Species WITHOUT a distribution focus in Europe with negative population trends and unfavourable conservation status that require Europe-wide conservation measures (BIRDLIFE INTERNATIONAL 2017).

Common name (*Scientific name*)	**Appendix I V-RL[1]**	**Red List Europe[2]**	**SPEC[3]**
Red-throated diver *(Gavia stellata)*	X	LC	3a
Black-throated diver *(Gavia artica)*	X	VU	3a
Northern fulmar (*Fulmarus glacialis*)		VU	3b
Gannet *(Morus bassanus)*		LC	
Black scoter (*Melanitta nigra*)		LC	
Greater black-backed gull *(Larus marinus)*		LC	
Lesser black-backed gull *(Larus fuscus)*		LC	
Herring gull *(Larus argentatus)*		LC	2b
Common gull *(Larus canus)*		LC	
Little gull *(Hydrocoloeus minutus)*	X	LC	3a
Kittiwake (*Rissa tridactyla*)		VU	3b
Sandwich tern *(Thalasseus sandvicensis)*	X	LC	
Common tern *(Sterna hirundo)*	X	LC	
Arctic tern *(Sterna paradisea)*	X	LC	
Guillemot *(Uria aalge*)		LC	3b
Razorbill *(Alca torda*)		LC	1b

1 Directive 2009/147/EC of the European Parliament and of the Council
2 BIRDLIFE INTERNATIONAL (2021) European Red List of Birds.
3 BIRDLIFE INTERNATIONAL (2017) European Birds of Conservation Concern
a hibernating
b breeding

2.10 Migratory birds

With regard to the status description and status assessment of the protected asset migratory birds, please refer to Chapter 2.10 of the North Sea Environmental Report on ROP 2021. Compared with the SEA for ROP 2021, only necessary updates or elaborations are to be presented.

In addition to this, there are now current investigations from the preliminary site investigation for Area N-9 from the July 2019 to 2021 (BioConsult SH et al. 2021e). The results of these investigations are largely comparable with the results from the surrounding areas. According to the experts, deviations can be attributed to the partly bad weather conditions during the surveys.

Compared with the North Sea Environmental Report on ROP 2021, there have been no changes in the state of knowledge on the occurrence and intensity of bird migration. According to current knowledge, the assessments in the North Sea Environmental Report on ROP 2021 remain valid.

2.11 Bats and bat migration

For a status description and status assessment of the protected asset bats, please refer to Chapter 2.11 of the North Sea Environmental Report on ROP 2021. The SEA has shown that no necessary updates or elaborations are apparent in this respect.

In addition, current findings from the BfN research project “Batmove” (FKZ 3515 821900) are now available (Seebens – Hoyer et al. 2021). As part of the research project, acoustic data on the occurrence of bat migration was collected in the North Sea along a network of stations concentrated along the coast and including two offshore sites close to the coast. It was not possible to cover the offshore areas of Zone 3 with suitable stations. Bat activity was detected at all stations. However, activity was lowest at the offshore locations.

Compared with the North Sea Environmental Report on ROP 2021, there have been no fundamental changes in the state of knowledge on the occurrence and intensity of bat migration. According to current knowledge, the assessments in the North Sea Environmental Report on ROP 2021 remain valid.

2.12 Biological diversity

With regard to the status description and assessment of biodiversity, please refer to the statements in Chapter 2.12 in the North Sea Environmental Report on ROP 2021. The SEA has shown that no necessary updates or elaborations are apparent in this respect.

2.13 Air

With regard to the status description and status assessment of the protected asset air, please refer to the statements in Chapter 2.13 of the North Sea Environmental Report on ROP 2021. The SEA has shown that no necessary updates or elaborations are apparent in this respect.

2.14 Climate

With regard to the description and assessment of the status of the protected asset climate, please refer to the statements in Chapter 2.14 of the North Sea Environmental Report on ROP 2021. The SEA has shown that no necessary updates or elaborations are apparent in this respect.

2.15 Seascape

With regard to the description and assessment of the status of the protected asset seascape, please refer to the statements in Chapter 2.15 of the North Sea Environmental Report on ROP 2021. The SEA has shown that no necessary updates or elaborations are apparent in this respect.

2.16 Cultural heritage and other material assets

With regard to the status description and status assessment of the protected asset cultural heritage and other material assets, please refer to the statements in Chapter 2.16 of the North Sea Environmental Report on ROP 2021. The SEA has shown that no necessary updates or elaborations are apparent in this respect.

2.17 Protected asset human beings, including human health

With regard to the status description and status assessment of the protected asset population and human health, please refer to Chapter 2.17 of the North Sea Environmental Report on ROP 2021. The SEA has shown that no necessary updates or elaborations are apparent in this respect.

2.18 Interrelationships between the protected assets

With regard to the description and assessment of interrelationships between the protected assets, please refer to the statements in Chapter 2.18 of the North Sea Environmental Report on ROP 2021. The SEA has shown that no necessary updates or elaborations are apparent in this respect.

3 Expected development in the event of non-implementation of the plan

The development of offshore wind energy plays a key role in meeting the climate protection and energy policy objectives of the German government. This is also reflected in the statutory expansion targets for offshore wind energy (Sec. 1, para. 2, sentence 1 WindSeeG).

The purpose of the SDP is to spatially define the areas and sites for wind turbines as well as the expected generation capacity on them and the necessary routes and locations for the entire required grid infrastructure or grid topology in the EEZ (Sec. 4, para. 2, Sec. 5 WindSeeG-E). Furthermore, the SDP also develops the temporal component of the development by determining the temporal sequence of the calls for tender for the sites for offshore wind turbines and the calendar years of the commissioning of grid connections. The SDP also specifies which site is to be centrally pre-surveyed and which is not in accordance with Sec. 5, para. 1, sentence 1, No. 3 WindSeeG-E). In addition, areas for other forms of energy generation can also be spatially designated for the practical testing and implementation of innovative concepts.

In accordance with the explanatory memorandum to WindSeeG-E, there are no alternatives (BT-Drs. 20/1634, p. 60). The law is necessary to achieve Germany's ambitious expansion targets for offshore wind energy as a significant contribution to the climate targets. On 3 February 2022, nature conservation issues relating to the development of offshore wind energy were discussed with nature conservation associations together with the Federal Minister for Environment, Nature Conservation, Nuclear Safety and Consumer Protection. On 8 February 2022, the existing offshore dialogue process was continued at ministerial level with the participation of the Federal Ministry for Environment, Nature Conservation and Nuclear Safety, the Federal Ministry for Digital and Transport, the BNetzA, the BSH, the BfN, the transmission system operators, and the offshore industry. A broad consensus emerged for the further development of offshore wind energy and the implementation of the expansion targets.

Against this background and in view of the drastic consequences of climate change – also for the state of the marine environment – which would have to be expected if the climate protection targets were not achieved, the assumption of a zero alternative in which development is assumed without the additional development of offshore wind energy is unrealistic.

In order to meet the expansion targets set out in Sec. 1, para. 2, sentence 1 WindSeeG-E, the construction of offshore wind turbines is necessary. As described above, no viable alternatives with which the climate protection targets could otherwise be achieved are currently apparent. Accordingly, the legislature considered the adverse effects on the marine environment caused by the legally defined expansion targets for offshore wind energy against the achievement of the climate protection targets within the framework of the expansion targets according to Sec. 1, para. 2, sentence 1 WindSeeG-E in favour of the orderly development of wind energy up to those expansion targets. As a result of this decision, the SDP serves the spatially and temporally ordered and efficient development of offshore wind energy with a series of additional regulations designed to minimise the adverse effect on the marine environment of the North Sea.

In order to be able to feed the electricity generated in the offshore wind farms in the EEZ into the onshore extra-high voltage grid, it is absolutely necessary to lay current-carrying subsea cables to the grid connection points on land. In this respect, too, there is no apparent alternative to the planned expansion targets for offshore

wind energy (including its grid connection) because of the need to protect the climate. In this framework, too, comprehensive planning by the SDP promotes the sparing use of land, and further regulations in the WindSeeG ensure that the environmental impacts of the subsea cables and pipelines identified in the SDP are as low as possible in each case.

With regard to the assessment for the individual protected assets, please refer to the statements in Chapter 3 of the North Sea Environmental Report on SDP 2020. In this respect, no additional or other significant impacts are to be expected from the present revision of the SDP. Furthermore, the SEA revealed that no required updates or elaborations are apparent with regard to the likely development in the case of the non-implementation of the plan.

4 Description and assessment of likely significant effects on the marine environment of implementing the Site Development Plan

In the following, the description and evaluation of the impacts on the environment concentrate on the protected assets for which significant impacts cannot be excluded from the outset by the implementation of the SDP. This includes the protected assets soil/space, benthos, biotopes, fish, marine mammals, seabirds and resting birds, migratory birds, bats and bat migration, climate, seascape, and cultural heritage and other material assets.

According to Sec. 40, para. 1, sentence 2 UVPG, the likely significant impacts on the environment of the implementation of the plan must be assessed. According to Sec. 40, para. 3 UVPG, the environmental impacts of the plan are provisionally assessed with a view to effective environmental precaution. According to Sec. 3, sentence 2 UVPG, the environmental assessment serves to ensure effective environmental precaution according to the applicable laws. According to Sec. 5, para. 3, No. 5 WindSeeG-E, the SDP shall exclude any threat to the marine environment with regard to the designations contained in the plan. The marine environment includes the protected assets and their habitat, including possible interrelationships, described in this environmental report. In the corresponding assessment of adverse effects on the marine environment, the special designations of Sec. 5, para. 3, No. 5 WindSeeG-E (with regard to protected areas) and Sec. 72, Para. 2 WindSeeG-E (with regard to legally protected biotopes) must also be observed.

Protected assets for which a significant adverse effect was ruled out in the environmental report on SDP 2020 (cf Chapter 2) and for which an assessment did not provide any indications of additional or other significant environmental impacts and for which an update or elaboration of the SEA already carried out for this protected asset is not required are not taken into account (Sec. 72, para. 1 WindSeeG-E). This concerns the protected assets plankton, water, and air as well as the protected asset humans, including human health. Possible impacts on the protected asset biological diversity are dealt with under the individual protected biological assets. All the protected assets listed in Sec. 2, para. 1 UVPG are investigated before the reviews for the legal framework governing the conservation of natural habits and species are presented. Statements on the general protection of nature and seascape according to Sec. 13 BNatSchG are also covered in the assessment of the individual protected assets.

According to Sec. 5, para. 2a WindSeeG-E, the SDP may make designations for areas for other forms of energy generation. In accordance with Sec. 3, No. 8 WindSeeG-E, an areas for other forms of energy generation is an area outside areas where offshore wind turbines and plants for other forms of energy generation can be erected in a spatial context. Installations in such areas may not be connected to the public power grid. The SDP defines the areas for other forms of energy generation SEN-1 in the EEZ of the North Sea. In the context of the SEA, a “classic” offshore wind farm is assumed based on the findings to date with regard to electricity generation for the areas for other forms of energy generation. Impacts on the environment beyond this are highly dependent on the respective use variant and will therefore be comprehensively examined at the approval level. In this respect, the SEA for the area for other forms of energy generation is carried out in the same way as the assessment of sites for offshore wind energy.

4.1 Soil/space

4.1.1 Areas, sites, and platforms

Wind turbines and platforms are still almost exclusively installed as deep foundations. The construction and operation of wind turbines can have various impacts on the protected assets soil and land; these are described in detail in Chapter 4.1.1 of the North Sea Environmental Report on SDP 2020.

Overall, even if the development of offshore wind energy in areas N-11 and N-14 to N-22 is extended, there is no reason to worry about any significant impacts on the protected assets soil and land. On one hand, the soil in Areas N-11 and N-14 to N-22 consists of a predominantly low-textured soil surface, which is essentially composed of homogeneous fine and medium sands.

4.1.2 Subsea cables

The construction and operation-related impacts caused by submarine cables are described in detail in Chapter 4.1.2 of the North Sea Environmental Report on SDP 2020.

With regard to the protected asset soil, no significant negative impacts are to be expected from the designations of the SDP on subsea cables. On the contrary, adverse impacts are avoided in comparison with non-implementation of the plan because the designations of the plan aim to minimise the use of the soil by reducing and bundling grid connection systems and minimising crossing structures.

With regard to the protected asset land, no significant impacts are to be expected as a result of the designations of the SDP. In total, based on the information on the model wind farm (cf. Chapter 4.5.3 of the scope of the current SEA), 0.081% of the area of the EEZ of the North Sea is directly taken up by the designations of the SDP for Scenario 1 and 0.084% for Scenario 2.

4.2 Benthos

4.2.1 Areas and sites

The construction and operation of wind turbines can have various impacts on the macrobenthos; these are described in detail in Chapter 4.2.1 of the Environmental Report on SDP 2020. These impacts can occur in a comparable manner in all areas designated for wind energy use. The impact on individual benthic species and communities depends, among other things, on their specific sensitivity to construction-related disturbances and, if necessary, must be assessed on a case-by-case basis in the subordinate planning and approval levels based on additionally collected inventory data. Compared with SDP 2020, the revision of the SDP includes additional areas for wind energy and is accompanied by partially higher land use on the individual sites. Nevertheless, according to the current state of knowledge, this does not result in any significant impacts on the protected asset benthos. Only small areas (usually 0.1–0.2% of the individual area) outside protected areas will be permanently affected by the project. Overall, the construction-related impacts on the protected asset benthos are assessed as short-term and small-scale; this is confirmed by findings from the operational monitoring of wind farms already in operation (e.g. Trianel wind farm Borkum, IfAÖ 2021b).

4.2.2 Platforms

The construction, installation, and operation-related impacts of the converter platforms on the benthic fauna largely correspond to those of the wind turbines and are described in detail in Chapter 4.2.2 of the Environmental Report on SDP 2020. They are spatially or temporally limited so that no significant adverse effects are to be expected. Additional, potentially significant impacts compared with SDP 2020 are not currently expected; furthermore, the SEA revealed that no required updates or elaborations are apparent.

4.2.3 Subsea cables

The laying and operation of subsea cables can also have impacts on the macrozoobenthos. Detailed descriptions can be found in Chapter 4.2.3 of the Environmental Report on SDP 2020. These impacts are small-scale and apply in a comparable way to all transmission line corridors. Taking into consideration the currently already applied preventive and mitigation measures, no significant impacts on the benthic communities are expected from the laying and operation of the subsea cables.

4.3 Biotopes

Possible impacts of the construction and operation of wind turbines and platforms and the laying and operation of subsea cables on the protected asset biotopes correspond to those described in Chapter 4.1 and Chapter 4.2 on the protected assets soil and macrozoobenthos.

They can result from a direct claim on biotopes, a possible cover by sedimentation of material released as a result of construction, and potential habitat changes. Significant construction-related, site-related, and operational impacts for biotopes not protected by law can generally be ruled out based on the assessments described in Chapter 4.1 and Chapter 4.2. Permanent habitat changes caused by the installation are limited to the immediate area of rockfills required in the case of subsea cables.

A special consideration of the possible loss of function and area and thus the significant adverse effect on the legally protected biotopes according to Sec. 30 BNatSchG is given in Chapter 4.15.

4.4 Fish

4.4.1 Areas and sites

According to current knowledge, the development of offshore wind energy is not expected to have any significant impacts on fish fauna as a result of the construction, foundations, and operation of wind turbines (WT). Detailed descriptions can be found in Chapter 4.4.1 of the North Sea Environmental Report on SDP 2020. The statements made there are supported by current findings. For example, investigations from Belgian offshore wind farms (OWF) showed increased fish densities of various species (e.g. plaice, sole, or striped lyrefish) inside the OWFs compared with outside (DEGRAER et al. 2020). In addition to the reef effect, the increased fish abundance could also be related to the restrictions on fishery in the OWF sites. In addition, after nine years of investigation in the Belgian OWF “C-Power”, there are first indications of a refuge effect for certain fish species (DEGRAER et al. 2020).

In general, the impact assessments to date are based on the assumption of a navigation ban in the OWF sites and the associated exclusion of active fishery. If these conditions change, an adjustment of the impact assessment for the fish fauna is to be expected.

The revision of the SDP provides for additional areas for wind energy and, in some cases, higher power densities on the sites (cf Chapter II.1 Draft SDP as well as Chapter 4.5.3 of the scope of the current SEA with regard to the ad-

justment of the model parameters). After reviewing the representations in the environmental reports for the SDP 2020, according to the current state of knowledge, there are no additional or other significant impacts on the protected asset fish for the draft SDP; furthermore, the SEA revealed that no necessary updates or elaborations are apparent.

4.4.2 Platforms

The construction-, installation- and operation-related impacts of the converter platforms on the fish fauna are spatially and temporally limited; this no significant adverse effects are to be expected. Detailed descriptions can be found in Chapter 4.4.2 of the North Sea Environmental Report on SDP 2020. No additional or other significant impacts are currently expected as a result of the revision of the plan; furthermore, the SEA revealed that no required updates or elaborations are apparent.

4.4.3 Subsea cables

The general impacts of submarine cables on fish fauna are presented in Chapter 4.4.3 of the North Sea Environmental Report on SDP 2020. The development of subsea cables and pipelines generally takes into consideration the gentlest possible laying methods, the bundling of pipelines, and an optimised cable laying procedure. Compared with the SEA for SDP 2020, no additional or other significant impacts of subsea cables on the protected asset fish are to be expected as a result of the increased development; furthermore, the SEA revealed that no necessary updates or elaborations are apparent.

4.5 Marine mammals

4.5.1 Areas and sites

The overall impacts of WT on marine mammals through the designation of the areas and sites for wind energy is expected to be insignificant. This also applies to a cumulative view.

The function and importance of the areas and sites in the German EEZ of the North Sea for harbour porpoises were assessed in Chapter 2.8 according to the current state of knowledge.

Construction-related impacts: With regard to the potential impacts of wind turbines on marine mammals, please refer to the statements in Chapter 4.2.5 of the Environmental Report on ROP 2021 and Chapter 4.5 of the Environmental Report on SDP 2020. The assessment made there remains valid even in view of the planned increase in power density.

If the threshold value of 160 dB re 1µPa2^s (single sound event level SEL_{05}) and 190 dB re 1µPa (peak level) valid at 750 m is complied with, a maximum disturbance radius of 8 km can be assumed in accordance with the noise mitigation concept of the Federal Ministry for the Environment (BMU) from 2013 (BMU 2013).

In view of the tightly timed development, it can be assumed that several construction sites will be operated simultaneously in some areas.

Potential cumulative effects of noise immission at parallel construction sites are considered in detail in Chapter 4.12.3.

According to current state of knowledge, operational noise from the wind turbines and the platform has no impacts on highly mobile fauna such as marine mammals. The investigations carried out as part of the operational monitoring for offshore wind farms have so far given no indications of avoidance by wind farm-related shipping traffic. So far, avoidance has been observed only during the installation of the foundations; this could be related to the large number and varying operating conditions of vehicles on the site.

The standardised measurements of the continuous noise immission from the operation of the wind farms, including the wind farm-related shipping traffic, have shown that low-frequency noise can be measured at a distance of 100 m from the respective wind turbine. However, with increasing distance from the installation, the noise from

the installation is only insignificantly different from the ambient sound. At a distance of only 1 km from the wind farm, higher sound levels are always measured than in the centre of the wind farm. The investigations have clearly shown that the underwater noise emitted by the installations cannot be clearly identified from other sound sources (e.g. waves or ship noise) even at short distances. The wind farm-related shipping traffic was also hardly differentiated from the general ambient noise, which is introduced by various sound sources such as other shipping traffic, wind, waves, rain, and other uses (MATUSCHEK et al. 2018).

In the measuring instruction for recording and analyses of underwater sound (BSH, 2011), a level difference of at least 10 dB is required between pulsating and background noise for a technically unambiguous calculation of impulse noise during pile driving. On the other hand, for the calculation or assessment of continuous sound measurements there is no minimum requirement in this respect because of a lack of experience and data. In the airborne noise range, a level difference of at least 6 dB between installation and background noise is required for the unambiguous assessment of installation or operating noise. If this level difference is not achieved, a technically unambiguous assessment of the installation noise is not possible, or the installation noise is not clearly distinguishable from the background noise level.

The results from the measurements of underwater noise that are available show that a 6 dB criterion such as this based on airborne sound can be fulfilled only in the close proximity to one of the installations at most. However, this criterion is no longer fulfilled even a short distance from the edge of the wind farm. As a result, the sound emitted by the operation of the turbines outside offshore wind farms does not clearly stand out acoustically from the existing ambient sound.

The biological relevance of continuous sound on marine species, particularly the harbour porpoise, has not yet been conclusively clarified. Continuous noise is the result of emissions from various anthropogenic uses as well as from natural sources. Reactions of fauna in the immediate vicinity of a source such as a moving ship are to be expected and can occasionally be observed (WISNIEWSKA et al. 2018). Such reactions are even essential for survival in order to avoid collisions, among other things. In contrast, reactions that were not observed in the immediate vicinity of noise sources can no longer be assigned to a specific source.

Behavioural changes are predominantly the result of various influences. Noise can certainly be a possible cause of behavioural changes. However, behavioural changes are primarily driven by the survival strategies of the fauna to capture food, escape predators, and communicate with conspecifics. For this reason, behavioural changes always occur in a situational way and in a different form.

The literature contains references to possible behavioural changes caused by ship noise, but the results are not well-founded enough to draw conclusions about the significance of behavioural changes or even for developing and implementing suitable mitigation measures (BSH 2021, Environmental report for the North Sea, Chapter 3.1.4).

Many international studies address the impacts of sound emitted by ships on marine mammals (whales, seals) or on fish and invertebrate species (COSENS ET AL., 1993, ERBE 2000, 2003, KRAUS ET LA., 2005, CLARK ET AL., 2009, GÖTZ ET AL., 2009, HUNTIGTON, 2009, CASTELLOTE ET AL., 2012, HATCHet al.,2012, ERBE ET AL, 2012, ROLAND ET AL, 2012, ANDERWALT ET AL, 2013, WILLIAMS ET AL, 2014, BLUNDELL ET AL, 2015, DYNDO ET AL, 2015, FINNERAN 2015, CULLOCH ET AL, 2016, ELLISSON ET AL, 2016, PINE ET AL, 2016, CHEN ET AL, 2017, HALLIDAY ET AL, 2017, FRANKEL & GABRIELE, 2017, WISNIEWSKA ET AL,

2018, MIKKELSEN ET AL, 2019). Many of these studies suggest that interference can occur by masking communication, particularly in baleen whales, which echo and communicate in low frequencies overlapping with ship sounds. Evidence can be found in numerous studies; however, the results of these are often not comparable, transferable, or reproducible (ERBE ET AL., 2019). The potential effects of disturbance from ship noise are also difficult to quantify and differentiate from other sources of disturbance. In addition, marine mammals have evolved adaptive mechanisms in order to maintain communication in noisy areas (ERBE et al., 2015; 2019). One of the known adaptations of whales to the acoustic environment in the oceans is the "Lombard effect". The Lombard effect is described as the ability to ensure communication between conspecifics by changing the volume, vocalisation rate, and frequency – even in noisy environments – and has been demonstrated in various animal groups. Cetaceans (e.g. the harbour porpoise) are also capable of increasing the volume and frequency of vocalisation as well as changing the frequency spectrum. This adaptation is a survival strategy to be able to forage effectively and efficiently, to escape predators, to maintain contact between mother and calf, and to seek out conspecifics (ERBE ET AL., 2019). Scientific reviews of the existing literature on the possible impacts of ship noise on cetaceans and fish clearly point to the lack of comparability, transferability, and reproducibility of the results (POPPER & HAWKINS, 2019; ERBE et al. 2019).

The investigations carried out over many years according to StUK as part of the operational monitoring of offshore wind farms in the German EEZ of the North Sea have so far not provided any indications that would point to an avoidance or change in behaviour of harbour porpoises in the wind farms, their surroundings, or along shipping routes (BioConsult, 2020; IfAÖ et al., 2020; PGU, 2021). In the southern area of the German EEZ of the North Sea with the two traffic separation zones and now with nine offshore wind farms in operation, the occurrence of the harbour porpoise has increased since 2012 (NACHTSHEIM et al., 2021b, GILLES et al., 2019).

Previous analyses of service traffic from some wind farms show that there are, on average, three trips per day for the purpose of supplying, maintaining, or repairing installations. Thus, the average number of wind farm-related shipping movements is within the range of normal shipping traffic in and around the sites of the offshore wind farms that it was before the wind farms were constructed. As a result of the bypassing of the wind farm areas from commercial shipping and the applicable regulations for use by fishing vessels (see Chapter 3.3), wind farms can be described as rather low-traffic zones.

It is known from oil and gas platforms that the attraction of different fish species leads to an enrichment of the food supply (FABI et al., 2004; LOKKEBORG et al., 2002). The recording of harbour porpoise activity in the immediate vicinity of platforms have also shown an increase in harbour porpoise activity associated with foraging during the night (CLAUSEN et al., 2021). It can thus be assumed that the possibly increased food supply in the vicinity of the wind turbines and other platforms is likely to be attractive to marine mammals.

As a result of the SEA, according to current knowledge and taking into consideration the protective measures mentioned above, no significant impacts on the protected asset marine mammals are to be expected from the construction and operation of wind turbines and other platforms within the areas and sites of the plan.

4.5.2 Platforms

The statements under 4.5.1 can also be applied to platforms.

4.5.3 Subsea cables

Construction-related impacts

During the installation phase, which is limited in time and space, short-term deterrence may occur as a result of construction-related shipping traffic. However, these effects do not go beyond the disturbances generally associated with slow ship movements. Possible changes in sediment structure and associated temporary benthic changes do not have significant impacts on marine mammals because they search for their prey in widely extended areas in the water column.

Operational sediment temperature increases have no direct impacts on highly mobile animals such as marine mammals. The influence of electromagnetic fields from submarine cables on the migration behaviour of marine mammals is largely unknown (GILL et al. 2005). However, because the strength of the magnetic fields that occur is considerably lower than the strength of the Earth's natural magnetic field, no significant impacts on marine mammals are to be expected.

As a result of the SEA, it can be said that, according to the current state of knowledge, no significant impacts on the protected asset marine mammals are to be expected as a result of the laying and operation of current-carrying cables.

4.6 Seabirds and resting birds

4.6.1 Areas and sites

The construction and operation of wind turbines can have various impacts on seabirds and resting birds; these are described in detail in Chapter 4.6.1 of the North Sea Environmental Report on SDP 2020 and Chapter 3.2.5 of the North Sea Environmental Report on ROP 2021. More recent findings come from the monitoring of German and Belgian offshore wind farms, among others.

For the guillemot, which is widespread in the German North Sea, previous findings indicate that reactions to offshore wind farms depend on a number of factors. DIERSCHKE et al. (2016) compiled findings on the behaviour of seabirds from 20 European wind farms. From the studies that were taken into consideration, it was found that Common Guillemots appear to react differently depending on the location of an offshore wind farm. In the wind farms considered, complete avoidance of the OWF area, partial avoidance behaviour up to adjacent areas or no avoidance behaviour at all was observed (DIERSCHKE et al. 2016). The authors attribute these differences to food availability at the respective location. MENDEL et al. (2018) add a seasonal aspect to the avoidance behaviour of guillemots. Using digital aerial transect surveys in the area north of Helgoland, the authors found differences in the avoidance behaviour before and during the breeding season. In spring, for example, a significant reduction in density up to 9 km from the wind farm projects north of Helgoland was observed, while no effect radius was found during the breeding season. MENDEL et al. (2018) link these differences to the reduced range and attachment to the breeding colony on Helgoland during the breeding season. In spring, however, guillemots are independent of a specific range and generally show a more westerly distribution (MENDEL et al. 2018). In a recent study, PESCHKO et al. (2020) confirmed the breeding season behaviour found by MENDEL et al. (2018) by using transmittered guillemots in the same area of investigation.

In contrast, an ongoing update of the study by GARTHE et al. (2018) with an extension of the species composition considered shows significant avoidance effects for the guillemot, the razorbill, the gannet, and the Northern fulmar as well as a variable response of the kittiwake and the lesser black-backed gull (GARTHE et al. 2022). The analyses are based on data from a maximum of two years of operation up to 2017; further years of operation after 2017 are to be included until the study is completed at the end of 2023 – just like other factors that can influence the distribution of seabirds and resting birds. In addition, research data and data from seabird monitoring on behalf of the BfN were included in the analyses. The current results of the study

were presented in a lecture at the Marine Environment Symposium in Hamburg on 19 May 2022 (GARTHE et al. 2022).

In the study, the largest significant avoidance distance for the guillemot was determined to be 21 km from the wind farm. Up to 91% fewer individuals were found in the 1 km radius around the wind farm, and up to 80% fewer individuals in the 5 km radius. The effect was greater in autumn than in winter.

Strong avoidance was also observed for the razorbill and the gannet (but only up to 3 km from the wind farm) as well as for the Northern fulmar (up to 6 km). In general, the effect size (i.e. what percentage of individuals were affected by habitat loss) revealed a dependence on the season. This seasonality as well as a seasonality of response (avoidance, attraction, indifferent behaviour) was also evident in the kittiwake and the lesser black-backed gull. For the latter species, avoidance effects were found up to 15 km away in summer, while an attraction effect was found up to 3 km away in autumn. Kittiwakes were also found to be attracted in winter – also up to 3 km away. In contrast, the species showed an avoidance reaction in the same radius of action in spring.

More recent investigations from the operational phases of German offshore wind farms confirm the small-scale avoidance behaviour previously observed in these offshore wind farms in terms of partial avoidance by the gannet, the guillemot, and the razorbill as well as for the little gull (IFAÖ et al. 2020, PGU 2021, BIOCONSULT SH 2022).

Thus, in the 5th year of the operational phase of the “Butendiek” OWF, for the species guillemot and razorbill, which were analysed together as auks, an avoidance distance of about 4 km was calculated based on the flight and ship survey results. The avoidance range determined after ship survey was between 2.8 and 5.4 km, whilst that determiend after flight survey was between 3.4 and 6.4 km (BIOCONSULT SH 2022). The distance calculated for the gannet ranges from 2.2 km for ship observations to 3.4 km for aircraft observations; for the little gull, it ranges from 4.3 km (aircraft observations) to 3.2 km (ship observations; BIOCONSULT SH 2022). Investigations from the operational phase of the wind farm cluster “North of Borkum” indicate a lower use of the wind farm areas in the operational phase for the little gull; furthermore, an avoidance reaction is not clearly recognisable (IFAÖ et al. 2020). For the gannet, the joint observation of the flight and ship surveys made it possible to statically determine a range of up to 2 km. For the species guillemot and razorbill analysed together as auks, the different analysis methods in the cluster “North of Borkum” indicate an avoidance range of up to at least 4 km; it was not possible to calculate avoidance distances. During the construction and operation phase, razorbills, guillemots, and gannets were observed in lower densities within the OWFs of “Cluster 6”; there was also as an increase in densities with increasing distance to the wind farm from 1 km distance (PGU 2021). Little gulls were not detected within the OWFs but rather directly in the immediate vicinity of the projects.

In the individual consideration of the more recent findings from OWF monitoring in the EEZ, lower avoidance effects result – at least for the guillemot and gannet – than from the combined analysis of monitoring and research data by GARTHE et al. (2022).

In Belgium, large numbers of gannets, razorbills, and guillemots were observed inside wind farms for the first time during the first two-day ship-based monitoring of all Belgian offshore wind farms in February 2021 (VANERMEN et al. 2021). All wind farms were in the operational phase; the most recent project went into operation at the end of 2020. The authors state that further investigations are needed in order to find out whether these observations are an episodic snapshot or

the first indications of a habituation effect. A previously published study reported significant avoidance of the Belgian wind farms “C-Power” and “Bligh Bank” as well as correspondingly significantly reduced numbers of gannets, guillemots, and razorbills in the immediate vicinity of the wind farm (VANERMEN et al. 2016). The wind farm had an attraction effect on the herring gull and the greater black-backed gull. The data came from five years of operational monitoring of the “Bligh Bank” OWF and three years of operational monitoring of the “C- Power” OWF. An extension of the data series by three years confirmed the results from the OWF “C-Power”(VANERMEN et al. 2019). Monitoring at the “Robin Rigg” OWF in Scotland found no change in the abundance of the guillemot at the wind farm over the study period (VALLEJO et al. 2017). The period of investigation covered a little more than 10 years of which the last 24 months fell on the operational phase and followed a construction phase of 18 months beforehand.

On the basis of the dynamic state of knowledge, in particular on the behaviour of the guillemot, it is currently not to be assumed that the development of offshore wind energy by 2031 in Zone 3 of the SDP will have a significant adverse effect on the protected asset seabirds and resting birds. For the development in Zones 4 and 5 of the SDP, this assessment must be verified on the basis of further investigations to be carried out.

4.6.2 Platforms

The general impacts of platforms on seabirds and resting birds are presented in Chapter 4.6.2 of the North Sea Environmental Report on SDP 2020. Compared with the SEA on SDP 2020, no additional or other significant impacts of platforms on the protected asset seabirds and resting birds are to be expected as a result of the increased development. Also because of the designations in the draft of the SDP, no further necessary updates or elaborations compared with the SEA of SDP 2020 are apparent in this respect.

4.6.3 Subsea cables

The general impacts of submarine cables on seabirds and resting birds are presented in Chapter 4.6.3 of the North Sea Environmental Report on SDP 2020. Compared with the SEA on SDP 2020, no additional or other significant impacts of subsea cables on the protected asset seabirds and resting birds are to be expected as a result of the increased development. Also because of the designations in the draft of the SDP, no further necessary updates or elaborations compared with the SEA of SDP 2020 are apparent in this respect.

4.7 Migratory birds

4.7.1 Areas and sites

The construction and operation of wind turbines can have various impacts on bird migration; these are described in detail in Chapter 4.7.1 of the North Sea Environmental Report on SDP 2020.

The scope for the current SEA (published on 30 June 2022) provides for various turbine scenarios for the further development of offshore wind energy, particularly in Zone 3 as well as Zones 4 and 5. The assumptions for the turbines (cf Chapter 4.5.3 of the scope) up to and including Scenario 1 for Zones 4 and 5 are already covered by the bandwidth consideration of SDP 2020. Only Scenario 2 for Zones 4 and 5 (with a total height of 385 m) is above the upper range of the total height of 350 m of SDP 2020.

Based on current knowledge, the potentially larger turbines in Zones 4 and 5 would not have any significant impacts on bird migration. A cross-project analysis from the monitoring of offshore wind farm projects showed a clear coastal orientation of bird migration in the EEZ of the North Sea (WELCKER 2019). Zones 4 and 5 are at a great distance from the coast.

Directly adjacent to Areas N-6 and N-9, the Netherlands has already designated the area for wind energy, NL 5-Oost, in the area of the Dutch EEZ. According to plans of the Netherlands, shipping route SN6 designated in ROP 2021 is no longer to be extended into the Dutch EEZ. Identical turbine parameters are assumed for both the plans on the Dutch side and the plans for offshore wind energy expansion in Zone 3 on the German side. It can be assumed that turbines in both areas are likely to have identical height parameters. This results in a larger total area of wind energy use overall. However, “staircase effects” resulting from turbines of different heights are unlikely. On the other hand, Areas N-21 and N-22 are located in Zone 2 for which the draft SDP assumes a total height of 170 m in Scenario 1 and 270 m in Scenario 2 (cf Chapter 4.5.3 of the scope on the current SEA). In addition to the projects already realised in Areas N-6 and N-8, the two areas under review could have turbines the same size as those on the Dutch side or smaller ones. A staircase effect would occur only with the implementation of smaller turbines during autumn migration, when the birds migrate from the north-east to the south-west and first fly to the smaller turbines of the OWFs on the German side. However, according to the current state of knowledge, the sites under review, N-21 and N-22, have no discernible significant impacts on bird migration. This applies accordingly to a possible extension of Area N-11 (shown in Fig.1 of the draft SDP).

According to current knowledge, the assessment in the North Sea Environmental Report on SDP 2020 remains valid. Significant impacts on bird migration can therefore be ruled out. Also because of the designations in the draft of the SDP, no further necessary updates or elaborations compared with the SEA of SDP 2020 are apparent in this respect.

4.7.2 Platforms

The construction-, installation-, and operation-related impacts of platforms on bird migration are described in detail in Chapter 4.7.2 of the North Sea Environmental Report on SDP 2020. No additional or other significant impacts are currently expected as a result of this revision of the plan.

4.7.3 Subsea cables

Installation- and operation-related impacts of the planned subsea cables on migratory birds can be excluded with the necessary certainty. A possible collision risk from construction vehicles can be classified as low because of the short-term nature of the construction phase.

4.8 Bats and bat migration

4.8.1 Areas and sites

The impacts of offshore wind energy projects on bats are described in Chapter 4.8.2 of the North Sea Environmental Report on SDP 2020. No additional or other significant impacts are expected as a result of this revision of the plan; furthermore, the SEA revealed that no necessary updates or elaborations are apparent.

4.8.2 Platforms

The construction-, installation-, and operation-related impacts of platforms on bats are described in Chapter 4.8.2 of the North Sea Environmental Report on SDP 2020. No additional or other significant impacts are expected as a result of this revision of the plan. Furthermore, the SEA revealed that no required updates or elaborations are apparent.

4.8.3 Subsea cables

Significant impacts on bats from the laying and operation of subsea cables can be ruled out with the required degree of certainty.

4.9 Climate

No significant negative impacts of the SDP on the climate are expected as a result of the designations on offshore wind energy.

The CO_2 savings associated with the development of offshore wind energy is expected to have positive impacts on the climate in the long term. This can make an important contribution to achieving the climate protection goals of the German government.

Assuming the continuation of the current CO_2 avoidance factor of electricity from offshore wind energy (UBA, 2019), this results in a CO_2 avoidance potential of approx. 67 and 143 Mt CO_2 equivalents per year for 2030 and 2038, respectively. For comparison: Annual emissions from power plants in the energy industry were 294.5 Mt CO_2 equivalents per year in 2016 (BMU, 2019).

Table 2 shows the avoidance potential for the years 2020, 2030, and 2038.

Table 2: Calculation of the CO_2 avoidance potential for the years 2020, 2030, and 2038.

	installed capacity	Full load hours	Annual electricity production	CO_2 avoidance factor	CO_2 avoidance per year
	GW	h/a	GWh/a	g CO_2eq/kWh	Mt CO_2eq/a
2020	7.2	3800	27,360	701	19.2
2030	30	3200	96,000	701	67.3
2038	60	3400	204,000	701	143.0

4.10 Seascape

4.10.1 Areas and sites

The impacts of the designations of the SDP on offshore wind energy are described in Chapter 4.10.1 of the North Sea Environmental Report on SDP 2020.

Even with the realisation of offshore wind farms in Areas N-14 to N-22, the adverse effect on the seascape as a result of the planned wind turbines on the coast can be classified as low.

4.10.2 Submarine cable

For the subsea cables, negative impacts on the seascape can be ruled out as a result of the relocation as submarine cables.

4.11 Cultural heritage and other material assets

The designations for the planning, construction, and operation of wind turbines and subsea cables and pipelines aim to avoid or reduce construction-related disturbances to the soil affect-

ing discovered and undiscovered cultural heritage by involving the specialist authorities at an early stage. Synergy effects are to be promoted through cooperation in the analysis of subsoil investigations and soil samples; this will be carried out in the context of the large-scale development of marine areas for wind energy and can provide new insights into cultural traces such as submerged seascapes.

The SEA for the SDP does not include a systematic survey or assessment of existing underwater cultural heritage. There is also no systematic survey in the downstream procedures; however, occasion-related investigations can be carried out or ordered. Within the scope of the suitability assessment, in particular the underlying preliminary site investigations of the bathymetry as well as the side scan sonar and the magnetometer are compared and, if necessary, verified by means of Remotely Operated Vehicles (ROV). These results of the site investigation are evaluated with regard to the protected asset soil. Cultural assets identified in this evaluation process (e.g. shipwrecks) are included in the suitability assessment.

In the planning approval procedure (which follows the determination of suitability or, in the case of sites that have not been centrally pre-investigated, the designation as a site in the SDP as the next level with environmental assessment), the BSH regularly orders the following in the event that any cultural and material assets are found: On the part of the developer, it must be ensured through suitable measures and with the involvement of monument protection and monument specialist authorities that scientific investigations and documentation of the properties can be carried out before the start of construction work and that objects of an archaeological or historical nature can be preserved and conserved either on site or through salvage. Conservation on site should be a priority.

There is therefore no reason to fear any significant impacts on the protected asset cultural heritage and other material assets.

4.12 Cumulative effects

4.12.1 Soil/space, benthos, and biotopes

A substantial proportion of the impacts on the environment caused by the areas and sites, platforms, and subsea cables on soil, benthos, and biotopes will occur exclusively during the construction period (e.g. formation of turbidity plumes, sediment rearrangement) and within a spatially narrowly defined area. Because of the gradual implementation of the construction projects, significant construction-related cumulative environmental impacts are not particularly likely. Possible significant cumulative impacts on the soil, which could have a direct impact on the protected asset benthos and biotopes, therefore result primarily from the permanent direct land use of the foundations and scour protection systems of the turbines and, in part, from the laid cable systems (crossing structures).

According to the precautionary principle, the maximum values resulting from the range of the model wind farm scenarios were used to calculate the land use. The calculation of the loss of function resulting from the interarray cabling was carried out in accordance with the reported capacity, assuming a 1 m wide cable trench. In the area of the cable trench, however, the adverse effect on sediment and benthic organisms will be essentially temporary. In the case of crossing particularly sensitive biotopes such as reefs or species-rich gravel, coarse sand, and shell layers, permanent adverse effect would have to be assumed.

Based on this conservative estimate, a maximum of 1544 ha of area will be claimed for the areas and sites for wind energy use or temporarily impaired in the case of interarray cabling. Of this, 2.04 ha are allotted to the up to 34 converter

platforms with associated scour protection (600 m² per platform).

For the subsea cables, this results in a mostly temporary loss of function over an area of maximum 790 ha. Outside the sensitive biotopes, a permanent loss of area and function as a result of the cable systems results exclusively from the crossing structures that become necessary. Based on an area of approx. 900 m² per crossing structure, the direct area use for approx. 640 crossing constructions amounts to approx. 57.6 ha. In total, therefore, up to 2,391 ha of soil will be claimed or, in the case of the submarine cables, temporarily affected; this corresponds to a share of approx. 0.084% of the total EEZ area.

In addition to the direct use of the soil and thus of the habitat of the organisms that have settled there, the installation foundations, scour protection, and crossing constructions lead to an additional supply of hard substrate. As a result, hard substrate-loving species untypical of the site (nursery and mobile predators) can colonise and directly or indirectly influence the natural soft substrate community. In addition, artificial substrates can lead to an altered spread of invasive species, among others. These indirect effects can lead to cumulative effects resulting from the construction of several offshore structures or rockfills in crossing areas of subsea cables and pipelines. However, reliable findings on effects beyond the sites of the wind farms or on the altered connectivity of invasive species are not yet available.

Because the (mainly temporary) land use is below 0.1% of the EEZ area even in the cumulative consideration of the grid infrastructure and the wind farm areas, according to current knowledge, no significant adverse effects that lead to a threat to the marine environment with regard to the soil and the benthos are to be expected – even in the cumulation of indirect effects.

4.12.2 Fish

The wind farms of the southern North Sea can have an additive effect beyond their immediate location. This becomes particularly relevant with increased farm numbers and the development of larger clusters. The impacts of the OWFs are concentrated on the regular navigation bans on fishery that have been imposed up to now as well as on the change in habitat and the corresponding interrelationships.

The general species composition of the fish fauna could change directly because species with different habitat preferences than the established species (e.g. reef dwellers) find more favourable living conditions and occur more frequently. For example, in the Danish wind farm Horns Rev, seven years after its construction, a horizontal gradient in the occurrence of hard-substrate-affine species was found between the surrounding sand areas and near the turbine foundations: Goldsinny wrasse, eelpout, and lumpfish occurred much more frequently near the wind turbine foundations than on the surrounding sandy areas (LEONHARD et al. 2011). This change could intensify as the number of wind farms on an area increases. Other possible effects of a large-scale development of offshore wind energy and the associated accumulation of local impacts could be:

- a change in species composition and diversity
- establishment and distribution of fish species adapted to reef structures
- an increase in the number of older individuals as a result of the expected reduction in fishing pressure
- better conditions for the fish as a result of a larger and more diverse food base,

In the event of a change to the previous navigation regulations for OWFs and the associated ex-

clusion of active fishery in the OWF sites, a re-assessment of cumulative effects on fish fauna would be necessary.

Overall, there is a need for research on the extent to which cumulative effects of OWFs affect the fish stocks of individual species in the long term.

4.12.3 Marine mammals

Construction-related impacts

Cumulative impacts on marine mammals, especially harbour porpoises, may occur mainly because of noise exposure during the installation of deep foundations. For example, marine mammals can be significantly affected by the fact that – if pile driving is carried out simultaneously at different locations within the EEZ – there is not enough equivalent habitat available to avoid and retreat to.

So far, the implementation of offshore wind farms and platforms has been relatively slow and gradual. From 2009 to 2018, pile driving work was carried out at 20 wind farms and eight converter platforms in the German EEZ of the North Sea. Since 2011, all pile driving work has been carried out using technical noise mitigation measures. Since 2014, the noise emission values have been reliably complied with and even undercut thanks to the successful use of noise mitigation systems. Most of the construction sites were located at distances of 40 to 50 km from each other and were temporally decoupled. There was thus no overlapping of sound-intensive pile driving work that could have led to cumulative impacts. Only in the case of the two directly adjacent projects Meerwind Süd/Ost and Nordsee Ost in Area N-4 was it necessary to coordinate the timing of the pile driving work, including the deterrence measures. The coordination was carried out successfully. The extensive monitoring methods have confirmed that cumulative impacts were excluded.

The analysis of the noise results with regard to noise propagation and the possibly resulting accumulation has shown that the propagation of impulsive noise is strongly limited when effective noise-minimising measures are applied (Brandt et al. 2018, Dähne et al., 2017).

Cumulative impacts of the present draft plan on the population of harbour porpoise are considered in accordance with the requirements of the noise mitigation concept of the BMU of 2013.

The noise mitigation concept of the BMU (2013) follows a habitat-based approach with regard to the assessment and avoidance of cumulative effects and includes area-related threshold value. In concrete terms, the legal requirements from the noise mitigation concept of the BMU (2013) provide for the following:

- It shall be ensured with the necessary certainty that, at any time, no more than 10% of the area of the German EEZ of the North Sea is affected by disturbance-triggering sound inputs from sound-intensive pile driving activities for the foundations of the piles (species protection law prohibition of disturbance, Sec. 44, para. 1, no. 2 BNatSchG).
- At the same time, it is necessary to exclude any adverse effect on the conservation objectives of the nature conservation areas by ensuring that no more than 10% of the area of one of the nature conservation areas is affected at any time by sound-intensive pile driving work for the foundations of the piles. During the sensitive period of the harbour porpoise from 1 May to 31 August, it shall also be ensured with the necessary certainty that no more than 1% of sub-area I of the “Sylt Outer Reef – Eastern German Bight” nature conservation area with its special function as a breeding area is affected by sound-intensive pile driving work for the

foundations of the piles from disturbance-triggering sound inputs (habitat protection in accordance with Sec. 34 BNatSchG).

In addition, the following assumptions were made in the noise mitigation concept based on the findings on the propagation of pile driving noise and on the impacts of pile driving noise on the harbour porpoise:

(a) The **propagation is**calculated **using a formula derived from ELMER et al., (2007)**, which depicts a stronger propagation attenuation at greater distances than that of THIELE & SCHELLSTEDE (1980). Investigations have shown that the frequently used formula according to THIELE & SCHELLSTEDE (1980) leads to an overestimation of the propagation of impact sound at large distances (Chapter 6, page 1, formula (1)).

(b) A **significant disturbance of the harbour porpoise occurs at 140 dB broadband sound exposure level** (Chapter 6, page 21).

(c) Taking into consideration (a) and (b), the result for practical implementation is a disturbance radius of **8 km with compliance with the noise limits of 160 dB SEL at 750 m** (Chapter 6, page 21, Table 1).

The aforementioned requirements from the noise mitigation concept of the BMU (2013) are part of the ordinance in the subordinate approval procedures for offshore projects.

On one hand, the requirements of the noise mitigation concept take into consideration the requirements of the designations of the BNatSchG and the Habitats Directive with regard to the protection of strictly protected species such as the harbour porpoise (cf BMU 2013, p. 5). At the same time, the requirements of the noise mitigation concept also fulfil the requirements of Commission Decision 2017/848/EU[4], which, among other things, lays down criteria and methodological standards for the description of good environmental status of marine waters and sets out specifications and standardised procedures for monitoring and assessment. The requirements thus ensure the implementation of Directive 2008/56/EC[5] (Marine Strategy Framework Directive, hereinafter: MSFD) with regard to the designation of threshold value for the protection of the marine environment from impulsive noise discharges.

Within the framework of the implementation of the MSFD, the sustainable use of the seas is required in order to achieve and maintain a good environmental status (Art. 1, para. 1 MSFD). Recommendations for practical implementation were developed by an expert group (TG-Noise) on behalf of the Commission (Dekeling et al. 2014). Good environmental status (GES) is thus a common European objective. In a list of qualitative descriptors for the designation of good environmental status (Annex I), the MSFD also includes descriptor 11, which comprises targets and objectives for the management of energy inputs/underwater noise in the marine environment. The EU Commission Decision 2017/848/EU sets out criteria for good environmental status as described above and addresses standards relevant to the assessment of

[4] Commission Decision (EU) 2017/848 of 17 May 2017 designating criteria and methodological standards for the characterisation of good environmental status of marine waters and specifications and standardised methods for monitoring and assessment and repealing Decision 2010/477/EU, OJ L 125, 18 May 2017 p. 43.

[5] Directive 2008/56/EC of the European Parliament and the Council dated 17 June 2008 for the establishment of a Framework for Community Action in the Marine Environment (Marine Strategy Framework Directive (MSFD)), OJ L 164 dated 25 June 2008, p. 19.

the descriptors. The criteria regarding impulsive underwater noise include both a spatial and temporal component. The EU states are called upon to define and use threshold values in order to ensure that the input of impulse noise does not have negative effects on populations of marine species (EU Commission, SWD (2020) 62 final).

From a species conservation perspective, the area of the EEZ represents the habitat of the local population of the harbour porpoise. In accordance with the noise mitigation concept, it must be ensured that less than 10% of the area of the EEZ is affected by disturbance-triggering pile driving noise at any time.

With a total area of the German EEZ in the North Sea of 28,539 km^2, the maximum area to be polluted is therefore 2,854 km^2. The application of the 10% criterion from the noise mitigation concept theoretically means that parallel pile driving work would be possible at up to 14 construction sites in the German EEZ of the North Sea while complying with the noise limits.

In order to avoid and mitigate cumulative impacts on the harbour porpoise population in the German EEZ, the ordinances of the downstream approval procedure shall specify a restriction of the sound exposure of habitats to maximum permitted proportions of the EEZ and nature conservation areas. According to this, the propagation of sound emissions may not exceed defined areas of the German EEZ and nature conservation areas. This ensures that sufficient high-quality habitats are available for the animals to escape at all times. The ordinance primarily serves to protect the harbour porpoise as a species as well as marine habitats by avoiding and minimising disturbances caused by impulsive noise immission.

The reservation area for harbour porpoise in the summer months, as defined in ROP 2021, comprises the Natura2000 site “Sylt Outer Reef” or Area I of the “Sylt Outer Reef – Eastern German Bight” nature conservation area and its indirect surroundings. Pile driving activities that have the potential to cause disturbances as a result of noise immission in the main concentration area of harbour porpoise during the sensitive season are coordinated in such a way that the proportion of the affected site remains below 1% at all times.

As a result of the spatial planning designation of the reservation area for the harbour porpoise, the standards for the protection of impulsive noise emissions applicable to projects at the “Sylt Outer Reef – Eastern German Bight” nature conservation area will also have to be taken into consideration for projects located in and near the reservation area within the framework of downstream approval procedures.

In addition, in accordance with the noise mitigation concept of the SMU (2013), all pile driving activities are coordinated with the aim of always keeping sufficient alternative sites in the protected areas, in equivalent habitats, and in the entire German EEZ free of pile driving noise that could cause disturbance to the harbour porpoise.

The draft of the SDP provides for an expanded development of offshore wind energy. The current draft shows that the simultaneous construction of several offshore wind farms is to be expected, especially in the years 2027 to 2030. Within the framework of the SEA, it is therefore necessary to screen possible cumulative impacts caused by the construction of the wind farms with regard to compliance with species protection and site protection requirements of the noise mitigation concept (BMU, 2013).

The noise mitigation concept of the BMU is a preventive measure to ensure the protection of the harbour porpoise from cumulative impacts caused by pile driving noise during the construction of offshore wind farms. The noise mitigation concept contains concrete specifications that take into consideration species protection and

habitat protection with regard to cumulative impacts.

As part of the SEA for the draft of the SDP, four scenarios were developed, and the potential exposure to disturbance-triggering pile driving noise was determined in accordance with the habitat-based approach anchored in the noise mitigation concept. The determination of polluted habitat parts serves the practical implementation of species and habitat protection requirements of the noise mitigation concept within the framework of the downstream suitability and approval procedures for offshore wind energy projects. The overall objective of this assessment is to identify measures to avoid and mitigate cumulative effects from the planned development of offshore wind energy, in particular the acceleration of the development in Zone 3.

Determination of the possible cumulative impacts of relevance to species protection law

For the calculation of the noise impact resulting from the simultaneous construction of several offshore wind farms (as absolute area in km^2 and % share of the area of the EEZ), assumptions are made regarding the spatial and temporal sequence of construction. Although the scenarios are based on the current state of planning, they are structured in such a way that the results can be transferred even if the spatial or temporal planning changes. The calculations of noise-impacted sites in the individual scenarios represent a "worst case". The values calculated as a matter of priority assume the maximum area exposed to sound that would be achieved by the simultaneous construction of several wind farms. In addition, however, more realistic values are also given; these result from an overlap of noise-impacted sites as a result of the simultaneous construction of offshore wind farms (area calculations in brackets).

The four scenarios are based on the following assumptions:

- 500 MW capacity corresponds to an offshore wind farm.
- Areas with higher planned capacity are divided into 500 MW offshore wind farm projects for the calculation; accordingly, a wind farm of corresponding size is integrated into the area consideration with several construction sites as a precaution.
- For every 500 MW of power, one construction site will be active with foundation work using pulse hammers.
- For adjacent sites, the pile driving points are assumed to be as far apart as possible for the purpose of calculation.
- The foundations will be laid 12 to 18 months before the wind turbines go into operation.
- The foundation work using impulse pile driving for a 500 MW site takes an average of four months.
- Unrestricted availability of vessels and construction technology is assumed.
- It is assumed that, limited by the alternative foundation technologies still under development, most foundations will be installed using impulse pile driving.
- Compliance with the noise limits of 160 dB SEL_{05} re 1 μPa^2s and 190 dB re 1µPa peak level at 750 m from the pile driving site is assumed.
- The definition, measurement units, calculation formulas, and verifiability of the noise limits shall be applied strictly according to the BSH measurement guideline (2011).

The summary table "Designations for sites and grid connection systems" from the draft of the SDP (Table 10) contains information on the provision of grid connection and commissioning of wind turbines in the areas and sites of Zone 3. In

order to achieve the objectives of the WindSeeG, it can be assumed that the number of construction sites will steadily increase from one to two, four, nine, and 11 up to as many as 17 construction sites in the period 2026 to 2029. Area 13.3 is excluded from the present examination of cumulative impacts; this will be developed at a later date when, in accordance with the draft SDP, considerably fewer projects will again be built in parallel.

Scenario 1

The SDP also provides for preventive and mitigation measures in order to exclude cumulative impacts as a result of the input of impulse noise during the foundation works for the turbine foundations. Measures include the timing coordination of pile driving works. Pile driving work at construction sites located in the same area or directly adjacent sites shall be coordinated in such a way that it can be ruled out with the necessary certainty that the prohibitions under Sec. 44, para. 1, No. 2 BNatSchG will be realised.

As an example, the disturbance radii of 8 km (pile driving noise > 140 dB SEL) for five construction sites (red dots) of Zone 3 for the year 2028 (development of Sites N-9.1, N-9.2, and N-9.3) were represented with GIS, and the area affected by disturbance-triggering noise was calculated. Within the construction year 2028, there will therefore be no more **than five construction sites with simultaneous pile driving activity** in the German EEZ of the North Sea at **any time**.

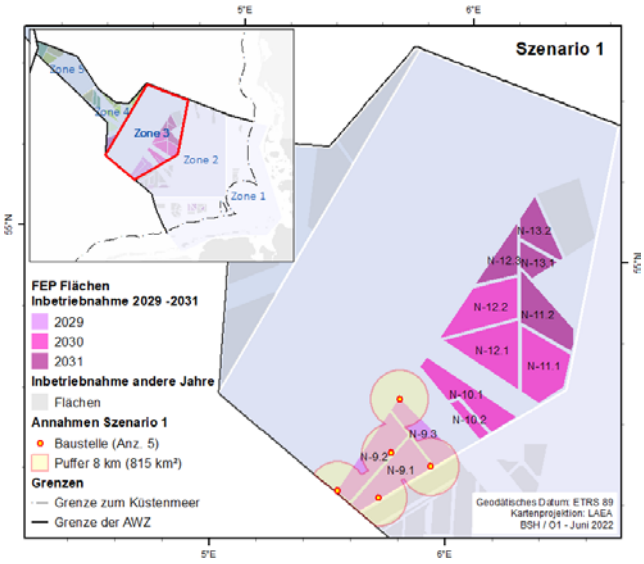

Figure 3: Pile driving in 2028 at five construction sites in area N-9.

The polluted area would be up to 1,000 km² (815 km² with overlap) in accordance with Scenario 1 and is shown in Figure 3. Under Scenario 1, 3.5% (2.9% with overlap) of the habitat would thus be exposed to disturbance-triggering pile driving noise; this is below the 10% target of the noise mitigation concept.

In the downstream approval procedure, the previous ordinance for the coordination of parallel pile driving works will be maintained in order to avoid the cumulative impacts of pile driving. Within the framework of enforcement, the BSH will reserve the right to take over the coordination of the pile driving work as required. Such coordination has already taken place in previous years and is an integral part of the enforcement practice of the BSH.

A significant disturbance in accordance with Sec. 44, para. 1, No. 2 BNatSchG is excluded with the necessary certainty in the implementation of Scenario 1.

Scenario 2

Like in Scenario 1, the SDP provides for preventive and mitigation measures in order to exclude cumulative impacts as a result of the input of impulse noise during the foundation works for the

turbine foundations. The measures include not only temporal but also spatial coordination of pile driving. Pile driving work at construction sites located in the same area or directly adjacent sites shall be coordinated in such a way that the realisation of the prohibitions according to Sec. 44, para. 1, No. 1 and No. 2 BNatSchG is excluded with the necessary certainty.

In Scenario 2, the number of construction sites **with parallel pile driving work** increases **from five to eight** within the construction year **2030**.

As an example, the disturbance radii of 8 km (pile driving noise > 140 dB SEL) for eight construction sites of Zone 3 for the year 2030 (development of Sites N-11.2, N-12.3, N-13.1, and N-13.2) were represented with GIS, and the area affected by disturbance-triggering noise was calculated.

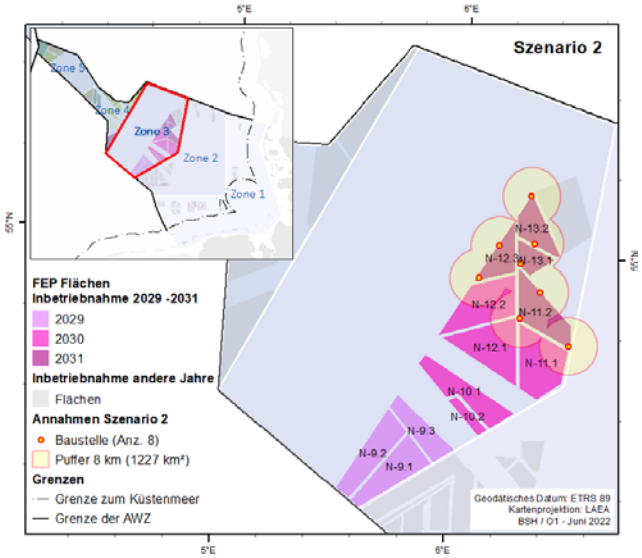

Figure 4: Pile driving in 2030 with eight construction sites spread over land in Areas N-11. N-12 and N-13.

The polluted area would be up to 1,600 km² (1,227 km² with overlap) and is shown in Figure 4. Under the second scenario, 5.6% (4.3% with overlap) of the habitat would be subject to disturbance-inducing pile driving noise.

In the SDP, in order to avoid the cumulative impacts of pile driving that may lead to the significant disturbance of harbour porpoise, measures for spatial coordination are included in addition to the measures for the temporal coordination of parallel pile driving activities.

If there are more than five construction sites with pile driving work within one year, the ordinance will, in any case, be supplemented in the subordinate approval procedures (Chapter 6). The spatial and temporal coordination of pile driving works is a purposeful addition to the previous ordinances in order to avoid cumulative impacts even if there are more than five construction sites within one year and to exclude the realisation of the prohibitions according to Sec. 44, para. 1, No. 2 BNatSchG with the necessary certainty.

In addition, for the sites considered in Scenario 2, such a measure of spatial and temporal coordination of pile driving would be necessary anyway because of the proximity to the main concentration area of the harbour porpoise and to Area I of the “Sylt Outer Reef – Eastern German Bight” nature conservation areas in order to exclude any adverse effect on the conservation objectives of the nature conservation area. A habitat protection assessment is provided in the final section of this chapter (“Determination of the possible cumulative impacts of relevance to habitat protection law”).

A significant disturbance in accordance with Sec. 44, para. 1, No. 2 BNatSchG can be ruled out provided that additional measures are ordered as part of the downstream approval procedures.

Scenario 3

The SDP includes principles and objectives as well as preventive and mitigation measures as in Scenario 1 and 2. However, the number of construction sites with **parallel pile driving works within the construction year 2029**increases **to the theoretically maximum possible number of 14.**

As an example, the disturbance radii of 8 km (pile driving noise > 140 dB SEL) for 14 construction sites of Zone 3 for the year 2029 (development of Sites N-10.1, N-10.2, N-11.1, N-12.1, and N-12.2) were represented with GIS, and the area affected by disturbance-triggering noise was calculated.

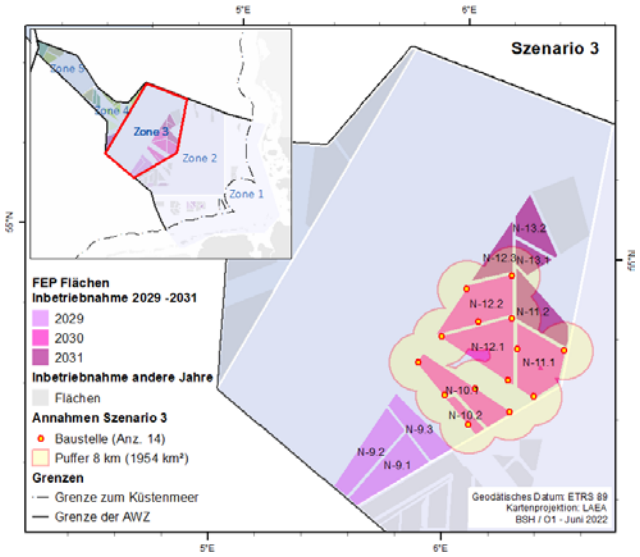

Figure 5: Pile driving works in 2029 spread over 14 construction sites in Areas from N-10, N-11, and N-12.

The polluted area would be up to 2,800 km² (2,036 km² with overlap) and is shown in Figure 5. In the third scenario, 9.8% (7.1% with overlap) of the habitat will be subject to disturbance-inducing pile driving noise. The potential small-scale expansion of Area N-11 has already been taken into account in this calculation.

In the SDP, in order to avoid the cumulative impacts of pile driving that may lead to the significant disturbance of harbour porpoise, measures for spatial coordination are included in addition to the measures for the temporal coordination of parallel pile driving activities.

If there are more than five construction sites with pile driving work within one year, the ordinances will, in any case, be supplemented in the subordinate approval procedures. As was already the case for Scenario 2, the ordinance would therefore also be supplemented in the downstream approval procedures in Scenario 3. In this case, the designation of times for pile driving would be imperative and purposeful in order to avoid cumulative impacts and to exclude a realisation of the prohibitions according to Sec. 44, para. 1, No. 2 BNatSchG.

Despite the assumed 14 pile driving sites in one year, the designation of site-specific pile driving times would ensure that no more than eight “pile driving sites” would be active at any time. The reduction of the number of parallel active pile driving sites to five to eight is necessary in order to be able to avoid possible overlaps of pile driving works resulting from technical or weather-related delays as far as possible.

A significant disturbance in accordance with Sec. 44, para. 1, No. 2 BNatSchG can be ruled out with the required degree of certainty provided that additional measures are ordered as part of the downstream approval procedures. The ordinances include the designation for not only the spatial but also the temporal contingents for the execution of pile driving works.

Scenario 4

The SDP does not include measures to avoid or mitigate cumulative impacts relevant to species conservation. There can be up to 17 active construction sites with parallel pile driving works if the required construction technology is available.

As an example, the interference radii of the 17 wind farm projects in Zone 3 for the year 2029 (development of Sites N-10.1, N-10.2, N-11.1, N-12.1, and N-12.2) were displayed with GIS, and the area affected by noise triggering interference was calculated.

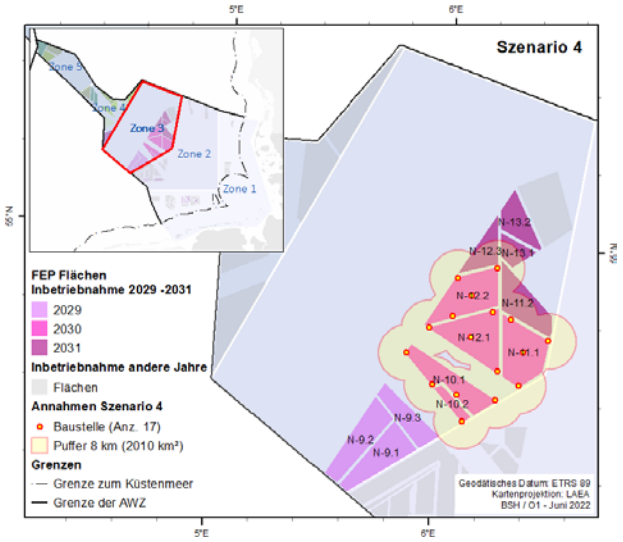

Figure 6: Pile driving works in 2029 spread over 17 construction sites in Areas from N-10, N-11, N-12, and N-13.

The polluted area would be up to 3,400 km² (2,104 km² with overlap) and is shown in Figure 6. In the fourth scenario, 11.9% (7.4% with overlap) of the habitat will be subject to disturbance-inducing pile driving noise. The potential small-scale expansion of Area N-11 has already been taken into account in this calculation.

Implementation in accordance with Scenario 4 would result in cumulative impacts on harbour porpoise as a result of pile driving. The requirements of the noise mitigation concept that no more than 10% of the area of the German EEZ in the North Sea should be exposed to pile driving noise would be exceeded. This would result in the realisation of the species protection prohibitions according to Sec. 44, para. 1, No. 2 BNatSchG.

Scenario 4 is thus ruled out.

Result of the examination of four scenarios for realisation by 2031

By implementing according to Scenario 4 (i.e. without consideration and designation of temporal and spatial coordination of pile driving activities), cumulative impacts on the harbour porpoise cannot be excluded. The cumulative impacts to be expected would result in the realisation of prohibitions under species protection law according to Sec. 44, para. 1, No. 2 BNatSchG.

Cumulative impacts from realisation in accordance with Scenario 1 are not expected. A prerequisite for this is the maintenance of the measure for the coordination of construction sites active in parallel in the subordinate approval procedures.

Cumulative impacts through realisation in accordance with Scenarios 2 and 3 can also be ruled out. A prerequisite for this is, however, in addition to the temporal coordination, the additional spatial coordination of pile driving work or the determination of temporal quotas for the execution of pile driving work within the framework of the ordinances in subordinate approval procedures. By limiting the number of parallel pile driving operations to a maximum of eight and distributing the pile driving operations accordingly throughout the year, it is possible to exclude with the required degree of certainty the realisation of species protection prohibitions according to Sec. 44, para. 1, No. 2 BNatSchG.

As a result, a number of preventive and mitigation measures are derived from the assessment of construction-related cumulative impacts; these are presented in more detail in Chapter 6. In addition, monitoring measures will be required (Chapter 8); these will be specified at the authorisation level.

Determination of the possible cumulative impacts of relevance to habitat protection law

Some of the sites in Zone 3, where foundation work will be carried out in 2029 and 2030, border directly on Area I of the “Sylt Outer Reef – Eastern German Bight” nature conservation area. The sub-sites located within a buffer zone of 8 km from the outer boundary of Area I are shown in Figure 7. In the construction year 2029, a sub-site of 5 km² in Site N-11.1 and a sub-site of 15 km² in Site N-12.2 will be affected. In the construction year 2030, the following sub-sites are affected: A sub-site of 134 km² in Site N-11.2, a

sub-site of 16 km² in Site N-12.3, a sub-site of 45 km² in Site N-13.1 and a sub-site of 22 km² in Site N-13.2. In addition, a sub-site of 71 km² is affected in Site 13.3; however, this is to be developed at a later date according to the current state of planning.

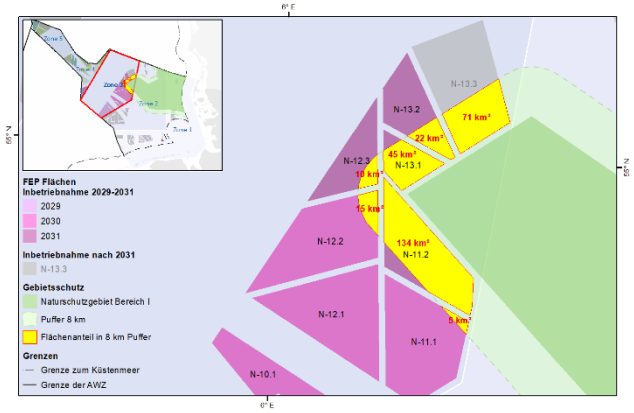

Figure 7: Representation of the sub-sites bordering Area I of the "Sylt Outer Reef – Eastern German Bight" nature conservation area and subject to the 1% criterion for pile driving during the sensitive period 1 May – 31 August.

For all sub-sites mentioned here, it is required that during pile driving activities in the period from 1 May to 31 August, less than 1% of the area of Area I, including a buffer zone of 8 km, is always affected by disturbance-triggering noise. In the course of implementation, it must be ensured that, in accordance with the target of the noise mitigation concept, the effect radius of 8 km must be estimated from the centre of the respective yellow sites in order to determine the proportion of the affected sites of Area 1 of the nature conservation area.

Cumulative impacts that lead to an adverse effect on the conservation objectives of the nature conservation area are excluded by ordinances for spatial and temporal coordination of pile driving works in the downstream approval procedures.

The 1% criterion in the period from 1 May to 31 August also applies to all sites located in and around the main concentration area of harbour porpoise in the German EEZ of the North Sea. The main concentration area extends west and northwest beyond Area I of the nature conservation area. For this reason, overlaps with the main concentration area including a buffer zone of 8 km with sites of Zone 3 are shown in Figure 8.

The affectedness of sub-sites in the construction year 2029 also remains unchanged in this respect and affects 5 km² in Site N-11.1 and 15 km² in Site N-12.2. In the construction year 2030, the following sites are affected with the respective percentage of disturbance-triggering: A sub-site of 134 km² in Site N-11.2, a sub-site of 34 km² in Site N-12.3, a total area of 50 km² in Site N-13.1, of which 19 km² are in the main concentration area of the harbour porpoise, and a total area of 92 km² in Site N-13.2, of which 44 km² are in the main concentration area of the harbour porpoise. In addition, almost the entire Area N-13.3 with 194 km² is located in the main concentration area of the harbour porpoise. Alone 0.5 km² of the Site N-13.3 are outside. However, according to the current state of planning, Site N-13.3 is to be developed at a later date and is therefore not the subject of the present assessment of cumulative impacts from pile driving in the construction years up to 2030.

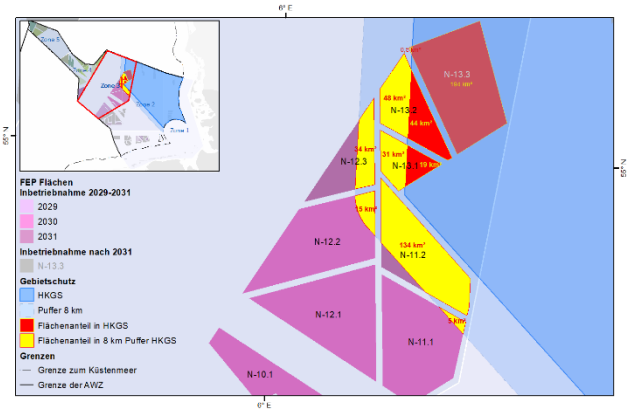

Figure 8: Depiction of the sub-sites located in and adjacent to the main concentration area of the harbour porpoise and which have to comply with the 1% criterion for pile driving during the sensitive period 1 May to 31 August.

Cumulative impacts that would lead to significant disturbance of the stock in the main concentration area of the harbour porpoise are excluded by ordinances for spatial and temporal coordination of pile driving in the downstream approval procedures.

Impacts related to operation

According to current knowledge, cumulative impacts from the operation of offshore wind turbines are not expected.

For the area of the targeted development by 2031 in Zone 3, the results from the long-term monitoring from 2014 to 2021 of the offshore wind farms “BARD Offshore 1”, “Veja Mate” and “Deutsche Bucht”, which are located in the immediate vicinity, are decisive. Both the airborne investigations and the acoustic surveys have confirmed that wind farm-related changes in the distribution and abundance of the harbour porpoise have not occurred. The acoustic survey even confirmed a more intensive use of the sites within the wind farms compared with the surrounding area (PGU, 2021).

The investigation of underwater noise in and around offshore wind farms has so far shown that the sound emitted by the turbines can be perceived only in the immediate vicinity (up to 100 m from the turbine). As part of a research project on behalf of the BSH (R&D project “OWF Noise”), the data from the underwater noise measurements at all wind farms in operation are currently being evaluated and subsequently assessed. The results from the research project to date have confirmed the following (as of 30 May 2022):

- The construction of the foundation (e.g. monopile, jacket) apparently has no influence on the sound radiated. Monopile wind turbines are no louder or quieter than other foundation types.
- Gearless wind turbines may be somewhat quieter than turbines with gearboxes but at least not louder.
- Nominal capacity of the WT: An increase of the sound level with the nominal capacity was not detected. On the contrary, in the range from 2 MW to 8 MW, there is a tendency for the level to drop by 2 to 3 dB.

In view of the planned development, monitoring measures will continue to be necessary and will be specified at the authorisation level. An overview of the planned monitoring measures is provided in Chapter 8.

As a result, according to the current state of knowledge, cumulative impacts from operations can be ruled out with the necessary certainty, even taking into consideration the service traffic.

4.12.4 Seabirds and resting birds

For the protected asset seabirds and resting birds, it was assessed whether additional or other significant environmental impacts arise compared with the SEA for the existing SDP or the SEA for ROP 2021. In addition, an examination was carried out to determine whether an update and elaboration of the assessment of the impacts on the protected asset seabirds and resting birds was necessary.

The assessment has shown that there are no additional or other significant environmental impacts and that, in this respect, no further updates or elaborations are currently required compared with the SEA on SDP 2020.

4.12.5 Migratory birds

For the description and assessment of cumulative effects, please refer to Chapter 4.12.5 of the North Sea Environmental Report on SDP 2020. At the present time, there are no findings to the contrary. The description and assessment of cumulative effects – with the result that significant cumulative effects can be ruled out – therefore continue to apply to the present revision of the

SDP. Thus, no additional or other significant impacts are expected as a result of this revision of the plan; furthermore, the SEA revealed that no necessary updates or elaborations are apparent. This also includes the areas under review (N-21 and N-22) as well as the potential extension of Area N-11 (cf Chapter 4.7.1)

4.13 Interrelationships

With regard to the description and assessment of interrelationships, please refer to the statements in Chapter 4.13 of the North Sea Environmental Report on ROP 2021.

4.14 Review of biotope protection law

In accordance with Sec. 30, para. 2, sentence 1 BNatSchG, all actions that may cause destruction or other significant adverse effect on the biotopes listed in Sec. 30, para. 2, sentence 1 BNatSchG are generally prohibited. In accordance with Sec. 72, para. 2 WindSeeG-E, Sec. 30, para. 2 BNatSchG shall be applied to projects under the WindSeeG with the proviso that a significant adverse effect on biotopes within the meaning of Sec. 30, para. 2, sentence 1 BNatSchG shall be avoided as far as possible.

The direct and permanent utilisation of a biotope, which is protected according to Sec. 30, para. 2 BNatSchG, is generally considered to be a significant adverse effect. A central component of the assessment approach according to LAMBRECHT & TRAUTNER (2007) is orientation values for quantitative-absolute area losses of an affected biotope occurrence, which may not be exceeded depending on its total size. A maximum value of 1% has been established as a guideline for relative land loss. Because a detailed assessment cannot be carried out within the framework of the SDP because of the lack of biotope mapping for most areas and sites, please refer to the subordinate planning and approval levels. A detailed description of the interventions to be taken into consideration, which could represent significant adverse effects within the meaning of the BNatSchG, has already been provided in the environmental reports on ROP 2021 and SDP 2020. The statements made there on the occurrence and potential impact of the individual areas and sites for wind turbines and transmission line corridors also remain valid. Compared with the standard of the previous assessment based on Sec. 30, para. 2 BNatSchG, Sec. 72, para. 2 WindSeeG-E sets lower requirements for possibly permissible adverse effects on legally protected biotopes. Therefore, in the absence of indications of additional or other significant impacts, it can be concluded from the result of the SEA on SDP 2020 in the first-law conclusion that the requirements of Sec. 72, para. 2 WindSeeG-E are also met by the designations in the draft of the SDP.

In the following, only findings that deviate from the representations in the environmental reports for ROP 2021 and SDP 2020 based on new data and new areas and sites included in the SDP are presented. Furthermore, the subsea cables outside the sites and areas are considered separately.

Areas N-21 and N-22

According to the available information, the occurrence of the legally protected biotopes “reefs”, “sandbanks”, and “species-rich gravel, coarse sand and shell layers” can largely be ruled out in the areas under assessment (N-21 to N-22) because of the predicted silt-rich fine sands and bathymetry according to LAURER et al. (2013). Despite the occurrence of sediments with partly high silt content and species of burrowing bottom mega-fauna, the legally protected biotope “Silt bottoms with burrowing bottom mega-fauna” can excluded because of the absence of sea pens.

Areas N-14 through N-18, N-20

There are also only few findings on biotope occurrences for Areas N-14 to N-18. However, because of the prevailing sediments, the legally

protected biotopes “sandbank”, “reefs” and “species-rich gravel, coarse sand and shell layers” are not expected to occur over a wide area. During explorations for the interconnector “Viking Link”, several marine boulders were identified; according to mapping instructions (BFN 2018), these are to be addressed as biotopes protected by law according to Sec. 30 BNatSchG (NATIONAL GRID VIKING LINK 2020). The occurrence of such punctual reef structures in the adjacent Sites N-17.1 and N-18.2 can therefore not be ruled out.

Area N-19

Area N-19 is located within an occurrence of LRT 1110 “Sandbanks with only slight permanent overtopping by seawater”, which is protected under the Habitats Directive. According to the parameters from the model wind farms, the construction of the turbines, the scour protection, and the interarray cabling results in a (in the case of the cables temporary) land use of up to 176 ha, which is considerably less than 1% of the area. Therefore, according to current knowledge, a significant adverse effect on the sandbank is not likely.

High-resolution mapping as part of the BfN projects has not yet been completed for this area. The occurrence of the legally protected biotope “species-rich gravel, coarse sand and shell layers” Site N-19 cannot therefore be completely ruled out according to the current state of knowledge and must be evaluated in the subordinate planning and approval levels (cf Chapter 2.2).

Subsea cables

Because of the lack of a reliable scientific basis for the small-scale biotopes “reefs” and “species-rich gravel, coarse sand and shell layers”, no statement can be made about the use of specially protected biotopes according to Sec. 30, para. 2 BNatSchG. An area-wide sediment and biotope mapping of the EEZ, which is currently being carried out, will provide a more reliable assessment basis. In practice, these protected biotopes are usually bypassed in the course of route planning; significant adverse effects are thus generally avoided. Until a large-scale biotope map is available, a detailed assessment must be carried out at the subordinate planning and approval levels. A significant adverse effect on sandbanks by the subsea cables can generally be ruled out because of the small-scale nature of the intervention.

4.15 Species protection law assessment

With regard to the species protection assessment, please refer to the statements in Chapter 5 of the North Sea Environmental Report on ROP 2021 and in particular to Chapters 5.2 and 5.3 of the North Sea Environmental Report on SDP 2020. In this context, the SEA in the current revision procedure of the SDP is limited to additional or other significant environmental impacts as well as to necessary updates and elaborations according to Sec. 5, para. 3, sentences 5–7 WindeeG-E.

With regard to marine mammals, Chapter 4.12.3 examined possible cumulative impacts on the harbour porpoise with relevance to species conservation in the context of the present SEA and against the background of the expected development by 2031 in the area of Zone 3. On the basis of four scenarios, it was determined that the implementation of the prohibitions according to Sec. 44, para. 1, No. 2 BNatSchG can be excluded by means of measures or additional orders in the subordinate approval procedures. The additional measures to avoid cumulative impacts by accelerating the development until 2031 are presented in Chapter 6. In the subordinate approval procedures, the species protection assessment is examined more closely based on concrete construction and operation plans, and the measures to avoid the realisation

of species protection prohibitions according to Sec. 44, para. 1, Mo. 2 BNatSchG are specified.

With regard to avifauna, there are currently no findings that indicate the realisation of prohibited species in the area of Zones 3, 4, and 5. A detailed audit must be carried out at the downstream audit level.

4.16 Compatibility assessment/review for the legal framework governing the conservation of natural habits

With regard to the review for the legal framework governing the conservation of natural habits, please refer to the statements in Chapter 6 of the North Sea Environmental Report on ROP 2021 and to the North Sea Environmental Report on SDP 2020. In this context, the SEA in the current revision procedure of the SDP is limited to additional or other significant environmental impacts as well as to necessary updates and elaborations according to Sec. 72, para. 1 WindSeeG-E, Sec. 5, para. 3, sentences 5–7 WindeeG-E.

The standard by which habitat protection is to be assessed in the present SEA of the draft of the SDP is changed compared with the requirements in SDP 2020 by the new Sec. 5, para. 3, No. 5 WindSeeG-E. If the SDP was previously not allowed to designate sites or areas in protected areas, the following now applies: The designation of an area, site, or area for other forms of energy generation must be compatible with the conservation objective of a protected area ordinance issued according to Sec. 57 BNatSchG; designations shall be permissible according to Sec. 34, para. 2 BNatSchG, they cannot lead to significant adverse effects on the components of the area relevant to the protective purpose of the respective protected area ordinance or if they meet the requirements of Sec. 34, para. 3 to 5 BNatSchG. Insofar as compliance with the requirements of the previous Sec. 5, para. 3, No. 5 WindSeeG was established in the SEA on SDP 2020 and no additional or other significant impacts on the protected areas are apparent, reference can be made to the results of the SEA on SDP 2020.

In Chapter 4.12.3, in the framework of this SEA on the draft of the SDP and against the background of the expected development by 2031, possible cumulative impacts on the harbour porpoise with relevance to species protection and habitat protection law are examined. Within the framework of the planned certification of the development in Zone 3 until 2031, special measures will be ordered for sites from Areas N-11, N-12, and N-13 as required in the noise mitigation concept (BMU, 2013). The measures to exclude a possible adverse effect on the conservation objectives of the nature conservation area or the main concentration area of the harbour porpoise in the sensitive period 1 May – 31 August as a result of cumulative impacts triggered by the acceleration of the development until 2031 are presented in Chapter 6. Chapter 8 additionally presents suitable monitoring measures.

In the subordinate approval procedures, the review for the legal framework governing the conservation of natural habits is deepened on the basis of concrete construction and operation plans, and the measures to exclude prohibited acts according to Sec. 34 BNatSchG are specified.

At the present time, there are no findings that indicate the realisation of prohibitions under habitat protection law in the area of Zones 3, 4, and 5. A detailed audit must be carried out at the downstream audit level.

4.17 Transboundary impacts

The SEA concludes that, as things stand at present, the designations of the SDP do not have significant impacts on the areas of neighbouring countries bordering the German EEZ of the North Sea.

Significant transboundary impacts can generally be ruled out for the following protected assets: soil, water, plankton, benthos, biotopes, seascape, and cultural heritage and other material assets and the protected asset human beings and human health. Possible significant transboundary impacts could result only from a cumulative assessment including all planned wind farm projects in the area of the German North Sea for the highly mobile protected assets marine mammals, seabirds and resting birds, and migratory birds if no avoidance and mitigation measures were ordered within the framework of downstream approval procedures.

With regard to the protected asset fish, the SEA comes to the conclusion that, according to the current state of knowledge, no significant transboundary impacts on the protected asset are to be expected as a result of the implementation of the SDP because, on one hand, the areas for which the SDP makes designations do not have a prominent function for the fish fauna. On the other hand, the recognisable and predictable effects are of a small-scale and temporary nature.

Based on current knowledge and taking into consideration avoidance and mitigation measures, significant transboundary impacts can also be excluded for the protected asset marine mammals. For example, the installation of the foundations of wind turbines and converter platforms is only permitted in the specific approval procedure if effective noise mitigation measures are implemented.

According to current knowledge, the draft SDP is not expected to have any significant impacts on protected asset seabirds and resting birds.

For migratory birds, erected wind turbines in particular can represent a barrier or a collision risk. Directly adjacent to Areas N-6 and N-9, the Netherlands has already designated the area for wind energy, NL 5-Oost, in the area of the Dutch EEZ. According to plans of the Netherlands, shipping route SN6 designated in ROP 2021 is no longer to be extended into the Dutch EEZ.

According to the Draft North Sea Programme 2022–2027 of the Netherlands, the area of the planned area NL 5-Oost is approx. 385.5 km² and has an expected capacity of 4 GW and a corresponding power density of approx. 10.4 MW/km². In a rough estimate, assuming 15 MW or 20 MW turbines, approx. 267 turbines or 200 turbines, respectively, would be erected in the area. It is assumed that the turbines could have a total height between 270 and 300 m with a rotor diameter between approx. 240 and 270 m. Because of the discontinuation of shipping route SN6, the planned shipping routes SN6 (in the area between N-6 and N-9) and SN12 are expected to lose their practical use. The present draft of the SDP therefore includes Areas N-21 and N-22 for use by offshore wind energy but first places them under review.

Identical turbine parameters are assumed for both the plans on the Dutch side and the plans for offshore wind energy expansion in Zone 3 on the German side. It can be assumed that turbines in both areas are likely to have identical height parameters. This results in a larger total area of wind energy use overall. However, “staircase effects” resulting from turbines of different heights are unlikely. On the other hand, Areas N-21 and N-22 are located in Zone 2 for which the draft SDP assumes a total height of 170 m in Scenario 1 and 270 m in Scenario 2. In addition to the projects already realised in Areas N-6 and N-8, the two areas under review could have turbines the same size as those on the Dutch side or smaller ones. A staircase effect would occur only with the implementation of smaller turbines during autumn migration, when the birds migrate from the north-east to the south-west and first fly to the smaller turbines of the OWFs on the German side.

However, significant transboundary impacts are not expected at this stage of the draft of the SDP

because birds prefer to migrate in good weather conditions where the turbines are visible.

The SEA concludes that, as things stand at present, the designations of the SDP do not have significant impacts on the areas of neighbouring countries bordering the German EEZ of the North Sea.

5 Evaluation of the overall plan

In summary, with regard to the planned areas and sites, platforms, and cable routes as well as the designation of the area for other forms of energy generation SEN-1, the impacts on the marine environment will be minimised as far as possible by means of orderly, coordinated overall planning of the SDP. By adhering strictly to preventive and mitigation measures, in particular for noise mitigation during the construction phase, significant impacts can be prevented by implementing the planned sites, areas, and platforms.

No areas or sites were defined in nature conservation areas. The requirements of Sec. 5, para. 3n No. 5 WindSeeG-E are thus fulfilled. According to Sec. 5, para. 3, Mo. 5 WindSeeG-E, a designation is inadmissible if the area, the site, or area for other forms of energy generation is not compatible with the conservation objective of a protected area ordinance issued according to Sec. 57 BNatSchG. In addition, Areas N-4 and N-5, which are largely within the main loon concentration area, remain under consideration for possible re-use.

The laying of subsea cables can be performed in as environmentally friendly manner as possible (e.g. by bypassing nature conservation areas and protected biotopes and by choosing a cable laying procedure that is as unobtrusive as possible). The planning principle for the increase of sediment temperature should ensure that significant negative impacts of cable heat-up on benthic communities are prevented. Avoiding crossings of subsea cables with each other as far as possible also serves to prevent negative impacts on the marine environment, in particular on the protected assets soil, benthos, and biotopes.

Based on the above descriptions and assessments, it must be concluded for the SEA, also with regard to any interrelationships, that, according to the current state of knowledge and at the comparatively abstract level of sectoral planning, no significant impacts on the marine environment within the area of investigation are to be expected as a result of the planned designations. The potential impacts are frequently small-scale and short-term because they are limited to the construction phase. So far, there is a lack of sufficient scientific knowledge and uniform assessment methods for the cumulative assessment of impacts on individual protected assets such as bat migration. Therefore, these impacts cannot be conclusively assessed within the framework of the present SEA or are subject to uncertainties and require a more detailed review either within the framework of downstream planning stages or the revision of the SDP.

Detailed data and findings are lacking for the areas and sites in the area north of shipping route SN10 for individual protected assets. The potential impacts can therefore not be conclusively assessed within the framework of the present SEA or are subject to uncertainties and require more detailed examination within the framework of downstream planning stages.

6 Measures envisaged to prevent, reduce, and offset any significant negative impacts of the site development plan on the marine environment

With regard to the measures envisaged to prevent, reduce, and offset any significant negative impacts of the SDP on the marine environment, please refer to the statements in Chapter 8 of the North Sea Environmental Report on SDP 2020.

Chapter 4.12.3 explicitly considered possible cumulative impacts of noise during the installation of foundations by means of impulse pile driving in the context of the planned development of offshore wind energy projects in the years 2027 to 2031 in Zone 3.

The examination of cumulative impacts from the currently planned development in the years 2027 to 2031 has shown that in accordance with Scenarios 2 and 3 with eight or even 14 offshore wind farms built in parallel in each case, additional preventive and mitigation measures will be necessary. The temporal and spatial coordination of pile driving is being considered as an effective measure; this must be determined as part of the approval process. In this respect, the approval authority will set quotas per construction year (i.e. determine time periods that each individual construction project must comply with in order to erect the foundations with impulse pile driving). The designation of pile driving quotas aims to limit the maximum number of construction projects carrying out simultaneous pile driving to a maximum of eight. By limiting the number of parallel pile driving operations to a maximum of eight and distributing the pile driving operations accordingly throughout the year, it is possible to exclude the realisation of species protection prohibitions according to Sec. 44, para. 1, No. 2 BNatSchG.

The specification of the measures for the spatial and temporal coordination of pile driving will take place within the framework of the subordinate approval procedures. Spatial and temporal quotas will be ordered by the approval authority on the basis of the review for the legal framework governing the conservation of natural habits and species in the individual procedure.

7 Examination of reasonable alternatives

In accordance with Art. 5, para. 1, sentence 1 SEA Directive in conjunction with the criteria in Appendix I SEA Directive and Sec. 40, para. 2, No. 8 UVPG, the environmental report contains a brief description of the reasons for the choice of the reasonable alternatives examined. Essentially, different types of alternatives can be considered for an examination of reasonable alternatives; in particular strategic, spatial or technical alternatives. The prerequisite is always that these are reasonable or can be seriously considered.

In principle, it should be noted that preliminary investigation of possible and conceivable alternatives is already inherent in all designations of the SDP in the form of standardised technical and planning principles. As can be seen from the justification of the individual planning principles, the respective principle is already based on a consideration of possible affected public concerns and legal positions so that a “preliminary examination” of possible alternatives has already taken place. There are already many different uses and legally protected concerns in the EEZ. An overall assessment of the uses and functions in the EEZ has already been carried out as part of the preparation and revision of the maritime spatial plan. The objectives and principles of ROP 2021 are to be largely adopted in the SDP and will be reviewed and weighed up with regard to the specific subjects of regulation of the concerns and rights presented in this procedure.

The zero alternative (i.e. not implementing the SDP) is not a reasonable alternative because the development of offshore wind energy is indispensable for achieving the national climate protection goals according to the current state of technology and scientific knowledge in order to avert drastic negative impacts of climate change – also for the state of the marine environment. The importance of achieving the expansion targets is now explicitly stated in Sec. 1, para. 3 WindSeeG-E. Accordingly, the construction of offshore wind turbines and offshore grid connections is in the overriding public interest and serves public safety (cf also Chapter 3).

The purpose and aim of introducing a sectoral plan with not only spatial but also temporal designations and standardised technology and planning principles is the precautionary control of the development of offshore wind energy necessary for climate protection. This is intended to ensure at the planning level that the legally defined expansion targets for wind energy can be achieved through a spatially ordered and land-saving development (Sec. 4, para. 2, No. 2 WindSeeG-E) and that environmental concerns are also examined at the planning level.

A strategic alternative (e.g. with regard to the targets of the federal government on which the planning is based) is not currently being considered for the SDP because the expansion targets of the federal government represent the planning horizon for the SDP. The expansion targets result from the legal requirement in Sec. 1, para. 2, sentence 1 WindSeeG-E. These are classified as imperative for climate protection; they are in the overriding public interest and serve public safety. Furthermore, they are also an essential basis for the demand planning of the onshore grid expansion. Because a coordinated approach to onshore and offshore grid and capacity expansion to mitigate vacancies or curtailments appears to make sense, choosing an alternative expansion strategy in this context is out of the question.

Spatial alternatives are rare in view of the underlying territorial context of ROP 2021 and against the backdrop of the considerably increased expansion targets. In accordance with Sec. 1, para. 2 WindSeeG-E, the aim of the WindSeeG is to increase the installed capacity of offshore wind turbines connected to the grid to at least 30 GW by 2030, to at least 40 GW by 2035, and to at least 70 GW by 2045.

As is clear from the designations of the SDP, the designated sites are not sufficient to achieve the long-term expansion target of at least 70 GW. In order to keep the need for additional potential areas as low as possible, a comparatively high power density is assumed on the designated sites. Compared with SDP 2020, this has been considerably increased for some sites in the current SDP draft. This is based on the results of an accompanying expert report on the SDP revision procedure on behalf of the BSH (Dörenkämper et al., 2022). To determine the expected annual energy production and the influence of shading effects on the electricity yield, extensive modelling was carried out in various development scenarios as part of a scientific report.

As a result, the power density on the sites is considerably increased – even if this reduces the expected full load hours. A higher overall output is thus possible on the sites defined in the draft SDP. On the area map of ROP 2021, this leads to a total installed capacity of 57.5 GW (taking into consideration the areas under assessment, N-21 and N-22, 60.5 GW) compared with the assumptions in the revision procedure for the ROP. In ROP 2021, a capacity potential of 40 GW was assumed to achieve the statutory expansion target. From an environmental and nature conservation point of view, an increase in power density seems preferable to the alternative of having to develop additional and possibly environmentally sensitive areas.

8 Measures envisaged for monitoring environmental impacts of implementing the site development plan

With regard to the planned monitoring measures, please refer to the statements in Chapter 10 of the North Sea Environmental Report on SDP 2020 and Chapter 10 of the North Sea Environmental Report on ROP 2021.

Reference is made at this point to the obligation laid down in Sec. 77, para. 4, No. 1 WindSeeG-E Act for the persons responsible under Sec. 78 WindSeeG-E (in particular, the addressees of the planning approval decision or the planning permission, operators of the OWFs) to carry out monitoring of the construction- and operation-related impacts of the installations on the marine environment during the construction phase and during the 10 years of operation of the installations and to transmit the data obtained to the BSH and the BfN without delay. Furthermore, please refer to the planned revision and corresponding adaptation of StUK4. Thus, with the growing and accelerated development of several sites, it is intended to counter potential, cumulative effects through a large-scale and temporally continuous study design. For example, the aim is to the record harbour porpoise not only within a construction area or, as in the past, a cluster of neighbouring offshore wind farms but rather in all natural units of the German EEZ over a continuous time series in order to be able to record potential changes in the harbour porpoise population in the German EEZ. These changes might not be recorded in the investigation of a single area. Specifically, the harbour porpoise acoustic survey network will be expanded to cover, if possible, the entire German EEZ of the North Sea or all areas covered by the plan. The same also applies to the method of recording by means of digital recording from the aircraft, which is used as a complement to acoustic recording. In this way, it is to be ensured that, even in the growing expansion scenario of the present SDP, species protection concerns will be met in accordance with the precautionary principle.

The adaptation of the study design is urgently required in order to ensure that the targets for the development of offshore wind energy in Zone 3 in the years 2029 to 2031 are as environmentally compatible as possible. The examination of cumulative impacts of the possible development scenarios in Chapter 4.12.3 has shown that additional preventive and mitigation measures will be necessary in order to take into cumulative effects the species and habitat protection requirements from the noise mitigation concept (BMU, 2013). For the specification and ordinance of preventive and mitigation measures, an elaboration of the review for the legal framework governing the conservation of natural habits and species is planned at the level of the subordinate approval procedures. In accordance with Sec. 44, para. 1, No. 2 BNatSchG, a significant disturbance of protected species must be avoided; such significant disturbance exists if the disturbance worsens the conservation status of the local population of a species. For this, impacts on the entire habitat of the local population have to be assessed. The data sources for this purpose must therefore include the abundance and distribution of the animals as well as the use of habitats throughout the habitat. In accordance with Sec. 34 BNatSchG, the conservation status of the populations and habitats in the nature conservation areas as well as the possible impacts of the individual project and the cumulative impacts of all projects inside and outside the nature conservation area must be assessed.

This requires solid data sources; this entails an adjustment of the StUK. The adaptation to large-scale and continuous investigations concerns site investigations and possible updates of benchmark assessments as well as construction and operational monitoring and is thus to be applied to sites that are developed according to the

central model as well as outside the central model.

The expansion and adaptation of the investigations in Zone 3 can be classified as urgent, taking into consideration the expansion targets for the years 2027 to 2031. The extension to Zones 4 and 5 should also follow. The adjustment of the investigations can be done in such a way that professional need and economic efficiency remain in balance. In addition, please refer to monitoring tools as presented in ROP 2021 and SDP 2020 (MARLIN, MarinEARS, among others).

9 Non-technical summary

9.1 Subject and occasion

In the context of the amendment and revision of the SDP initiated on 17 December 2021, areas and sites are defined for the implementation of the statutory expansion targets for offshore wind energy that go beyond SDP 2020 and were therefore not included in the SEA carried out in previous preparation, update, and revision procedures of the SDP.

In contrast to the last revision of the SDP, with the conclusion of the revision procedure for maritime spatial planning, there is now an up-to-date maritime spatial plan, the ROP 2021, including a comprehensive SEA.

The revision of the SDP will essentially build on the designations of the maritime spatial planning for offshore wind energy and subsea cables and pipelines and develop them in terms of sectoral planning.

Against this background, the SEA for the revision of the SDP will also be largely based on the results of the SEA carried out in the maritime spatial planning revision procedure. According to Sec. 5, para. 3, sentences 5–7 WindSeeG-E, it must be determined at which stage certain environmental assessments are to be focussed in order to avoid multiple assessments in multi-stage planning and approval processes. The environmental assessment shall be limited to additional or other significant impacts on the environment as well as to necessary updates and elaborations.

The same applies in accordance with Sec. 72, para. 1, sentence 1 WindSeeG-E with regard to previous, more up-to-date results from environmental assessments within the framework of central site investigations compared with SDP 2020 or the previous SDP.

The SEA for the revision of the SDP is also based on the environmental reports for the preparation and revision of the SDP from 2019 and 2020 and, where they provide relevant and more up-to-date or in-depth results, on the SEAs for central site investigations of sites in the North Sea. Insofar as new knowledge on existing designations is available and relevant, this will also be taken into consideration.

In the following, the scope of the assessment is therefore limited to additional or other significant environmental impacts as well as to necessary updates and elaborations.

The main document of the SEA is the present Environmental Report. It identifies, describes, and assesses the likely significant impacts that the implementation of the SDP will have on the environment and possible alternative planning options, taking into consideration the essential purposes of the plan. The update and revision of the SDP and the implementation of the SEA will be carried out with due consideration for the environmental conservation objectives.

9.2 Methodology of the Strategic Environmental Assessment

The methodology is based primarily on the designations of the plan to be examined. Within the framework of this SEA, it is determined, described, and evaluated for each of the designations whether the designations have likely significant impacts on the protected assets concerned. In accordance with Sec. 1, para. 4 UVPG in conjunction with Sec. 40, para. 3 UVPG, in the environmental report the competent authority provisionally assesses the environmental impacts of the designations with regard to effective environmental precautions in accordance with applicable laws. According to the special legal standard of Sec. 5, para. 3, sentence 1, 2 WindSeeG-E, the designations may not pose a threat to the marine environment, among other things. In addition, the provisions of Sec. 5, para. 3, sentence 1, No. 5 WindSeeG-E (protected areas) and Sec. 72, para. 2 WindSeeG

(marine biotopes) must be observed in particular.

The methodology of the SEA is explained in detail in the scope. Reference is made at this point to the defined scope of 30 June 2022.

Data sources

With regard to the data and knowledge basis for the SEA and any difficulties in compiling the documents, please refer to Chapter 5 of the scope of 30 June 2022.

9.3 Summary of the tests related to the protected assets

Area

The increased expansion targets, which envisage achieving at least 30 GW by 2030, at least 45 GW by 2035, and at least 70 GW by 2045, lead to the development of offshore wind energy and thus to the designations of the present draft of the SDP. Because of the limited availability of land in the German EEZ of the North Sea, a land-sparing development in the sites available for offshore wind energy is imperative.

Overall, the additional areas N-14 to N-22, which go beyond the designations of SDP 2020, do not give rise to any significant impacts on the protected asset space. Please refer to the statements on the status description and assessment in Chapter 2.1 in the North Sea Environmental Report on ROP 2021 as well as the impacts described in Chapter 4.1 in the North Sea Environmental Report on SDP 2020.

The percentage of direct land use by wind turbines, platforms, and subsea cables remains less than 0.1% of the total area of the EEZ of the North Sea – even taking into consideration Areas N-14 to N-22.

Soil

With regard to the status description and status assessment of the protected asset soil, please refer to the statements in Chapter 2.2 of the North Sea Environmental Report on ROP 2021 and to Chapter 4.1 of the North Sea Environmental Report on SDP 2020. The data availability has increased. The current investigations of the EEZ sediment mapping project confirm the statements in the aforementioned environmental report on ROP 2021. Only in the area of the North-western region of the German EEZ in the “Doggerbank” nature conservation area and the adjacent Areas N-17 and N-19 are there indications of coarse sandy and gravelly areas in the current investigations. Potential coast community sites can therefore still not be completely ruled out in these areas at present.

Overall, there are no significant impacts on the protected asset soil For details on the assessment of potential impacts, please refer to the North Sea Environmental Report on SDP 2020.

Water

With regard to the status description and status assessment of the protected asset water, please refer to the statements in Chapter 2.3 of the North Sea Environmental Report on ROP 2021. Any updates or elaborations of the status description are not apparent compared with the SEA for ROP 2021.

According to the current state of knowledge, there is no reason to worry about significant impacts on the protection objective water.

Benthos

The benthos in the EEZ of the North Sea is largely characterised by a few widespread communities. Special communities, some of them rich in species, remain restricted to a few sites; these are characterised by mostly heterogeneous sediment structures. In the EEZ, such structures are predominantly found within the nature conservation area. The benthic communities in the areas and sites are thus generally of no particular importance for wind energy use. Exceptions to this are the communities in the small-scale heterogeneous areas found in Areas N-1,

N-2, and N-5. Also, of above-average importance are communities with a high density of deep burrowing crayfish species, which can occur locally especially in Areas N-6 to N-10, N-14, N-16, and N-21, and N-22, and the communities characterised by high species diversity in Area N-19.

The deep foundation of the wind turbines and platforms causes disturbance of the soil, sediment turbulence, and the formation of turbidity plumes. However, because of the prevailing sediment composition, these adverse effects will have only a small-scale effect and are limited in time. Significant adverse effects on the protected asset benthos during the construction phase are not to be expected. Because of the construction, there is a small-scale habitat loss for the benthic communities. In addition, the introduction of hard substrates in the immediate vicinity of the structures can lead to changes in species composition. Relevant adverse effects on the benthos caused by the wind turbines are not to be expected.

The laying of the subsea cables also causes only small-scale and short-term disturbances of the benthos as a result of sediment re-suspension and turbidity plumes in the area of the ~Ka~. With regard to the description and assessment of the status of the protected asset benthos, please refer to the statements in Chapter 2.6 of the North Sea Environmental Report on ROP 2021. The assessment of the status described there is confirmed and selectively supplemented by the findings from recent literature and newly collected data described below.

The current investigations within the framework of the preliminary site investigations in Sites N-6.6, N-6.7, and N-7.2 essentially confirmed the information provided in the environmental report on ROP 2021 with regard to the species inventory and the dominance structure of the benthic communities as well as the occurrence of species of burrowing soil mega-fauna (BIOCONSULT 2022A, B, IFAÖ 2021).

Parts of areas N-14, N-15, N-16, N-17, N-18, and N-20 are core areas of occurrence of burrowing ground mega-fauna species according to GUTOW et al. (2020). Modelling confirms that parts of Sites N-16.1 and N-16.2 belong to the range of the Norway lobster. However, in Areas N-17, N-18, and N-20, the deep burrowing mega-fauna is predominantly represented by the tadpole *Echiurus echiurus* according to GUTOW et al. (2020). Areas N-14 and N-15 are not core areas for deep burrowing mega-fauna (GUTOW et al. 2020). According to the assessments in the environmental report on ROP 2021, the benthos is therefore of average importance in these areas and of above-average importance in areas and sites with significant occurrences of deep burrowing crayfish species.

Only little benthic data are currently available for Areas N-21 and N-22 under consideration as well as for the possible extension of Site N-11. Because of the location, the findings for Sites N-6 to N-10 are likely to be largely transferable to these sites. Consequently, an average importance of the sites for the protected asset benthos can be assumed. In contrast, the local occurrence of deep burrowing crayfish species (as modelled by GUTOW et al. (2020) for the sites) would have an above-average importance.

The community of Area N-19 is dominated by short-lived polychaete species (IOW & AWI 2017). However, character species also include the tadpole *Echiurus echiurus* (which is one of the deep-digging bottom mega-fauna species) as well as the sand-dwelling anthozoan *Halcampa chrysanthenum* and the mussel species *Abra prismatica*. In addition, mainly young individuals of the long-lived black clam *Arctica islandica* are regularly found here (IOW & AWI 2017). Overall, the species diversity in this area is similar to that on the “Doggerbank”. The results confirm the assessment in the environmental report of ROP 2021 that the benthos in this area is of above-average importance for the German EEZ. The community of the Central North

Sea occurring there remains restricted to the area of Area N-19 within the German EEZ but is relatively widespread in sea areas of neighbouring states.

The construction-, installation-, and operation-related impacts of the wind turbines, converter platforms, and subsea cables on benthic fauna are described in detail in Chapter 4.2 of the Environmental Report on SDP 2020. They are spatially or temporally limited so that no significant adverse effects are to be expected. Additional, potentially significant impacts compared with SDP 2020 are not currently expected.

Biotopes

With regard to the data availability and description of the status of the protected asset biotopes, please refer to the statements in Chapter 2.5 of the North Sea Environmental Report on ROP 2021.

Possible impacts of the construction and operation of wind turbines and platforms and the laying and operation of subsea cables on the protected asset biotopes correspond to those described in Chapter 4.1 on the protected assets soil and macrozoobenthos.

They can result from a direct claim on biotopes, a possible cover by sedimentation of material released as a result of construction, and potential habitat changes. Significant construction-, installation, and operation-related impacts on biotopes not protected by law can generally be ruled out. In subsea cables, permanent habitat changes caused by the installation are limited to the immediate area of artificial hard substrates, which become necessary in the case of crossing structures.

A summary of the potential occurrence and potential impact of the legally protected biotopes according to Sec. 30, para. 2 BNatSchG in the areas and sites as well as the corridors of the subsea cables is provided in the following section “Biotope protection”.

Fish

The fish fauna shows a typical species composition in the area of the OWF sites, platforms, and submarine cable routes. According to current knowledge, the planned sites do not represent a preferred habitat for any of the protected fish species. As a result, the fish stock in the planning area is not of outstanding ecological importance compared with adjacent marine areas.

The impacts on the fish fauna from the construction of the wind farms, converter platforms, and subsea cables are limited in space and time. During the construction phase of the foundations, the converter platforms and the laying of the subsea cables, the fish fauna may be temporarily subjected to adverse effects in small areas by sediment turbulence and the formation of turbidity plumes. Because of the prevailing sediment and current conditions, the turbidity of the water is expected to decrease again quickly. Based on the current state of knowledge, the adverse effects will therefore remain small-scale and temporary.

Overall, small-scale adverse effects on adult fish can be expected to be minimal. In addition, the fish fauna is adapted to the natural sediment turbulence caused by storms that are typical here. Furthermore, during the construction phase, noise and vibrations may lead to the temporary repellence of fish. Sound inputs during the construction phase must be reduced by appropriate measures.

Further impacts on the fish fauna may come from the additionally introduced hard substrates. Recent scientific investigations from Belgian OWFs showed increased fish densities of various species (e.g. plaice, sole, and striped lyrefish) inside the OWFs compared with outside (DEGRAER et al. 2020). In addition to the reef effect, the increased fish abundance could additionally be related to the restrictions on fishery as a result of the previous navigation regulations in the OWF sites. The increase of sediment temperature and

magnetic fields that could emanate from submarine cables are also not expected to have any lasting impacts on mobile fish fauna.

In general, the impact assessments to date are based on the assumption of a navigation ban in the OWF sites and the associated exclusion of active fishery. If these conditions change, an adjustment of the impact assessment for the fish fauna is to be expected.

According to current knowledge, the planned construction of wind farms and the associated converter platforms and submarine cable routes is not expected to have a significant adverse effect on the protected asset fish.

Marine mammals

According to the current state of knowledge, it can be assumed that the German EEZ is used by harbour porpoises for traversing, inhabitation, and as a food and area-specific breeding area. Based on the knowledge available, it can be concluded that the EEZ is of medium to high importance for harbour porpoises in certain areas. Use varies in the sub-areas of the EEZ. This also applies to seals and grey seals. Areas N-1, N-2, and N-3 are of medium to high importance for harbour porpoises (seasonally in spring) and low to medium importance for grey seals and harbour seals. Area N-4 is located in the identified main concentration area of harbour porpoise in the Deutschen Bucht during the summer months and is therefore of high importance. For harbour seals and grey seals, Area N-4 is of medium importance. The sites of Area N-5 are located in a large area which is used both as a feeding and breeding area for harbour porpoises – even though the main concentration area is located within Area I of the “Sylt Outer Reef – Eastern German Bight” nature conservation area. In general, it can be assumed that area N-5 is particularly important for harbour porpoises. For harbour seals and grey seals, Area N-5 is of medium importance. Areas N-6 to N-12 are of medium importance for harbour porpoises. However, parts of Area N-11 and Area N-13 are intensively used by harbour porpoises as a feeding ground in summer. They are located in the immediate vicinity of the contiguous main concentration area of harbour porpoise in the German Bight and are therefore particularly imporant for harbour porpoises in the summer months. For harbour seals and grey seals, Areas N-6 to N-13 are of minor importance. However, taking into account the current site investigations, environmental monitoring, and research that assumes a population shift, the values of the individual areas for the harbour porpoise do not change. For Areas N-14 to N-19, please refer to the assessment in the Environmental Report on the North Sea ROP 2021. It states that the data availability for the reservation areas EN14 to EN19 is not sufficient in order to be able to assess the occurrence of the harbour porpoise and the importance of the areas. Systematic investigations to capture seasonal patterns, inter-annual variability, and abundance are lacking. Based on the data available, it can be assumed that Reservation area EN19 is of medium importance (high importance in summer). Sites N-21 and N-22, which have been added to the current SDP for the use of wind energy, are located in the middle of areas for which comprehensive knowledge on the occurrence of the harbour porpoise is already available. These two sites are thus also considered to be of medium importance for the harbour porpoise.

Hazards to marine mammals can be caused by noise emissions during pile driving of the foundations of offshore wind turbines and converter platforms. Without the use of noise mitigation measures, significant adverse effects on marine mammals during pile driving cannot be excluded. In the specific approval procedure, therefore, the driving of piles of offshore wind turbines and converter platforms will only be permitted if effective noise mitigation measure are used. For this purpose, the SDP will designate the principle of noise mitigation in the text.

This states that the installation of the foundations must be carried out using effective noise mitigation measures to comply with applicable noise emission values. In the specific approval procedure, extensive noise mitigation measures and monitoring measures are ordered to comply with applicable noise emission values (sound event level (SEL) of 160 dB re 1 µPa²s and maximum peak level of 190 dB re 1 µPa at a distance of 750 m around the pile driving or placement site). Suitable measures shall be taken to ensure that no marine mammals are present in the vicinity of the pile driving site.

Current technical developments in the reduction of underwater noise show that the impacts of noise immission on marine mammals can be considerably reduced by the application of appropriate measures. The noise mitigation concept of the BMU has also been in force since 2013. In accordance with the noise mitigation concept, pile driving activities must be coordinated in such a way that sufficiently large areas, especially within the protected areas and the main distribution area of harbour porpoise in the summer months, are kept free of impacts caused by impact noise (see following section “Cumulative effects”). According to current knowledge, significant impacts on marine mammals caused by the operation of offshore wind turbines and converter platforms can be excluded.

The exclusion of the construction of offshore wind turbines and converter platforms in Natura 2000 areas, as stipulated in the SDP, contributes to a reduction of the threat to harbour porpoises in important feeding and breeding areas.

After implementation of the mitigation measures to be ordered (for centrally pre-surveyed areas) as part of the determination of suitability or (for all sites) in the approval procedure to comply with applicable noise emission values in accordance with the planning principle, the construction and operation of the planned offshore wind turbines and converter platforms is currently not expected to have any significant negative impacts on marine mammals. No significant impacts on marine mammals are expected from the laying and operation of subsea cables. This assessment of impacts will remain for marine mammals even with the implementation of the Plan as amended by the extension of Areas N-14 to N-22, subject to the avoidance and mitigation measures set out in the downstream procedures and the spatial and temporal coordination of pile driving activities to avoid potential cumulative effects.

Seabirds and resting birds

With regard to the status description and status assessment of the protected asset seabirds and resting birds, please refer to the statements in Chapter 2.9 of the North Sea Environmental Report on ROP 2021.

In addition, for Areas N-6 and N-7 as well as for the areas in Zone 3 (N-9 to N-13), current investigations are now available within the framework of the preliminary site investigation. These investigations confirm the already known species composition, its spatial distribution, and the occurrence depending on the season (seasonality) of the seabird species found there. In general, the occurrence of all species show strong fluctuations within a single year and between different years. To this end, for most species, there is a tendency for higher numbers in the area of Areas N-10 to N-13 than in the area of Areas N-6 to N-9 during the study period August 2018 to June 2021 (BIOCONSULT SH, IBL UMWELTPLANUNG & IFAÖ 2021a, b, c, d).

More recent investigations will be carried out on the designated areas in Zones 4 and 5 (N-14 to N-20), and the considerations from the environmental report on ROP 2021 will be reviewed in the context of the downstream assessment levels.

For Areas N-21 and N-22 under consideration as well as for a possible extension of Area N-11, the findings for Sites N-6 to N-11 are transferable to

these areas because of their location. After designating the sites, more recent investigations will also be carried out for these sites, and the considerations from the environmental report on ROP 2021 will be reviewed as part of the downstream assessment levels.

An update of the "European Red List of Birds" (BIRDLIFE INTERNATIONAL 2017) has not led to any change in the assessment of the criterion conservation status for the areas under consideration.

The construction-, installation-, and operation-related impacts of wind turbines, converter platforms, and subsea cables on seabirds and resting birds are described in detail in Chapter 4.6 of the North Sea Environmental Report on SDP 2020 and Chapter 3.2.5 of the North Sea Environmental Report on ROP 2021.

An ongoing update of the study by GARTHE et al. (2018) with an extension of the species composition considered shows significant avoidance effects for the guillemot up to 21 km, for Northern fulmar up to 6 km, and for razorbill and gannet up to 3 km (GARTHE et al. 2022). The effect strength of the fauna also depends on the time of year. In the case of the kittiwake and the lesser black-backed gull, the reaction itself (avoidance, attraction, indifferent behaviour) also depends on the season. The lesser black-backed gull is attracted to the wind farm in autumn and avoids it in summer. The kittiwake avoids the OWF in winter and is attracted to it in winter (Garthe et al. 2022). Current findings from OWF monitoring in the EEZ show lower avoidance effects for the Common Guillemot and Northern Gannet than from the combined analysis of monitoring and research data by Garthe et al. (2022)(IFAÖ et al. 2020, PGU 2021, BIOCONSULT SH 2022).

On the basis of the dynamic state of knowledge, in particular on the behaviour of the guillemot, it is currently not to be assumed that the development of offshore wind energy by 2031 in Zone 3 of the SDP will have a significant adverse effect on the protected asset seabirds and resting birds. For the development in Zones 4 and 5 of the SDP, this assessment must be verified on the basis of further investigations to be carried out.

Migratory birds

With regard to the status description and status assessment of the protected asset migratory birds, please refer to Chapter 2.10 of the North Sea Environmental Report on ROP 2021.

In addition to this, there are now current investigations from the preliminary site investigation for Area N-9 from the July 2019 to 2021 (BioConsult SH et al. 2021e). The results of these investigations are largely comparable with the results from the surrounding areas. Deviations can be attributed to the partly bad weather conditions during the surveys.

Compared with the North Sea Environmental Report on ROP 2021, there have been no changes in the state of knowledge on the occurrence and intensity of bird migration. According to current knowledge, the assessments in the North Sea Environmental Report on ROP 2021 remain valid.

The construction and operation of wind turbines can have various impacts on bird migration; these are described in detail in Chapter 4.7.1 of the North Sea Environmental Report on SDP 2020.

The draft SDP provides for various turbine scenarios for the further development of offshore wind energy, especially in Zones 3 as well as 4 and 5. The assumptions for the turbines up to and including Scenario 1 for Zones 4 and 5 (cf Chapter 4.5.3 of the scope for the current SEA) are already covered by the bandwidth consideration of SDP 2020. Only Scenario 2 for Zones 4 and 5 (with a total height of 385 m) is above the upper range of the total height of 350 m of SDP 2020.

Based on current knowledge, the potentially larger turbines in Zones 4 and 5 would not have any significant impacts on bird migration. A cross-project analysis from the monitoring of offshore wind farm projects showed a clear coastal orientation of bird migration in the EEZ of the North Sea (WELCKER 2019). Zones 4 and 5 are at a great distance from the coast.

Sites N-21 and N-22 under assessment have no significant impacts on bird migration. This applies accordingly to a possible extension of Area N-11 (shown in Fig.1 of the draft SDP).

According to current knowledge, the assessment in the North Sea Environmental Report on SDP 2020 remains valid. Significant impacts on bird migration can therefore be ruled out.

Bats

For a status description and status assessment of the protected asset bats, please refer to Chapter 2.11 of the North Sea Environmental Report on ROP 2021.

In addition, current findings from the BfN research project “Batmove” (FKZ 3515 821900) are now available (Seebens – Hoyer et al. 2021). As part of the research project, acoustic data on the occurrence of bat migration was collected in the North Sea along a network of stations concentrated along the coast and including two offshore sites close to the coast. It was not possible to cover the offshore areas of Zone 3 with suitable stations. Bat activity was detected at all stations. However, activity was lowest at the offshore locations.

Compared with the North Sea Environmental Report on ROP 2021, there have been no fundamental changes in the state of knowledge on the occurrence and intensity of bird migration. According to current knowledge, the assessments in the North Sea Environmental Report on ROP 2021 remain valid.

The impacts of offshore wind energy projects on bats are described in Chapter 4.8.2 of the North Sea Environmental Report on SDP 2020. No additional or other significant impacts are currently expected as a result of this revision of the plan. The same applies to platforms and subsea cables.

Air

The SEA has shown that, compared with the statements in the North Sea Environmental Report on ROP 2021, no necessary updates or elaborations of protected asset air are apparent. This applies accordingly to the assessment of environmental impacts on the protected asset. In this regard, please refer to the North Sea Environmental Report on SDP 2020. Overall, the designations of the current draft of the SDP do not result in any measurable impacts on the protected asset air.

Climate

The SEA has shown that, compared with the statements in the North Sea Environmental Report on ROP 2021, no necessary updates or elaborations of protected asset climate are apparent. This applies accordingly to the assessment of environmental impacts on the protected asset. Here, too, please refer to the North Sea Environmental Report on ROP 2021. Negative impacts on the climate are not expected; on the contrary, the CO_2 savings associated with the development of offshore wind energy can be expected to have positive impacts on the climate in the long term.

Seascape

The SEA has shown that, compared with the statements in the North Sea Environmental Report on ROP 2021, no necessary updates or elaborations of the protected asset seascape are apparent. This applies accordingly to the assessment of environmental impacts on the protected asset. Here, too, please refer to the North Sea Environmental Report on ROP 2021. Overall, no significant impacts on the protected asset seascape can be assumed.

Cultural heritage and other material assets

With regard to the status description and status assessment of the protected asset cultural heritage and other material assets, please refer to the statements in Chapter 2.16 in the North Sea Environmental Report on ROP 2021.

The SEA for the SDP does not include a systematic survey or assessment of existing underwater cultural heritage. The same applies to downstream procedures. However, investigations may be carried out or ordered on an *ad hoc* basis.

According to the current state of knowledge, there is no reason to fear significant impacts on the cultural heritage and other material assets.

Humans, including human health

The SEA has shown that, compared with the statements in the North Sea Environmental Report on ROP 2021, no necessary updates or elaborations of protected asset humans are apparent. This applies accordingly to the assessment of environmental impacts on the protected asset. Here, too, please refer to the North Sea Environmental Report on SDP 2020. Overall, no significant impacts on the protected asset “humans” are to be expected.

Interrelationships

In general, impacts on any one protected asset will lead to various consequences and interrelationships between the protected assets. The essential interconnection of the protected biological assets exists via the food chains. Possible interactions during the construction phase result from sediment relocation and turbidity plumes as well as noise emissions. However, these interrelationships occur only briefly and are limited to a few days or weeks.

Installation-related interrelationships (e.g. through the introduction of hard substrate) are permanent but to be expected only locally. This could lead to a small-scale change in food supply.

Because of the variability of the habitat, interrelationships can be described only in an imprecise manner overall. In principle, according to the current state of knowledge, no interrelationships that could result in a threat to the marine environment are discernible.

9.4 Cumulative impacts

Soil, benthos, and biotopes

Significant construction-related cumulative adverse effects on the protected assets soil, benthos, and biotopes are not to be expected because of the fundamental small-scale nature of the respective effects and the gradual development of the wind farms and the grid connection systems.

Possible cumulative impacts on the soil, which could also have a direct impact on the protected asset benthos and legally protected biotopes, result from the permanent direct area use of the foundations of the wind turbines and platforms and from the cable systems laid. According to the precautionary principle, the maximum values resulting from the range of the model wind farm scenarios were used to calculate the land use.

Based on this conservative estimate, a maximum of 1544 ha of area will be claimed for the areas and sites for wind energy use or temporarily impaired in the case of interarray cabling. Of this, 2.04 ha are allotted to the up to 34 converter platforms with associated scour protection (600 m² per platform).

For the subsea cables, this results in a mostly temporary loss of function over an area of maximum 790 ha. Outside the sensitive biotopes, a permanent loss of land and function as a result of the cable systems results exclusively from the construction of up to 640 crossing structures totalling up to 57.6 ha. In total, therefore, up to 2,391 ha of soil will be directly claimed or, in the case of the submarine cables, temporarily affected; this corresponds to a share of approx. 0.084% of the total EEZ area.

In addition to direct use, installation foundations, scour protection, and crossing structures lead to an additional supply of hard substrate. As a result, hard substrate-loving species untypical of the site can colonise and exert an influence on the community of natural soft substrates. In addition, artificial substrates can lead to an altered spread of invasive species, among others. These indirect effects can lead to cumulative effects resulting from the construction of several offshore structures or rockfills in crossing areas of subsea cables and pipelines. However, reliable findings on effects beyond the sites of the wind farms or on the altered connectivity of invasive species are not yet available. Because the (mainly temporary) land use is below 0.1% of the EEZ area even in the cumulative consideration of the grid infrastructure and the wind farm areas, according to current knowledge, no significant adverse effects that lead to a threat to the marine environment with regard to the soil and the benthos are to be expected – even in the cumulation of indirect effects.

Fish

The wind farms of the southern North Sea can have an additive effect beyond their immediate location. This becomes particularly relevant with increased farm numbers and the development of larger clusters. The impacts of the OWFs are concentrated on the regular navigation bans on fishery that have been imposed up to now as well as on the change in habitat and the corresponding interrelationships.

The general species composition of the fish fauna could change directly because species with different habitat preferences than the established species (e.g. reef dwellers) find more favourable living conditions and occur more frequently. For example, in the Danish wind farm Horns Rev, seven years after its construction, a horizontal gradient in the occurrence of hard-substrate-affine species was found between the surrounding sand areas and near the turbine foundations: This change could intensify as the number of wind farms on an area increases.

In the event of a change to the previous navigation regulations for OWFs and the associated exclusion of active fishery in the OWF sites, a reassessment of cumulative effects on fish fauna would be necessary.

Overall, there is a need for research on the extent to which cumulative effects of OWFs affect the fish stocks of individual species in the long term.

Marine mammals

Cumulative impacts on marine mammals, in particular harbour porpoises, may occur mainly due to noise exposure during pile driving of the foundations. For example, these protected assets could be significantly adversely affected by the fact that, if pile driving takes place simultaneously at different locations within the EEZ, there may not be sufficient space to evade and retreat.

The current draft of the SDP provides for an expanded development of offshore wind energy.

The current draft shows that the simultaneous construction of several offshore wind farms is to be expected, especially in the years 2027 to 2030. Within the framework of the strategic environmental assessment, it is therefore necessary to screen possible cumulative impacts caused by the construction of the wind farms with regard to compliance with species protection and site protection requirements of the noise mitigation concept (BMU, 2013).

On the basis of the noise mitigation concept and some basic assumptions (Chapter 4.12.3.), various development scenarios with cumulative effects on noise pollution are therefore presented in this environmental report on the current draft of the SDP. In accordance with the noise mitigation concept, an area share of 10% of the German EEZ is used as a threshold value for the maximum area exposed to sound. In contrast, in the different scenarios, the sounded area is calculated by an increasing number of simultaneous construction sites. For each construction site, a disturbance radius of 8 km is assumed. Theoretically, 14 simultaneous construction sites with pile driving are possible with the threshold value from the noise mitigation concept; this results in a total area of up to 2,800 km² (1,954.25 km² with overlapping of the interference radii of individual construction sites). This corresponds to an area proportion of 9.8% (6.85% with overlapping of the disturbance radii of individual construction sites) of the habitat that is affected by disturbance-triggering pile driving noise. However, in order to establish a buffer for further impulse noise sources (other than those caused by pile driving) as well as temporal overlaps of different construction projects as a result of construction delays or bad weather phases, a designation of a maximum of eight parallel construction sites is sought. Thus, a significant undercutting of the maximum area affected by noise immission on the basis of the noise mitigation concept is envisaged.

Seabirds and resting birds

With regard to the cumulative effects on the protected asset seabirds and resting birds, please refer to Chapter 4.11.4 of the Environmental Report on ROP 2021 for the North Sea and Chapter 4.12.4 of the Environmental Report on SDP 2020 for the North Sea.

Migratory birds

With regard to the cumulative effects on the protected asset migratory birds, please refer to Chapter 4.11.5 of the Environmental Report on ROP 2021 for the North Sea and Chapter 4.12.5 of the Environmental Report on SDP 2020 for the North Sea.

9.5 Result of the nature conservation assessments

Review of biotope protection law

In accordance with Sec. 30, para. 2, sentence 1 BNatSchG, all actions that may cause destruction or other significant adverse effect on the biotopes listed in Sec. 30, para. 2, sentence 1 BNatSchG are generally prohibited. In accordance with Sec. 72, para. 2 WindSeeG-E, Sec. 30, para. 2, sentence 1 BNatSchG shall be applied to projects under the WindSeeG with the proviso that a significant adverse effect on biotopes within the meaning of Sec. 30, para. 2, sentence 1 BNatSchG shall be avoided as far as possible. The direct and permanent use of a biotope protected under Sec. 30, para. 2 BNatSchG is generally considered to have a significant adverse effect if it has significant negative impacts on the biotope in question. A central component of the assessment approach according to LAMBRECHT & TRAUTNER (2007) is orientation values for quantitative-absolute area losses of an affected biotope occurrence, which may not be exceeded depending on its total size. Because a detailed assessment cannot be carried out within the framework of the SDP because of the lack of biotope mapping for most areas and sites, please refer to the subordinate planning

and approval levels. A detailed description of the interventions to be taken into consideration, which could represent significant adverse effects within the meaning of the BNatSchG, has already been provided in the environmental reports on ROP 2021 and SDP 2020. The statements made there on the occurrence and potential impact of the individual areas and sites for wind turbines and transmission line corridors also remain valid. In view of the designations of the current draft of the SDP, significant adverse effects on biotopes within the meaning of Sec. 30, para. 2 BNatSchG are avoided as much as possible so that the requirements of Sec. 72, para. 2 WindSeeG-E are met.

In the following, therefore, only deviating findings based on new data and areas and sites newly included in the current draft of the SDP are presented. Furthermore, the subsea cables outside the sites and areas are considered separately.

Areas N-21 and N-22

According to the available information, the occurrence of the legally protected biotopes "reefs", "sandbanks", and "species-rich gravel, coarse sand and shell layers" can largely be ruled out in the areas N-21 to N-22 because of the predicted silt-rich fine sands and bathymetry according to LAURER et al. (2013). Despite the occurrence of sediments with partly high silt content and species of burrowing bottom megafauna, the legally protected biotope "Silt bottoms with burrowing bottom mega-fauna" can excluded because of the absence of sea pens.

Areas N-14 through N-18, N-20

There are also only few findings on biotope occurrences for Areas N-14 to N-18. However, because of the prevailing sediments, the legally protected biotopes "sandbank", "reefs" and "species-rich gravel, coarse sand and shell layers" are not expected to occur over a wide area. During explorations for the interconnector "Viking Link", several marine boulders were identified. According to the mapping instructions (BFN 2018), these are to be addressed as biotopes protected by law according to Sec. 30, para. 2 BNatSchG. The occurrence of such punctual reef structures in the adjacent Sites N-17.1 and N-18.2 can therefore not be ruled out.

Area N-19

Area N-19 is located within an occurrence of LRT 1110 "Sandbanks with only slight permanent overtopping by seawater", which is protected under the Habitats Directive. According to the parameters from the model wind farms, the construction of the turbines, the scour protection, and the interarray cabling results in a (in the case of the cables temporary) land use of up to 176 ha, which is considerably less than 1% of the area. Therefore, according to current knowledge, a significant adverse effect on the sandbank is not likely.

High-resolution mapping as part of the BfN projects has not yet been completed for this area. The occurrence of the legally protected biotope "species-rich gravel, coarse sand and shell layers" Site N-19 cannot therefore be completely ruled out according to the current state of knowledge and must be evaluated in the subordinate planning and approval levels (cf Chapter 2.2).

Subsea cables

Because of the lack of a reliable scientific basis for the small-scale biotopes "reefs" and "species-rich gravel, coarse sand and shell layers", no statement can be made about the use of specially protected biotopes according to Sec. 30, para. 2 BNatSchG. An area-wide sediment and biotope mapping of the EEZ, which is currently being carried out, will provide a more reliable assessment basis. In practice, these protected biotopes are usually bypassed in the course of route planning; significant adverse effects are thus generally avoided. Until a large-scale biotope map is available, a detailed assessment must be carried out at the subordinate planning and approval levels. A significant adverse effect

on sandbanks by the subsea cables can generally be ruled out because of the small-scale nature of the intervention.

Species protection law assessment

With regard to the species protection assessment, please refer to the statements in Chapter 5 of the North Sea Environmental Report on ROP 2021 and in particular to Chapters 5.2 and 5.3 of the North Sea Environmental Report on SDP 2020.

With regard to marine mammals, Chapter 4.12.3 examined possible cumulative impacts on the harbour porpoise with relevance to species conservation in the context of the present SEA and against the background of the expected development by 2031 in the area of Zone 3. On the basis of four scenarios, it was determined that the implementation of the prohibitions according to Sec. 44, para. 1, No. 2 BNatSchG can be excluded by means of measures or additional orders in the subordinate approval procedures. The additional measures to avoid cumulative impacts by accelerating the development until 2031 are presented in Chapter 6. In the subordinate approval procedures, the species protection assessment is examined more closely based on concrete construction and operation plans, and the measures to avoid the realisation of species protection prohibitions according to Sec. 44, para. 1, Mo. 2 BNatSchG are specified.

With regard to avifauna, there are currently no findings that indicate the realisation of prohibited species in the area of Zones 3, 4, and 5. A detailed audit must be carried out at the downstream audit level.

Review for the legal framework governing the conservation of natural habits

With regard to the review for the legal framework governing the conservation of natural habits, please refer to the statements in Chapter 6 of the North Sea Environmental Report on ROP 2021 and to the North Sea Environmental Report on SDP 2020.

In Chapter 4.12.3 of this SEA and against the background of the expected development by 2031, possible cumulative impacts on the harbour porpoise with relevance to species protection and habitat protection law are examined. Within the framework of the planned certification of the development in Zone 3 until 2031, special measures will be ordered for sites from Areas N-11, N-12, and N-13 as required in the noise mitigation concept (BMU, 2013). The measures to exclude a possible adverse effect on the conservation objectives of the nature conservation area or the main concentration area of the harbour porpoise in the sensitive period 1 May – 31 August as a result of cumulative impacts triggered by the acceleration of the development until 2031 are presented in Chapter 6. Chapter 8 additionally presents suitable monitoring measures.

In the subordinate approval procedures, the review for the legal framework governing the conservation of natural habits is deepened on the basis of concrete construction and operation plans, and the measures to exclude prohibited acts according to Sec. 34 BNatSchG are specified.

At the present time, there are no findings that indicate the realisation of prohibitions under habitat protection law in the area of Zones 3, 4, and 5. A detailed audit must be carried out at the downstream audit level.

9.6 Transboundary impacts

The SEA concludes that, as things stand at present, the designations of the SDP do not have significant impacts on the areas of neighbouring countries bordering the German EEZ of the North Sea.

Significant transboundary impacts can generally be ruled out for the following protected assets: soil, water, plankton, benthos, biotopes, seascape, and cultural heritage and other material assets and the protected asset human beings

and human health. Possible significant transboundary impacts could result only from a cumulative assessment including all planned wind farm projects in the area of the German North Sea for the highly mobile protected assets marine mammals, seabirds and resting birds, and migratory birds if no avoidance and mitigation measures were ordered within the framework of downstream approval procedures.

With regard to the protected asset fish, the SEA comes to the conclusion that, according to the current state of knowledge, no significant transboundary impacts on the protected asset are to be expected as a result of the implementation of the SDP because, on one hand, the areas for which the SDP makes designations do not have a prominent function for the fish fauna. On the other hand, the recognisable and predictable effects are of a small-scale and temporary nature. Based on current knowledge and taking into consideration avoidance and mitigation measures, significant transboundary impacts can also be excluded for the protected asset marine mammals. For example, the installation of the foundations of wind turbines and converter platforms is only permitted in the specific approval procedure if effective noise mitigation measures are implemented. According to current knowledge, the draft SDP is not expected to have any significant impacts on protected asset seabirds and resting birds.

For migratory birds, erected wind turbines in particular can represent a barrier or a collision risk. Directly adjacent to Areas N-6 and N-9, the Netherlands has already designated Area NL 5-Oost in the area of the Dutch EEZ. According to plans of the Netherlands, shipping route SN6 designated in ROP 2021 is no longer to be extended into the Dutch EEZ.

According to the Draft North Sea Programme 2022–2027 of the Netherlands, the area of the planned area NL 5-Oost is approx. 385.5 km² and has an expected capacity of 4 GW and a corresponding power density of approx. 10.4 MW/km². Because the discontinuation of shipping route SN6, the planned shipping routes SN6 (in the area between N-6 and N-9) and SN12 are likely to lose their practical utility. The present draft of the SDP therefore includes Areas N-21 and N-22 for use by offshore wind energy but first places them under review.

Identical turbine parameters are assumed for both the plans on the Dutch side and the plans for offshore wind energy expansion in Zone 3 on the German side. It can be assumed that turbines in both areas are likely to have identical height parameters. This results in a larger total area of wind energy use overall. However, “staircase effects” resulting from turbines of different heights are unlikely. On the other hand, Areas N-21 and N-22 are located in Zone 2 for which the draft SDP assumes a total height of 170 m in Scenario 1 and 270 m in Scenario 2. In addition to the projects already realised in Areas N-6 and N-8, the two areas under review could have turbines the same size as those on the Dutch side or smaller ones. A staircase effect would occur only with the implementation of smaller turbines during autumn migration, when the birds migrate from the north-east to the south-west and first fly to the smaller turbines of the OWFs on the German side.

However, significant transboundary impacts are not expected at this stage of the draft of the SDP because birds prefer to migrate in good weather conditions where the turbines are visible.

The SEA concludes that, as things stand at present, the designations of the SDP do not have significant impacts on the areas of neighbouring countries bordering the German EEZ of the North Sea.

9.7 Measures envisaged to prevent, reduce, and offset any significant negative impacts of the site development plan on the marine environment

With regard to the measures envisaged to prevent, reduce, and offset any significant negative impacts of the SDP on the marine environment, please refer to the statements in Chapter 8 of the North Sea Environmental Report on SDP 2020.

The present SEA explicitly considered possible cumulative impacts of noise during the installation of foundations by means of impulse pile driving in the context of the planned development of offshore wind energy projects in the years 2027 to 2031 in Zone 3.

The examination of cumulative impacts from the currently planned development in the years 2027 to 2031 has shown that in accordance with Scenarios 2 and 3 with eight or even 14 offshore wind farms built in parallel in each case, additional preventive and mitigation measures will be necessary. The temporal and spatial coordination of pile driving is being considered as an effective measure; this must be determined as part of the approval process. In this respect, the approval authority will set quotas per construction year (i.e. determine time periods that each individual construction project must comply with in order to erect the foundations with impulse pile driving). The designation of pile driving quotas aims to limit the maximum number of construction projects carrying out simultaneous pile driving to a maximum of eight. By limiting the number of parallel pile driving operations to a maximum of eight and distributing the pile driving operations accordingly throughout the year, it is possible to exclude the realisation of species protection prohibitions according to Sec. 44, para. 1, No. 2 BNatSchG.

The specification of the measures for the spatial and temporal coordination of pile driving will take place within the framework of the subordinate approval procedures. Spatial and temporal quotas will be ordered by the approval authority on the basis of the review for the legal framework governing the conservation of natural habits and species in the individual procedure.

9.8 Examination of reasonable alternatives

In accordance with Art. 5, para. 1, sentence 1 SEA Directive in conjunction with the criteria in Appendix I SEA Directive and Sec. 40, para. 2, No. 8 UVPG, the environmental report contains a brief description of the reasons for the choice of the reasonable alternatives examined. Essentially, different types of alternatives can be considered for an examination of reasonable alternatives; in particular strategic, spatial or technical alternatives.

The zero alternative (i.e. not implementing the SDP) is not a reasonable alternative because the orderly yet accelerated development of offshore wind energy as stipulated in Sec. 1, para. 1 WindSeeG-E (with regard to the expansion targets) and in Sec.s 2, 2a WindSeeG-E is imperative for achieving the national climate protection targets. Without this development, drastic consequences – also for the marine environment – are threatened by climate change. (cf Chapter 3). The purpose and aim of introducing a sectoral plan with not only spatial but also temporal designations and standardised technology and planning principles is the precautionary and orderly control of the development of offshore wind energy. This is intended to ensure at the planning level that the statutory expansion targets for offshore wind energy set out in Sec. 1, para. 2 WindSeeG-E are achieved and that development takes place in a spatially orderly and land-saving manner (in accordance with Sec. 4, para. 2, No. 2, para. 3 of the WindSeeG-E) and that environmental concerns are also examined at the planning level.

A strategic alternative (e.g. with regard to the targets of the federal government on which the

planning is based) is not currently being considered for the SDP because the expansion targets of the federal government represent the planning horizon for the SDP. The expansion targets result from the legal requirement in Sec. 1, para. 2, sentence 1 WindSeeG-E.

Spatial alternatives are rare in view of the underlying territorial context of ROP 2021 and against the backdrop of the considerably increased expansion targets. As is clear from the designations of the SDP, the designated sites are not sufficient to achieve the long-term expansion target of at least 70 GW. In order to keep the need for additional potential areas as low as possible, a comparatively high power density is assumed on the designated sites. Compared with SDP 2020, this has been considerably increased for some sites in the current SDP draft. From an environmental and nature conservation point of view, an increase in power density seems preferable to the alternative of having to develop additional and possibly environmentally sensitive areas.

9.9 Measures envisaged for monitoring environmental impacts of implementing the site development plan

With regard to the planned monitoring measures, please refer to the statements in Chapter 10 of the North Sea Environmental Report on SDP 2020 and Chapter 10 of the North Sea Environmental Report on ROP 2021.

Reference is made at this point to the obligation laid down in Sec. 77, para. 4, No. 1 WindSeeG-E Act for the persons responsible under Sec. 78 WindSeeG-E (in particular, the addressees of the planning approval decision or the planning permission, operators of the OWFs) to carry out monitoring of the construction- and operation-related impacts of the installations on the marine environment during the construction phase and during the 10 years of operation of the installations and to transmit the data obtained to the BSH and the BfN without delay. Furthermore, please refer to the planned revision and corresponding adaptation of StUK4. Thus, with the growing and accelerated development of several sites, it is intended to counter potential, cumulative effects through a large-scale and temporally continuous study design. For example, the aim is to the record harbour porpoise not only within a construction area or, as in the past, a cluster of neighbouring offshore wind farms but rather in all natural units of the German EEZ over a continuous time series in order to be able to record potential changes in the harbour porpoise population in the German EEZ. These changes might not be recorded in the investigation of a single area. Specifically, the harbour porpoise acoustic survey network will be expanded to cover, if possible, the entire German EEZ of the North Sea or all areas covered by the plan. The same also applies to the method of recording by means of digital recording from the aircraft, which is used as a complement to acoustic recording. In this way, it is to be ensured that, even in the growing expansion scenario of the present SDP, species protection concerns will be met in accordance with the precautionary principle.

The adaptation of the study design is urgently required in order to ensure that the targets for the development of offshore wind energy in Zone 3 in the years 2029 to 2031 are as environmentally compatible as possible. The examination of cumulative impacts of the possible development scenarios has shown that additional preventive and mitigation measures will be necessary in order to take into cumulative effects the species and habitat protection requirements from the noise mitigation concept (BMU, 2013). For the specification and ordinance of preventive and mitigation measures, an elaboration of the review for the legal framework governing the conservation of natural habits and species is planned at the level of the subordinate approval procedures. In terms of species protection law,

significant impacts on the entire habitat of the local population must be assessed in accordance with the requirements of Sec. 44, para. 1, No. 2 BNatSchG. The data sources for this purpose must therefore include the abundance and distribution of the animals as well as the use of habitats throughout the habitat. In accordance with the requirements of Sec. 34 BNatSchG, the conservation status of the populations and habitats in the nature conservation areas as well as the possible impacts of the individual project and the cumulative impacts of all projects inside and outside the nature conservation area must be assessed.

This requires solid data sources; this entails an adjustment of the StUK. The adaptation to large-scale and continuous investigations concerns site investigations and possible updates of benchmark assessments as well as construction and operational monitoring and is thus to be applied to sites that are developed according to the central model as well as outside the central model.

The expansion and adaptation of the investigations in Zone 3 can be classified as urgent, taking into consideration the expansion targets for the years 2027 to 2031. The extension to Zones 4 and 5 should also follow. The adjustment of the investigations can be done in such a way that professional need and economic efficiency remain in balance. In addition, please refer to monitoring tools as presented in ROP 2021 and SDP 2020 (e.g. MARLIN, MARINEars).

9.10 Evaluation of the overall plan

In summary, with regard to the planned areas and sites, platforms, and cable routes as well as the designation of the area for other forms of energy generation SEN-1, the impacts on the marine environment will be minimised as far as possible by means of orderly, coordinated overall planing of the SDP. By adhering strictly to preventive and mitigation measures, in particular for noise mitigation during the construction phase, significant impacts can be prevented by implementing the planned sites, areas, and platforms.

No areas or sites were defined in nature conservation areas. Therefore, the requirements of Sec. 3, para. 3, No. 5 WindSeeG-E are fulfilled; according to these, designations must be compatible with the conservation objective of a protected area ordinance issued according to Sec. 57 BNatSchG.

In addition, Areas N-4 and N-5, which are largely within the main loon concentration area, remain under consideration for possible re-use.

For the SEA, it should be noted that, based on current knowledge and at the comparatively more abstract level of sectoral planning, no significant impacts on the marine environment within the area of investigation are to be expected as a result of the planned designations. To date, there is a lack of sufficient scientific knowledge and uniform assessment methods for the cumulative assessment of impacts on individual protected assets. Therefore, these impacts cannot be conclusively assessed within the framework of the present SEA or are subject to uncertainties and require a more detailed review either within the framework of downstream planning stages or the revision of the SDP.

Detailed data and findings are lacking for the areas and sites in the area north of shipping route SN10 for individual protected assets. The potential impacts can therefore not be conclusively assessed within the framework of the present SEA or are subject to uncertainties and require more detailed examination within the framework of downstream planning stages.

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