

Environmental Impact Assessment Report for the ‘BC-Wind Offshore Wind Farm’ Project – UPDATE

VOLUME II. Content of the EIA Report

Gdańsk, December 2024

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Environmental Impact Assessment
Report for the:
**„BC-Wind Offshore Wind Farm” -
UPDATE**



Gdańsk, December 2024

Gdańsk, 23 grudnia 2024

Dane podmiotu składającego oświadczenie

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OŚWIADCZENIE

kierującego zespołem autorów Raportu o oddziaływaniu na środowisko przedsięwzięcia pn.:
„Morska Farma Wiatrowa BC-Wind” - AKTUALIZACJA

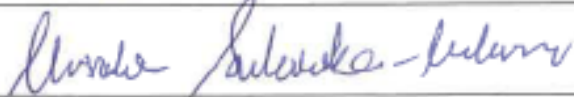
Oświadczam, że spełniam wymagania określone w art. 74a ust. 2 ustawy z dnia 3 października 2008 r. o udostępnianiu informacji o środowisku i jego ochronie, udziale społeczeństwa w ochronie środowiska oraz o ocenach oddziaływania na środowisko (Dz.U.2024.1112 t.j.).

Jestem świadoma odpowiedzialności karnej za złożenie fałszywego oświadczenia.


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Environmental Impact Assessment Report for the: „BC-Wind Offshore Wind Farm” – UPDATE

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List of abbreviations

Abbreviation	Definition
μPa	micropascal – a unit of pressure
AIS	Automatic Identification System – fitted aboard all ships of 300 gross tonnage and upwards. It ensures an automatic exchange of data used to avoid collisions between ships and to identify ships for the coastal marine vessel traffic service
APV 2021	the Applicant Proposed Variant for which the Investor obtained a decision on environmental conditions (or the variant approved by the DEC) – in this Report treated as the RAV 2024
BIAS	Baltic International Acoustic Survey
BirdLife International	an international non-governmental organisation working to protect birds and their habitats
Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Official Journal of the EU L 20/7 of 26 January 2010)
BOD₅	5-day biochemical oxygen demand
BSAP	Baltic Sea Action Plan for improving the environmental quality of the Baltic Sea
CFCs	chlorofluorocarbons
CIEP	Chief Inspectorate of Environmental Protection
CO₂	carbon dioxide
C-POD	Continuous Porpoise Detector
dB	decibel – a logarithmic measure of sound intensity (pressure)
DBBC	Double Big Bubble Curtain – an underwater noise reduction system
DBT	dibutyltin
DEC	a decision on environmental conditions within the meaning of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection, and environmental impact assessments (Journal of Laws of 2008 No. 199, item 1227, as amended)
diving benthophages	waterbird species that dive to the bottom of a body of water to feed on benthic organisms
DPD	detection positive day
DPM	detection positive minute
EEZ	Exclusive Economic Zone within the meaning of the Act of 21 March 1991 on the maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 1991 No. 32, item 131, as amended)
EIA	Environmental Impact Assessment
EIA Act	Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessments (Journal of Laws of 2008, item 199, pos. 1227, as amended)
EIA Report	Environmental Impact Assessment Report within the meaning of the Act of 3 October 2008 on the provision of information on the environment and environmental protection, public participation in environmental protection and on environmental impact assessments (Journal of Laws of 2008 No. 199, item 1227, as amended)
EMF	electromagnetic field
EU	European Union
EUROBATS	Agreement on the Conservation of Populations of European Bats
GBS	Gravity Based Structure
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Official Journal of the EU L 206 of 22 July 1992)
habituation	acclimatisation to the permanent occurrence of a given factor that does not pose a direct threat
heavy metals	a group of metals that are characterised by high density and often toxicity (arsenic, chromium, zinc, copper, cadmium, lead, mercury, nickel)
HELCOM	Helsinki Commission – Baltic Marine Environment Protection Commission
HF	high frequency
HFCs	hydrofluorocarbons
HF-weighted SEL	sound exposure level with a frequency weighting function according to susceptibility to noise-induced hearing damage in porpoises (NMFS 2018 was used in the EIA Report)
HSD	Hydro Sound Damper – a noise mitigation system

Hz	hertz – a unit of frequency with 1 Hz equalling 1 cycle per second
IALA	International Association of Lighthouse Authorities
ICES	International Council for the Exploration of the Sea
ICES 25-26	ICES Subdivisions 25-26
ichthyophages	species of birds that feed on fish
IMO	International Maritime Organization
IMWM-NRI	Institute of Meteorology and Water Management – National Research Institute
infauna	invertebrates living in seabed sediment
IUCN	International Union for Conservation of Nature
kHz	kilohertz – a unit of frequency with 1 kHz equalling 1000 cycles per second
LC	Least Concern – according to the IUCN Red List, this category denotes species which do not meet the criteria for being classified as threatened or near-threatened; this group includes common, widely distributed species
LOI	organic matter content in a sample marked as loss on ignition
LUA	Limited Use Area
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, adopted in London on 2 November 1973, together with Annexes I, II, III, IV, and V, as well as the 1978 Protocol relating thereto, adopted in London on 17 February 1978 together with Annex I
MBT	monobutyltin
MI GMU	Maritime Institute of the Gdynia Maritime University
MSFD	Marine Strategy Framework Directive (Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Journal of the EU 164/19, as amended)
MSPPSA	Maritime Spatial Plan of Polish Sea Areas
MW	megawatt – a unit of power in the International System of Units (SI)
NM	nautical mile
NMFS	National Marine Fisheries Service – a US federal agency responsible for the management of national marine resources, which has published criteria for assessing the impact of noise on marine mammals, including the weighting of the frequency of the sounds received
NOAA	US National Oceanic and Atmospheric Administration
NOVANA	a national environmental monitoring programme of the Danish Nature Agency that includes the monitoring of Natura 2000 sites
NPS	National Power System
NRS	Noise Reduction System, including the technical optimisation, arrangement, as well as the appropriate selection of equipment
NT	Near Threatened – according to the IUCN Red List, this category denotes species which are close to, but not yet included in the VU category
nutrients	essential chemical elements (biogenic substances) found in every living organism, including carbon, hydrogen, nitrogen, oxygen, phosphorus and sulphur
OHS	Occupational Health and Safety
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic of 22 September 1992 (Official Journal of the EU L 1998 No. 104, p. 2)
OWF	Offshore Wind Farm
OWPS	Offshore Wind Power Station
PVSDP	Pomeranian Voivodeship Spatial Development Plan
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
phenological periods	changes in the phenomena of animate nature occurring in annual cycles
phytobenthos	aquatic plants, including vascular plants rooted in the seabed (e.g. seagrass), as well as macroalgae which attach themselves to hard surfaces (pebbles, wrecks, structures) or lie freely on the seabed
POPs	persistent organic pollutants
ppm	parts per million
PSE	Polskie Sieci Elektroenergetyczne S.A.

PSzW	permit for the construction and use of artificial islands, installations and devices in the Polish Maritime Areas in accordance with the Act of 21 March 1991 on the maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 1991 No. 32, item 131, as amended)
PSzW no. MFW/4/13	permit of 6 February 2013 for the construction and use of artificial islands, installations and devices, issued by the Minister of Transport, Construction and Maritime Economy to C-Wind Polska Sp. z o.o. (ref. no.: GT7/62/1172655/decyzja/2013)
PSzW no. MFW/7/12	permit of 9 May 2012 for the construction and use of artificial islands, installations and devices, issued by the Minister of Transport, Construction and Maritime Economy to C-Wind Polska Sp. z o.o. (ref. no.: GT7ak/62/1165094/decyzja/2012)
PTS	Permanent Threshold Shift
PTS (1h cum.)	permanent threshold shift as a result of cumulative noise from 1 hour of piling
PTS (single strike)	permanent threshold shift as a result of a single pile driver strike
PW-weighted SEL	sound exposure level with a frequency weighting function according to susceptibility to noise-induced hearing damage in seals (NMFS 2018 was used in the EIA Report)
RAV 2024	the Rational Alternative Variant, understood in this EIA Report as the variant for which the Investor obtained a decision on environmental conditions
RDEP	Regional Directorate for Environmental Protection
RES	Renewable Energy Sources
rms	root mean square
ROV	Remotely Operated Vehicle
RP	the Republic of Poland (Polish: <i>Rzeczpospolita Polska</i>)
RWA 2024	Rational alternative variant of the project, understood in this EIA Report as the variant for which the investor has obtained an Environmental Decision
S²	particle acceleration
SAMBAH	Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise – an international research project
SDF	Standard Data Form for Natura 2000 sites
SECA/ECA	Sulphur Emission Control Areas/Emission Control Areas
SEL	Sound Exposure Level
SEL_{cum}	cumulative Sound Exposure Level – the level of sound exposure accumulated over a period of 1 hour, e.g. from multiple pile driver strikes
SM4M	an underwater sound recorder
soft start	a procedure involving a gradual increase in pile driver impact energy and, as a consequence, a gradual increase in noise level, in order to allow fish, birds and marine mammals to leave and move away from the works area
SPEC	Species of European Conservation Concern – a rank of special concern taking into account the threat category and the species occurrence in Europe and the world, assigned to bird species by BirdLife International
SPEC 2	a higher concern category (species the global populations of which are concentrated in Europe and have unfavourable conservation status in Europe)
SPEC 3	a higher concern category (species the global populations of which are not concentrated in Europe but whose conservation status in Europe is unfavourable)
SPL	Sound Pressure Level
SRH	Noise Reduction system, including technical optimization of the organization as well as the appropriate selection of equipment
TBT	tributyltin – an organotin compound
territorial sea	maritime area with a width of 12 nautical miles (22224 m), measured from the baseline of the sea
TOC	Total Organic Carbon
TSP	typical species presence index
TSS	Traffic Separation Scheme
TSS Ławica Słupska	Traffic Separation Scheme 'Ławica Słupska'
TTS	Temporary Threshold Shift
TTS (1h cum.)	temporary threshold shift as a result of cumulative noise from 1 hour of piling
TTS (single strike)	temporary threshold shift as a result of a single pile driver strike
UAS	MIKE Underwater Acoustic Simulator – original DHI software for the numerical modelling of underwater noise
UMPL	Unified Model PL – a numerical atmospheric model for Poland

UNCLOS	United Nations Conventions on the Law of the Sea
VIEP	Voivodeship Inspectorate of Environmental Protection
VMS	Vessel Monitoring System
VU	Vulnerable – according to the IUCN Red List, this category denotes species that may become extinct relatively soon, but not as soon as those categorised as Endangered
WWR 2024	the variant selected for implementation – assessed in this Report based on the specified parameters of the APV 2021

1. INTRODUCTION

1.1 INTRODUCTION

This Environmental Impact Report Update for the B-Wind and C-Wind Offshore Wind Farms (hereinafter: the BC-Wind OWF) was prepared by EKO-KONSULT Sp. z o.o. in Gdańsk on the basis of the EIA Report prepared in October 2021 by MEWO S.A. in cooperation with the following subcontractors: the Maritime Institute of the Maritime University in Gdynia (formerly: the Maritime Institute in Gdańsk), the Marine Fisheries Institute – National Research Institute, the Institute of Applied Ecology (IfAO), Marea Sp. z o.o., and DHI Polska Sp. z o.o.

All content that has been updated in this Report in comparison to its original version has been highlighted in grey.

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This Environmental Impact Report was prepared for the purposes of the proceedings to amend the decision on environmental conditions issued on 16 September 2022, ref: RDOŚ-Gd-WOO.420.50.2021.KSZ.AM.10 (hereinafter: the DEC). The Report focuses on the specific technical solutions of the project that is the construction of the BC-Wind OWF in the variant selected for implementation that were not possible to specify at the stage of preparation of the EIA Report in 2021.

The fundamental assumptions of the project, which is the construction of the BC-Wind OWF, did not change, but basic parameters related to the advancement of design works have been further specified. First of all, geotechnical research was performed, which allowed the location of the turbines within the OWF area to be pre-determined, followed by an arrangement of cables inside the farm and narrowing down the foundation technology. These factors influenced the decision to update the environmental impact assessment for the BC-Wind OWF, so as to adjust the content of the issued decision to the current technical and organisational assumptions of the project, and clarify the possible environmental impact of its execution.

All basic parameters of the project have been narrowed down in comparison to the parameters analysed when the environmental decision was being issued. The proposed changes in the parameters of the BC-Wind OWF are presented below.

Tab. 1.1. Summary of the basic parameters of the BC-Wind OWF included in the DEC, and the requested changes

Name of the facility or definition of the parameter	Unit	Value/data in the DEC	Proposed amendment
Number of wind turbines (maximum)	pcs	41	39*
Construction height with rotor (maximum)	m	330	300
Rotor diameter (maximum)	m	280	250
Number of offshore substations	pcs	2	1
Number of other building facilities (non-productive infrastructure)	pcs	4	4
Length of cable ducts inside the OWF (maximum)	km	188	approx. 100
Method of foundation	-	gravity, monopile, truss, tripod	monopile, truss

* ultimately, the Investor is planning to build 34 wind turbines, however the DEC amendment also includes 5 backup locations

Source: Investor data

The planned project is the BC-Wind OWF with a total maximum power of 500 MW, located in the maritime areas of the Republic of Poland (within the exclusive economic zone), at a distance of approx. 22.6 km from the coast (fig. 1.1).

The area covered by the environmental decision encompasses approx. 86.28 km², meanwhile the development area is approx. 78.71 km².

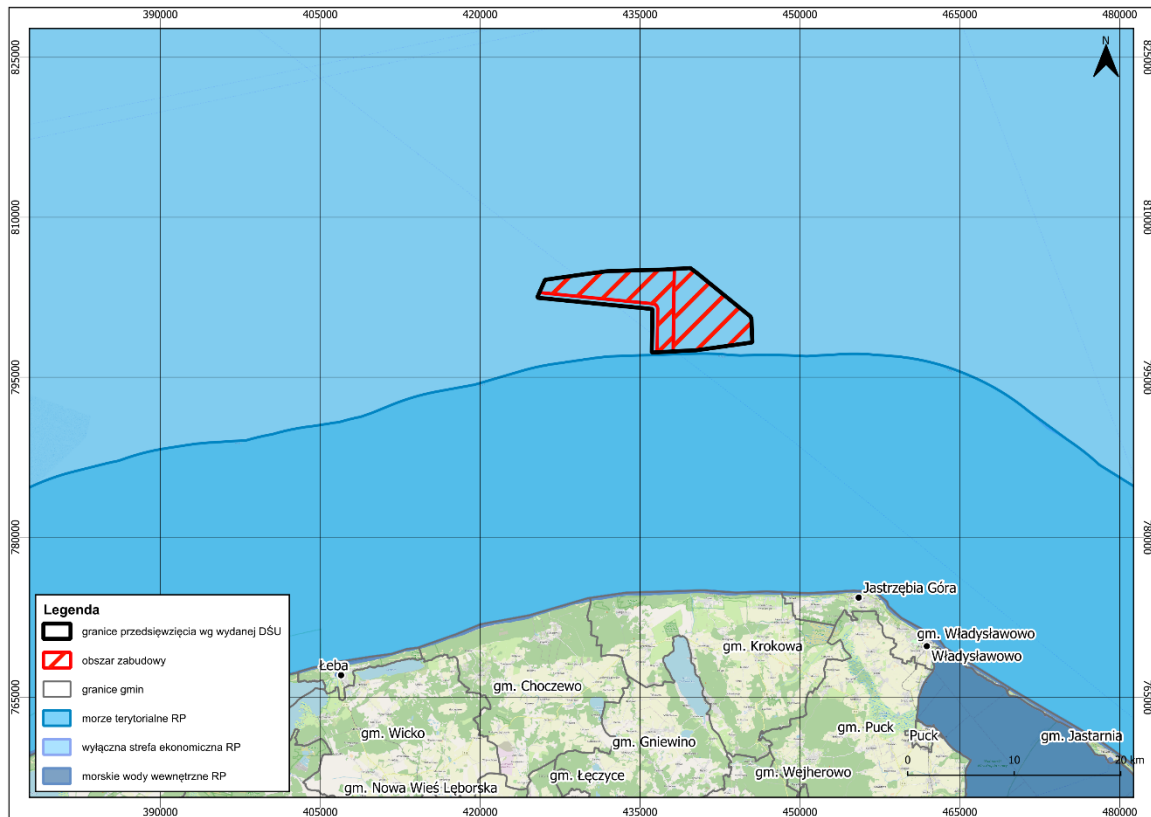


Fig. 1.1 Location of the BC-Wind OWF

Source: own elaboration based on data from the Investor and SIPAM

1.2 OBJECTIVE AND SCOPE OF THE EIA REPORT

The Report was prepared in connection with the planned initiation of the procedure to amend the DEC in accordance with Article 87 of the Act of 3 October 2008 on providing information on the environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws of 2024, item 1112, consol.) - hereinafter referred to as the EIA Act. Pursuant to the quoted article, the provisions of the EIA Act apply accordingly. The nature of the proceedings in question, i.e. amending an existing decision rather than obtaining a new one, has a major impact on the shape and content of this Report.

The purpose of the environmental impact assessment process is primarily:

- the verification of the environmental and spatial conditions during the phases of construction, exploitation and future decommissioning of the project, as well as potential emergency events, that were established in the 2021 Report;
- the verification of the nature, significance and extent of potential environmental, spatial, landscape and social effects associated with the implementation and exploitation of the project, based on the specified project parameters;
- the identification of opportunities to reduce potential negative impacts;
- the identification of opportunities for mitigating adverse impacts and the extent of monitoring during the construction and exploitation phases.

Tab. 1.2 Content of the EIA Report in relation to the report scope established in Articles 62 and 66 of the EIA Act

Content of Articles 62 and 66 of the EIA Act	Chapter numbers corresponding to the requirements of Articles 62 and 66 of the EIA Act
Analysis of the criteria listed in Article 62(1): The EIA identifies, analyses and evaluates the direct and indirect impacts of a project on:	
(a) the environment and population, including human health and living conditions	Volume I, Volume II Chapter 7.10
(b) tangible goods	Volume I, Volume II Chapter 7.10
(c) monuments	Volume I, Volume II Chapter 7.6
(d) landscape, including cultural landscape	Volume I, Volume II Chapter 7.7
(e) the interaction between the elements listed above	Volume I, Volume II Chapters 9 and 10
(f) availability of mineral deposits	Volume I, Volume II Chapter 7.2
(g) risks of major accidents, and natural and construction disasters	Volume I, Volume II Chapter 13
(h) the possibilities and means of preventing and reducing the negative impact of the project on the environment	Volume I, Volume II, Chapter 15
(i) the extent of monitoring required	Volume I, Volume II Chapter 16
Analysis of the criteria listed in Article 66(1): The environmental impact report shall contain information making it possible to analyse the criteria listed in Article 62(1), and shall include:	
A description of the planned project, in particular:	
a) the characteristics of the entire project and the conditions of use of the site during the construction and operation or use phases, including with regard to special flood hazard areas	Volume I, Volume II Chapter 3
(b) the main characteristics of the production processes	Volume I, Volume II Chapter 3
(c) the anticipated types and quantities of emissions, including waste, resulting from the construction and operation or use phases of the planned project	Volume I, Volume II Chapters 3 and 9.13
(d) information on biodiversity and the use of natural resources, including soil, water and land surface	Volume I, Volume II Chapters 3.4, 7.4.8, 9.1, 9.2 and 9.3
(e) information on energy demand and consumption	Volume I, Volume II Chapter 3.4
(f) information on demolition work for projects likely to have a significant impact on the environment	Not applicable
(g) risks of major accidents or natural and man-made disasters, assessed on the basis of scientific knowledge, taking into account the substances used and the technologies employed for the project, including risks related to climate change	Volume I, Volume II Chapter 13
A description of the natural elements of the environment covered by the scope of the predicted impact of the planned project on the environment, including:	
(a) the elements of the environment protected under the Nature Conservation Act of 16 April 2004, and the ecological corridors within the meaning of that Act	Volume I, Volume II Chapter 7.5
(b) the hydromorphological, physico-chemical, biological and chemical characteristics of the waters	Volume I, Volume II Chapter 7.3
(c) the results of the nature inventory	Volume II Chapters 7.4 and 7.5, Volume II Appendix 1
(d) other data on which the description of the natural elements is based	Volume II Chapters 1.3.3 and 1.4
e) a description of existing monuments in the vicinity or direct range of impact of the planned project protected under the provisions on the protection and care of monuments	Volume I, Volume II Chapters 7.6 and 9.6
(f) a description of the landscape in which the project is to be located	Volume I, Volume II Chapter 7.7
g) information on the connections with other projects, in particular on the accumulation of impacts of executed, completed or planned projects for which a decision on environmental conditions has been issued, located in the area where the project is planned to be executed, the area of impact of the project, or having an impact area falling within the area of impact of the planned project – to the extent in which their impacts may lead to the accumulation of impacts with the planned project	Volume I, Volume II Chapter 11
(h) a description of the predicted effects on the environment if the project is not implemented, taking into account available environmental information and scientific knowledge	Volume I, Volume II Chapter 5
Variant descriptions, taking into account the specific characteristics of the project or its impact, including:	

(a) the Applicant Proposed Variant and the Rational Alternative Variant	Volume I, Volume II Chapter 4
(b) a reasonable, environmentally preferable variant, together with a justification for its choice	Volume I, Volume II Chapter 14
(c) the determination of the predicted impact of the analysed variants on the environment, including in the event of a major industrial accident and a natural and construction disaster, on the climate, including greenhouse gas emissions and impacts relevant for adaptation to climate change, as well as possible transboundary environmental impacts	Volume I, Volume II Chapter 10
A comparison of the impacts of the analysed variants on:	
(a) people, plants, animals, fungi and natural habitats, water and air	Volume I, Volume II Chapters 9 and 10
(b) the land surface, including earth movements and the landscape	Volume I, Volume II Chapters 9 and 10
(c) tangible goods	Volume I, Volume II Chapters 9 and 10
(d) monuments and cultural landscape covered by existing documentation, in particular a register or a record of monuments	Volume I, Volume II Chapters 9 and 10
(e) the forms of nature conservation referred to in Article 6(1) of the Nature Conservation Act of 16 April 2004, including the objectives and subjects of protection of Natura 2000 sites, and the continuity of ecological corridors connecting them	Volume I, Volume II Chapters 9 and 10
(f) the elements listed in Article 68(2)(2)(b), where they have been taken into account in the environmental impact report for the project or where they are required by a competent authority	Volume I, Volume II Chapters 9 and 10
(g) the interaction between the elements referred to in points (a) to (f)	Volume I, Volume II Chapters 9 and 10
Justification for the Applicant Proposed Variant, taking into account the information referred to in points 6 and 6a of Art. 66 par. 1 of the EIA Act	Volume I, Volume II Chapter 4
A description of the forecasting methods used by the Applicant	Volume I, Volume II Chapter 1.4
and a description of the predicted significant environmental impacts of the planned project, including direct, indirect, secondary, cumulative, short, medium and long-term, permanent and temporary environmental impacts resulting from: (a) the existence of the project, (b) the use of environmental resources, (c) emissions	Volume I, Volume II Chapters 9 and 10
A description of anticipated actions aimed at avoiding, preventing, limiting or compensating for negative environmental impacts, in particular on the forms of nature conservation referred to in Article 6 (1) of the Nature Conservation Act of 16 April 2004, including the objectives and subjects of protection of Natura 2000 sites, and the continuity of ecological corridors connecting them, together with an assessment of their effectiveness during the construction, operation, use or decommissioning phase, respectively	Volume I, Volume II Chapter 15
If the planned project involves the use of an installation – a comparison of the proposed technology with the technology meeting the requirements referred to in Article 143 of the Act of 27 April 2001 – the Environmental Protection Law	Volume I, Volume II Chapter 18
Reference to environmental objectives arising from strategic documents relevant to the implementation of the project	Volume I, Volume II Chapters 2 and 9.3
Justification for meeting the conditions referred to in Articles 68(1), (3) and (4) of the Act of 20 July 2017 – the Water Law, if the project affects the possibility of achieving the environmental objectives referred to in Article 56, Article 57, Article 59 and Article 61(1) of that Act	Not applicable – the project will not affect the possibility of achieving these environmental objectives – as per the results of the assessment of impact on WB
Indication whether it is necessary to establish a limited use area for the planned project, as specified in the Act of 27 April 2001 – the Environmental Protection Law – and the determination of the borders of such an area, restrictions on the use of the land, technical requirements for the buildings and ways of using them; this does not apply to projects involving the construction or reconstruction of a road and projects involving the construction or reconstruction of a railway line or a public use airport	Volume II Chapter 19 – the establishment of a limited use area was not deemed necessary
Graphic presentation of the issues	Volumes I-III
Presentation of issues in cartographic form at a scale corresponding to the subject matter and detail of the issues analysed in the report, and enabling a comprehensive presentation of the analyses on the impact of the project on the environment that have been carried out	Volumes I-III

An analysis of possible social conflicts related to the planned project	Volume I, Volume II Chapter 17
Presentation of a proposal for monitoring of the impact of the planned project during the phase of its implementation, operation or use, in particular on the forms of nature protection referred to in Article 6(1) of the Nature Conservation Act of 16 April 2004, including the objectives and subjects of protection of Natura 2000 sites, and the continuity of ecological corridors connecting them, and information on available results of other monitoring which may be significant for the purpose of determination of required obligations in this regard	Volume I, Volume II Chapter 16
Indication of any difficulties encountered in the preparation of the report due to technical deficiencies or gaps in contemporary knowledge	Volume I, Volume II Chapter 20
A summary, in non-specialist language, of the information contained in the report, for each element of the report	Volume I
The date of the report, the name and signature of the author and, if the report is produced by a team of authors, the name and signature of the team leader, and the names, surnames and signatures of the members of the team of authors	Volume II Title page
A declaration made by the author and, if the report is produced by a team of authors, by the leader of the team, that the requirements referred to in Article 74a(2) have been met, attached to the report	Volume II First page
Sources of information on which the report is based	Volume II, Chapters 1.3.3, 1.4 and 22
If it is determined that the project may have a significant impact on a Natura 2000 site, the EIA Report should also contain data to determine the lack of alternative solutions and information required to determine whether the requirements of overriding public interest support the project	Not applicable – no significant impact on the subjects of protection of Natura 2000 sites has been determined – the assessment of impact on Natura 2000 sites has been featured in Volume II, Chapter 9.5
If the planned project is a linear public purpose investment or a non-linear public communications investment, and the Applicant Proposed Variant runs through the area of a national park or a nature reserve, the environmental impact report should also contain data making it possible to determine the absence of alternative solutions	Not applicable
If the possibility of a transboundary environmental impact is identified, the information referred to in paragraph 1, points 1-16, should take into account the determination of the scale of impact of the planned project outside the territory of the Republic of Poland	Volume II Chapter 12 – no transboundary impact has been identified
If it is necessary to establish a limited use area for the planned project, the report should be accompanied by a copy of a cadastral map, certified by a competent authority, indicating the course of the boundaries of the area in which it is necessary to establish the limited use area	Volume II Chapter 19 – the establishment of a limited use area was not deemed necessary
If the planned project involves the use of an installation subject to an integrated permit, the environmental impact report should contain a comparison of the proposed technique with the best available techniques	Volume II Chapter 18
The report on the environmental impact of the project should take into account the impact of the project during the phases of its construction, operation or use, and decommissioning	Volume II Chapter 9
The environmental impact report should take into account the environmental information resulting from strategic environmental assessment relevant to the project in question	Volume II Chapter 2

Source: own elaboration

1.3 FORMAL AND LEGAL ASPECTS OF PREPARING THE REPORT

1.3.1 Qualification of the project

The planned project, involving the construction of the BC-Wind OWF in the maritime areas of the Republic of Poland, was classified according to the Regulation of the Council of Ministers of 10 September 2019 on projects likely to have a significant impact on the environment (Journal of Laws 2019, item 1839, as amended), as belonging to the so-called 1st category of projects that obligatorily require the preparation of an EIA Report. The basis for the qualification was § 2(1)(5)(b):

'(5) installations using wind power to generate electricity:

(a) with a total rated power of no less than 100 MW,

(b) located in the maritime areas of the Republic of Poland;'

In addition, the Investor is planning the construction of an offshore substation and power cables, which are not classified by the Regulation on projects likely to have a significant impact on the environment. However, those plans were taken into account during the analyses in this Report.

The authority competent to carry out the procedure for amending the environmental decision in the analysed case is the Regional Director for Environmental Protection in Gdańsk, who issued the decision on environmental conditions for the BC-Wind OWF in 2022.

1.3.2 Legal acts which form the basis of the Report

The main pieces of legislation that formed the basis of this Report are listed below:

- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (the Birds Directive) (Official Journal of the EU L 20/7 of 26 January 2010);
- Council Directive 92/42/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) (Official Journal of the EU L 206 of 22 July 1992);
- Directive 2005/35/EC of the European Parliament and of the Council of 7 September 2005 on ship-source pollution and on the introduction of penalties, including criminal penalties, for pollution offences (Official Journal of the EU L 255 of 30 September 2005, p. 11, as amended);
- United Nations Convention on Biological Diversity adopted in Rio de Janeiro on 5 June 1992 (Journal of Laws 2002 No. 184, item 1532);
- Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws 2024, item 1112, consol.);
- Act of 16 April 2004 on nature conservation (Journal of Laws 2022, item 916, consol., as amended);
- Act of 21 March 1991 on maritime areas of the Republic of Poland and maritime administration (Journal of Laws 2022, item 457, consol., as amended);
- Act of 27 April 2001 on Environmental Protection Law (Journal of Laws 2022, item 2556, consol., as amended);
- Act of 28 March 2003 on the establishment of the multiannual 'Programme for the protection of sea shores' programme (Journal of Laws 2016, item 678);
- Act of 14 December 2012 on waste (Journal of Laws 2022, item 699, consol., as amended);
- Act of 16 March 1995 on the prevention of pollution from ships (Journal of Laws 2020, item 1955, consol., as amended);
- Act of 17 December 2020 on the promotion of electricity generation in offshore wind farms (Journal of Laws 2022, item 1050, consol., as amended);
- Act of 21 August 1997 on real estate management (Journal of Laws 2021, item 1899, consol., as amended);
- Act of 7 July 1994 – the Construction Law (Journal of Laws 2021, item 2351, consol., as amended);
- Act of 9 June 2011 – the Geological and Mining Law (Journal of Laws 2022, item 1072, consol., as amended);
- Act of 23 July 2003 on the protection and care of historical monuments (Journal of Laws 2022, item 840, consol.).

In addition, the formal and legal conditions considered in the Report include the following:

- Regulation of the Council of Ministers of 10 September 2019 on projects likely to have a significant impact on the environment (Journal of Laws 2019, item 1839, as amended);
- Regulation of the Minister of the Environment of 9 October 2014 on the protection of plant species (Journal of Laws 2014, item 1409);
- Regulation of the Minister of the Environment of 16 December 2016 on the protection of animal species (Journal of Laws 2016, item 2183, as amended);

- Regulation of the Council of Ministers of 14 April 2021 on the adoption of a spatial development plan for internal sea waters, territorial sea and the exclusive economic zone at a scale of 1:200 000 (Journal of Laws 2021, item 935);
- Regulation of the Minister of Infrastructure of 25 February 2021 on the adoption of an update of the set of environmental objectives for marine waters (Journal of Laws 2021, item 569);
- Regulation of the Council of Ministers of 11 December 2017 on the adoption of the National Programme for the Protection of Marine Waters (Journal of Laws 2017, item 2469);
- Regulation of the Minister of Climate of 2 January 2020 on the waste catalogue (Journal of Laws 2020, item 10);
- Regulation of the Minister of Infrastructure of 21 December 2002 on port plans for the management of waste and cargo residues from ships (Journal of Laws 2002 No. 236, item 1989);
- Regulation of the Minister of the Environment of 14 June 2007 on permissible levels of noise in the environment (Journal of Laws 2014, item 112, consol.);
- Regulation of the Minister of the Environment of 24 August 2012 on the levels of certain substances in the air (Journal of Laws 2021, item 845, as amended);
- Regulation of the Minister of Transport and Maritime Economy of 1 June 1998 on technical conditions to be met by maritime hydraulic structures and their location (Journal of Laws 1998 No. 101, pos. 645);
- Regulation of the Minister of Climate of 17 December 2019 on permissible levels of electromagnetic fields in the environment (Journal of Laws 2022, item 2630, consol.);
- Regulation of the Minister of Economy of 21 December 2005 on the essential requirements for equipment used outdoors with regard to the emission of noise into the environment (Journal of Laws 2005 No. 263, item 2202, as amended).

1.3.3. Project data sources

The basis for the source of information about the project in this update of the Report was the preliminary version of the construction project, which made it possible to clarify many issues related to the parameters of the project and its impacts.

First and foremost, the location of up to 39 wind turbines and an offshore substation was determined and, following this, possible cable route corridors were specified. On the basis of data on the geological structure, three possible methods of cable-laying were established, i.e. ploughing, mechanical cutting, and jetting, depending on the characteristics of the seabed present along the route. One foundation technique has also been adopted, i.e. using monopiles; optionally, in the case of an electrical substation (OSS) and/or select wind turbines, it may be necessary to use a truss foundation). The degree of advancement of the design work has enabled a more precise determination of the possible impacts of the BC-Wind OWF on the marine environment.

The following, among others, were used:

- Geological-engineering documentation on the preliminary identification of geological-engineering conditions of the seabed for the foundation of offshore wind farm complexes 'B-Wind' and 'C-Wind', MEWO S.A., March 2023;
- Cable Burial Risk Assessment Report, Ramboll, PROJMORS, August 2023;
- Basis of Design – Metocean Conditions BC-Wind, June 2023;
- Navigational expert assessment of the impact of an offshore wind farm and its installation set on the safety and efficiency of ship navigation in Polish maritime areas, Maritime Institute of the Maritime University of Gdynia, December 2023;
- Hazard and Pollution Control Plan for the BC-Wind offshore wind farm and its installation set, Maritime Institute of the Maritime University of Gdynia, September 2023.

The main sources of project data in the previous version of the Report (2021) were:

- permits for the construction and use of artificial islands, installations and devices in Polish maritime areas,
- Oil Pollution Prevention Plan, MEWO S.A., Maritime University of Gdynia, Gdańsk 2021,
- Navigational expert assessment, MEWO S.A., Maritime University of Gdynia, Gdańsk 2021,

- Expert opinion on the safety implications of research into the identification and exploitation of mineral resources of the seabed, MEWO S.A., Maritime University of Gdynia, Gdańsk 2021.

1.4. METHODOLOGICAL ASSUMPTIONS OF THE EIA REPORT AND PRIMARY SOURCES OF ENVIRONMENTAL DATA

The methodological assumptions have been adapted to the nature of this study as the subject of the assessment is the BC-Wind OWF defined through the specification of basic parameters, which significantly affects the methodology of preparing an environmental impact assessment. The structure and a significant part of those methodological assumptions remain the same as those of the Report prepared in 2021. Maintaining the internal structure of this Report analogous to that of 2021 is intended to enable comparability of the material constituting the basis for the DEC issued in 2021 with the material developed in connection to the introduced changes. All updated content being highlighted in grey is also intended to facilitate the perception of the most important changes in the Report. These mainly include newly developed and detailed principles for minimising negative environmental impacts and monitoring these impacts, adapted to the current standards, including the information contained in the draft guidelines for OWFs commissioned by the General Director for Environmental Protection.

The EIA Report for the BC-Wind OWF prepared in 2021 by MEWO S.A. was based on a concept of an envelope description of the project, which had a significant impact on the approach to the environmental impact assessment. The envelope concept meant that in the case of an assessment of a selected parameter with the possibility of applying different technical solutions, an environmental impact assessment was performed for the potentially most environmentally burdensome solution. It was assumed that if the most burdensome solution did not have a significantly negative impact on the environment, the other solutions, being less burdensome, would also be acceptable. An example of the envelope approach to assessment can be seen in the assessment of impact of foundation-laying. The Gravity Based Structure (GBS) requires extensive work related to sediment transfer and it is the most burdensome solution in this respect, while installing a large-diameter monopile will generate the most noise. In line with the envelope concept, the amount of sediment displaced when using GBS and the underwater noise generated when driving the large-diameter pile were parameters considered for assessment in the 2021 EIA Report.

This approach resulted in an assessment of the environmental impact of the most burdensome technology for each given environmental element. At the same time, it made it impossible to precisely determine the environmental impact of the planned project, and therefore the environmental decision imposed an obligation to carry out a reassessment of the environmental impact at the building permit stage.

The current update of the EIA Report, due to the stage of advancement of the BC-Wind OWF project, makes it possible to be more precise in the specification of the parameters of the project; the location of the power plant, cable routes, turbine parameters, and the method of foundation are preliminarily determined. This data enabled a more precise assessment of the impact of the planned project, including more precise modelling of the noise source and underwater noise propagation, suspended matter dispersion, and collision with migratory birds, all which are included in this Report.

The main assumption of the methodology adopted in this Report was to determine how the parameters of the BC-Wind OWF, as well as the method of its construction and exploitation, affect the nature, extent and magnitude of impacts caused during the phases of construction, exploitation and decommissioning of the BC-Wind OWF. The subject of the assessment are the consequences for the assessment of the scale and magnitude of the impact caused by the introduction of modifications to the project for which the decision on environmental conditions has already been issued.

The nature of the impacts resulting from the specification of the project parameters could be as follows:

- The specification does not affect the nature, scale and magnitude of the impact – neutral;
- The specification reduces the magnitude of the impact – positive;
- The specification increases the magnitude of the impact – negative.

In the case of the requested amendment to the DEC, the specification of the parameters of the BC-Wind OWF is not predicted to result in adverse effects relative to those assessed in the 2021 Report, as all the basic, project-defining parameters have decreased.

1.4.1. Methodology for assessing the scale and significance of impacts

The work was carried out in accordance with the scheme for the preparation of an environmental impact report, taking into account:

- the results of environmental studies and nature inventories;
- the conditions of programming and planning documents at the international, national and regional level, as well as the results of environmental impact forecasts for these documents, which may have an impact on the planned project;
- the preliminary design data of the planned project, including an indication of the activities in the construction, overlapping construction and exploitation, exploitation and decommissioning phases, together with an indication of the environmental risks and their potential effects;
- the results of informational meetings.

In developing the EIA Report, primary use was made of:

- guidelines, manuals and other materials on the subject of EIA Report preparation;
- experience of the team of authors and common good practices.

The EIA Report considers three phases of the planned project:

- construction;
- exploitation;
- decommissioning.

The purpose of the preparation of the EIA Report update is to determine the potential environmental impacts of the planned project based on the more detailed parameters of the project established at the stage of preparing the construction project. The assessment has the character of an analytical and study work, performed by a team of specialists. In preparation of the EIA Report, analyses of descriptive and cartographic materials were carried out. Impact assessment methodology was applied, as well as interpretation of the results of the conducted research and inventories.

In compiling the Report, the following were analysed in particular:

- technical and technological aspects of the planned project affecting the magnitude of its impact;
- environmental, spatial and social conditions of the planned project;
- variation possibilities (locational, technical, technological, organisational and logistical);
- the magnitude and significance of potential environmental impacts;
- opportunities to avoid and reduce adverse environmental impacts;
- the scope of monitoring.

The EIA Report analysed the planned project in terms of the techniques and technologies used, as well as the operating conditions. Among other things, the information contained in the documentation of the planned project was used and the potential impact of similar activities that may cumulate was analysed.

Relevant environmental, spatial and social conditions were identified on the basis of the available data and environmental studies and inventories. On this basis, potential impacts and risks associated with the planned project were identified. The extent and scope of the anticipated environmental impact was also determined. Comparisons were made with analogous cases in terms of environmental conditions and the magnitude and nature of impacts.

The approach applied to the assessment of the scale and magnitude of the impacts results from the authors' experience gained during the environmental impact assessments of projects planned to be executed in maritime areas, including OWFs. The adopted approach enabled the indication of comprehensive actions aimed at avoiding, preventing and limiting negative impacts associated with the planned project.

The figure below (Fig. 1.2) shows a schematic diagram of the method of preparation of the EIA Report in relation with the data concerning the planned project and the performed environmental research. Environmental studies indicate the use of both the environmental studies and nature inventories carried out for the purpose of this Report, as well as the results of other studies, e.g. for projects located closest to the planned project, in connection with the development of documents such as protected areas protection plans (resulting from environmental monitoring or monitoring/research carried out in connection with other activities or projects), available publicly or in literature.

During the first stage of the assessment, activities resulting from the implementation of the planned project in its various phases, i.e. construction, exploitation and decommissioning, as well as the phase of overlapping construction and exploitation, were identified. On the basis of environmental and inventory studies carried out for the purposes of the EIA Report, the elements of the environment (receptors) likely to be affected by those activities were also identified. In the second stage of the assessment, links between sources of potential impacts and individual receptors were identified based on literature and expert experience.

The identified impacts were assigned characteristics in four categories:

- the nature of the impacts (positive or negative);
- the type of the impacts (direct, indirect, secondary/simple, cumulative/reversible, permanent);
- the extent of the impacts (local, regional) and whether the impact is transboundary;
- the temporal range of impacts (short-term, medium-term, long-term, permanent, temporary).

At the same time, the resistance of receptors to individual impacts in cases of possible interaction between impact and receptor was determined. Given the attributed characteristics of the impacts and the established receptor resistance to them, a scale (magnitude) of impacts, specific to the individual interaction between impact and receptor, was determined. The magnitude (scale) of the impact was described on a five-point scale: (1) negligible, (2) small, (3) moderate, (4) large and (5) very large.

Taking into account the prevalence of a given receptor, its significance and the role it plays in the environment and, above all, its protection status, individual receptors, considered as an environmental resource, were assigned a value (importance), also determined on a five-point scale: (1) irrelevant, (2) low, (3) moderate, (4) high and (5) very high.

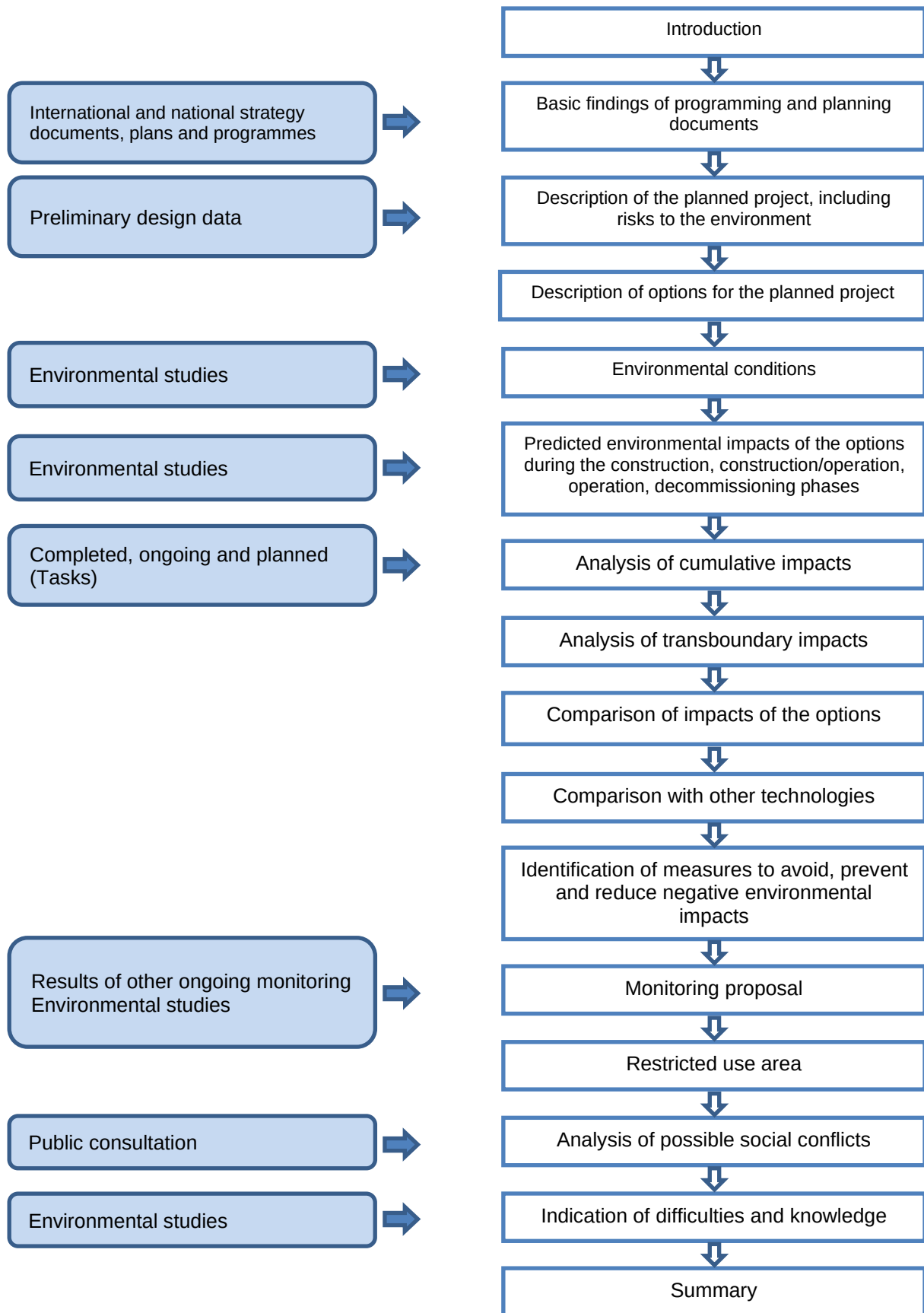


Fig. 1.2. General outline for the preparation of an environmental impact report

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 52

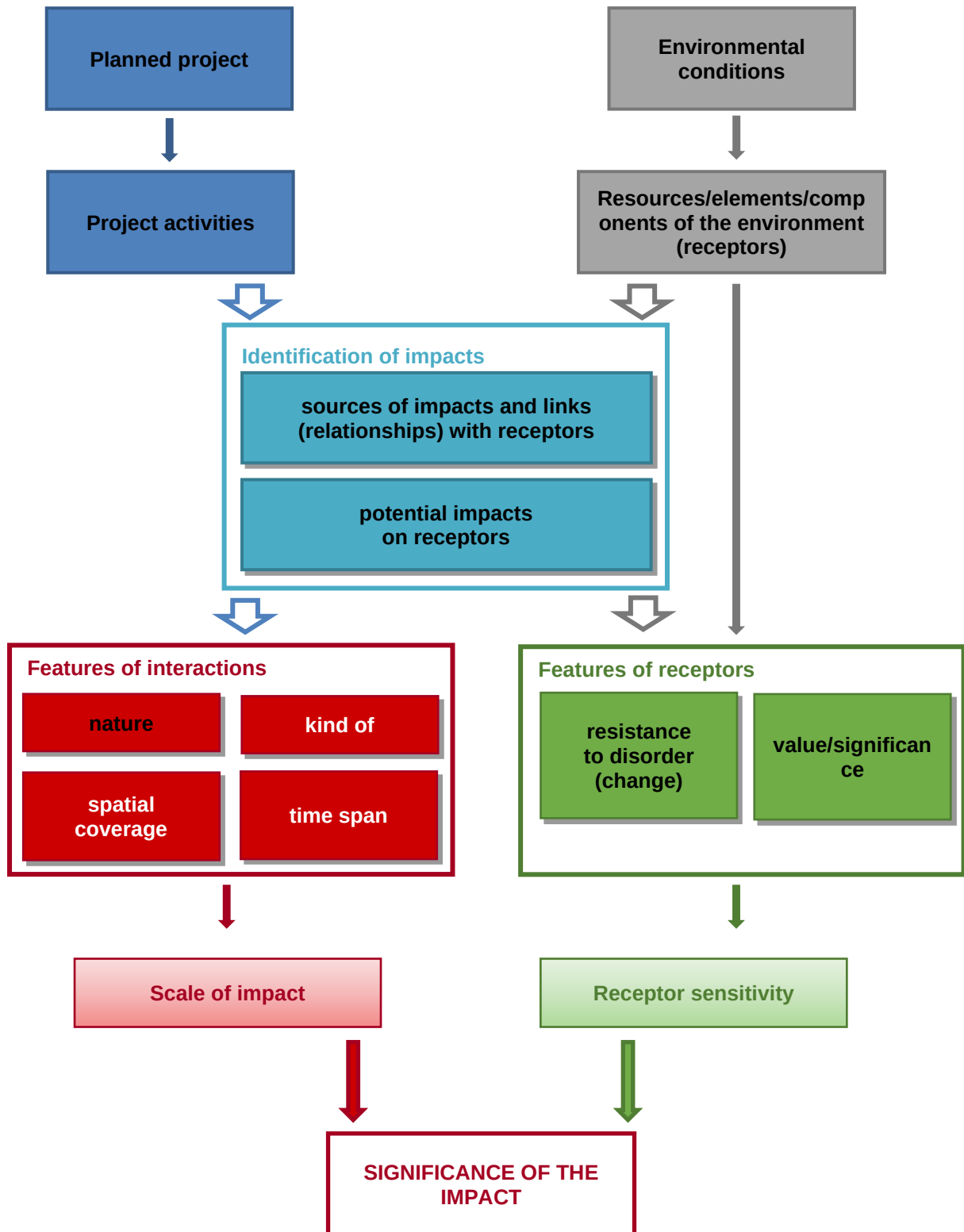


Fig. 1.3 Diagram of environmental impact identification and impact assessment with the determination of impact significance

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 56 (based on the ESPOO REPORT, 2017)

In the next stage of the assessment, given the assigned impact magnitude (scale) and receptor sensitivity, impact significance was also determined on a five-point scale (tab. 1.3):

- negligible impact;
- minor impact;
- moderate impact;
- relevant impact;
- significant impact.

Tab. 1.3 Matrix defining the significance of the impact in relation to the scale of the impact and the value of the resource

Impact significance		Receptor sensitivity				
		Irrelevant	Low	Moderate	High	Very high
Scale (size) of impact	Negligible	Negligible	Negligible	Negligible	Negligible	Minor
	Small	Negligible	Negligible	Minor	Minor	Moderate
	Moderate	Negligible	Minor	Minor	Moderate	Moderate
	Large	Negligible	Minor	Moderate	Relevant	Significant
	Very large	Minor	Moderate	Moderate	Significant	Significant

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 57

According to the environmental impact assessment methodology described above, a significant impact may occur if a 'very large' scale impact and at least a 'high' receptor sensitivity, or a 'large' scale impact and 'a very high' receptor sensitivity, are identified at the same time.

1.4.2 Methodology of nature inventories

During the preparation of this EIA Report, the results of the environmental studies and nature inventories carried out between 2019 and 2021 for the BC-Wind OWF were used, which formed the basis for the preparation of the 2021 EIA Report. The report takes into account the results of environmental studies conducted in the vicinity of the wind farms Baltica 2 and Baltica 3 (from 2012-2013), Baltica 2 and Baltica 3 (from 2016-2017), and Baltic Power (from 2018-2019). There is currently no more up-to-date environmental data on the vicinity of the planned project. The scope of work also included the results of an informational meeting with fishermen. These results were used to specify issues of public interest and to develop the section of this report dedicated to the analysis of possible social conflicts.

The table below (tab. 1.4) presents the characteristics of studies on the marine environment that were carried out for the purpose of development of the EIA Report. Detailed survey methodologies for individual elements are presented in the inventory reports attached as Appendix 1 to this Report.

Tab. 1.4 Survey characteristics of abiotic and biotic elements of the marine environment

Type of research	Date of testing	Research coverage	Scope of research
Abiotic elements			
Geophysical	03.2020-06.2020	Area (1 Mm)	Measurements (on profiles, every 80 m): • bathymetric (multibeam echosounder); • sonar (side scan sonar); • magnetometric; • seismoacoustic and seismic (two sediment profilometers operating at different frequencies, high and low). Vision-based inspection carried out with a ROV. Analysis of material collected from magnetometric, bathymetric and sonar measurements, and video inspections of selected sites.
Meteorological	10.2019-01.2021	Area (1 Mm)	Measurements using a survey buoy to measure meteorological conditions. Registration:

Type of research	Date of testing	Research coverage	Scope of research
			- wind speed and direction; - atmospheric pressure; - temperature and humidity.
Hydrological	10.2019-01.2021	Area (1 Mm)	Measurements using two sets to measure hydrological parameters (one under the meteorological buoy and one in the shallowest part of the OWF area). Registration: - wave height, period and direction; - the speed and direction of ocean currents (in the surface, middle and bottom layers); - temperature, turbidity and water conductivity (at depths of 1, 4, 8, 16 m and above the bottom). Surface and bottom layer water sampling at 35 stations, including 6 stations sampling water in standard vertical profiles. Measurement of water temperature and conductivity (during water sampling) using a CTD probe. Physicochemical analyses of indicators in accordance with the reference methods (or equivalent) set out in Annex No. 7 to the Regulation of the Minister of Maritime Economy and Inland Navigation of 9 October 2019 on the form and manner of monitoring of surface water bodies and groundwater bodies (Journal of Laws 2019, item 2147).
Geochemical	01.2020-08.2020	Area (1 Mm)	Collection of 161 surface sediment samples (winter campaign) and 150 surface sediment samples (summer campaign) in a uniform grid with an average density of 1 sample per 1 km². Laboratory analyses on the basis of EN-ISO standards or, in their absence, in accordance with test procedures developed by an accredited laboratory or applicable test methodologies.
Acoustic	12.2019-01.2021	Area (2 Mm)	Acoustic background measurements using 2 hydrophones
Biotic elements			
Phytobenthos	06.2020	Area (1 Mm)	Analysis of bathymetric and sonar data. Vision inspection carried out by ROV on 6 transects; Analysis of footage.
Macrozoobenthos	06.2020	Area (1 Mm)	Collection of 146 quantitative soft-bottom samples in a uniform grid with an average density of 1 sample per 1 km². Collection of 10 hard-bottom samples, including 9 quantitative samples and 1 qualitative sample. Laboratory analysis of: - taxonomic composition; - numbers; - biomass.
Ichthyofauna	10.2019-07.2020	Area (1 Mm)	Acoustic measurement using a research echo sounder. Sampling (ichthyofauna) using pelagic trawls and survey net sets. Sampling (ichthyoplankton) using Bongo nets. Ichthyological analysis in terms of: - length and individual weight; - gender and stage of gonadal maturity; - the degree to which stomachs are filled; - age. Ichthyoplankton analysis of: - taxonomic composition; - numbers; - length of larvae and fry.
Marine mammals	10.2019-11.2020	Area (2 Mm)	Passive acoustic recording of porpoises using 5 porpoise underwater acoustic detectors (C-POD).

Type of research	Date of testing	Research coverage	Scope of research
			Aerial observations on 5 transects.
Migratory birds	08.2019-05.2020	Area (2 Mm)	Visual observations, acoustic recordings and recordings using radars: vertical and (at 1 station) horizontal.
Seabirds	09.2019-08.2020	Area (2 Mm) and three areas: Słupsk Bank, Southern Middle Bank, the coastal strip	Counts of birds sitting on the water and in flight along: • 4 transects in the OWF area (2 Mm); • 8 transects in the Słupsk Bank Natura 2000 site (PLC990001); • 6 transects in the Southern Middle Bank area; • 8 transects in the area of the coastal strip.
Bats	08.2019-05.2020	Area (2 Mm)	Acoustic recording using recorders at 2 stations and along 3 transects with a total length of 55 km.

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 53-55

For the purpose of updating the knowledge of the marine environment in the area of the planned project, publicly available sources of information were additionally analysed, most notably:

- Catch data from 2020-2023;
- Latest HELCOM data on harbour porpoise surveys in the Baltic Sea;
- State Environmental Monitoring data on the state of the marine environment.

1.4.3. Methodology for assessing impacts on Natura 2000 sites

The assessment of the impact of the planned project on Natura 2000 sites was carried out taking into account the recommendations of the European Commission's manual, 'Assessment of plans and projects in relation to Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC', Official Journal of the European Union C 437/01, of 28 October 2021.

According to the guidelines, the Natura 2000 impact assessment can be divided into 3 stages:

Stage 1: Initial inspection;

Stage 2: Appropriate assessment;

Stage 3: Derogation from Article 6(3) of the Habitats Directive.

As no potential for significant adverse impacts on Natura 2000 sites that could not be eliminated or minimised has been identified during the assessment, it was completed at Stage Two: Appropriate Assessment.

1.4.4. Methodology for calculating the spread of suspended solids

For the purposes of this EIA Report update, a remodelling of the dispersion of suspended solids was carried out based on the specified parameters of the project, including the methods of foundation construction and cable-laying between the turbines. A full description of the methodology is included in Appendix 2 to this Report, while the details of the modelling approach in relation to the modelling undertaken as part of the 2021 EIA Report are presented in Chapter 8.1 of this Report.

1.4.5. Methodology for calculating the noise emissions

For the purpose of this EIA Report update, a remodelling of the underwater noise propagation was carried out based on the specified parameters of the project, including the foundation construction method, and the study was extended to include sound source modelling. A full description of the methodology is included in Appendix 3 to this Report, while a reference to the initial modelling and the newly adopted modelling inputs are presented in Chapter 8.2 of this Report.

1.4.6. Methodology for modelling the risk of collision of the BC-Wind OWF with birds

For the purpose of this EIA Report update, a remodelling of the barrier effect and the risk of collision of migratory birds with BC-Wind turbines was carried out based on the specified parameters of the project. A full description of the methodology is included in Appendix 4 to this Report, while basic differences in the adopted parameters and the conclusions from the comparison of the modelling from the EIA Report from 2021 and the current modelling are presented in Chapter 8.3 of this Report.

2. CONDITIONALITY RESULTING FROM STRATEGIC AND PLANNING DOCUMENTS

In this chapter, reference is made to the environmental objectives of international, national and regional documents concerning the protection of the Baltic Sea. Reference is also made to documents that relate to the promotion of offshore wind energy, as well as planning documents. In accordance with Article 59a para. 4 point 23 of the Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments (Journal of Laws 2024, item 1112, consol.), the planned project is a strategic investment, which, according to Article 80 para. 2a of the EIA Act, is not subject to the requirement of ascertaining the compliance of the project's location with the arrangements of the spatial development plan of internal sea waters, territorial sea and the exclusive economic zone (the MSPPSA). However, it should be noted that the project is consistent with it, as indicated in Chapter 2.4 of this Report.

2.1 INTERNATIONAL DOCUMENTS

Baltic documents and initiatives

The Baltic region is characterised by long-standing cooperation at an international level in areas such as spatial development and planning (VASAB), marine environment protection (HELCOM), or energy (BASREC). The European Union Strategy for the Baltic Sea Region (EUSBSR), which is the first EU strategy at a macro-regional level with an intra-EU character, was adopted in 2009.

Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM)

The Helsinki Convention – the Convention on the Protection of the Marine Environment of the Baltic Sea Area – was formulated in Helsinki on 9 April 1992 (Journal of Laws of 2000 No. 28, item 346). This convention defines the principles of cooperation of all Baltic Sea states on comprehensive protection of the Baltic Sea against all types of pollution, and its implementing body is the Helsinki Commission (HELCOM), based in Helsinki.

The Helsinki Commission's work is primarily based on 5 permanent working groups, including: on the State of the Environment and Nature Conservation (STATE & CONSERVATION); on the Implementation of the Ecosystem Approach (GEAR); on Reduction of Pressures from the Baltic Sea Catchment Area (PRESSURE); and 3 temporary ones, including the HELCOM-VASAB MSP, the Joint HELCOM-VASAB Marine Spatial Planning Working Group. Activities undertaken due to the Helsinki Convention resulted in the Baltic Sea Action Plan (BSAP), which was updated in October 2021.

HELCOM groups that may refer to impacts caused by offshore wind energy include the PRESSURE working group, which deals with i.a. underwater noise, and the HELCOM-VASAB MSP group, which deals with spatial planning.

Actions to protect the Baltic Sea are reflected in the Baltic Sea Action Plan (BSAP), adopted at the HELCOM Ministerial Meeting in 2007. The programme was updated in 2021. It contains a number of actions to reduce the environmental impact of offshore structures, including those related to impulse noise from OWF construction, monitoring of underwater noise, options for its reduction, design of marine mammal deterrent devices, etc.

The 2013 Ministerial Meeting in Copenhagen adopted **Recommendation 34E/1** on the protection of important bird habitats and migration routes in the Baltic Sea from the negative effects of offshore wind and wave energy production. This document emphasises the positive aspect of wind energy development in the context of climate change, recommending specific steps that can help reduce the negative environmental impact of the investment. It should be emphasised that the planned investment will be implemented in accordance with HELCOM Recommendation 34E/1. The provisions of this recommendation relate mainly to the actions of states that are parties of the Helsinki Convention and as such do not apply to the planned investment, but the Applicant assumes that the investment will

be carried out in such a way as to avoid or minimise the impact of the investment on the environment, including in particular important bird habitats and their migration routes.

VASAB

VASAB was founded in August 1992 at a ministerial-level conference in Karlskrona. It is an intergovernmental cooperation of the ministers of the 11 Baltic Sea region countries responsible for development and spatial planning. In its strategy document *Long-Term Perspective for the Territorial Development of the Baltic Sea Region* (2009), VASAB sets out the directions for the region's development in the 2030 perspective. One of these is to strengthen internal and external accessibility, and offshore wind energy development is indicated as a way to achieve energy independence for the region. Action 18 of the LTP explicitly indicates the need to exploit this potential in the Polish maritime areas (PMA) in the short term.

The planned project is in line with the development directions for the Baltic Sea region suggested by VASAB.

On 13 December 2022, the VASAB Committee on Spatial Planning and Development of the Baltic Sea Region approved the new strategy document *VASAB Vision for the Territorial Development of the Baltic Sea Region in 2040*. VASAB Vision 2040 sets out a long-term territorial perspective for the Baltic Sea Region, covering the land and sea spatial elements of the region, respecting its diversity and specificity and taking into account sustainability, integration and cooperation. The document sets out future actions to be implemented together with stakeholders to address challenges at different levels, sectors and borders.

One of the actions is to pursue the development of secure and decentralised energy systems and to develop climate-resilient energy systems throughout the Baltic Sea region: assessing the robustness of energy systems and their possible climate impacts, developing new and safer energy systems for the future, and investing in renewable energy sources. The planned project is in line with the actions proposed in the VASAB Vision 2040 strategy document.

AFS Convention

Poland is also a signatory to the International Convention on the Control of Harmful Antifouling Systems on Ships, signed in London on 5 October 2001 (Journal of Laws 2008 No. 134, item 851), referred to as the 'AFS Convention'. The AFS Convention is a framework convention allowing the prohibition of harmful antifouling systems used on ships in accordance with clearly defined procedures, taking due account of the precautionary principle expressed in the Rio Declaration on Environment and Development. The AFS Convention, at this stage, prohibits the use of organotin compounds on ships.

EU Strategy for the Baltic Sea Region (EUSBSR)

The European Union Strategy for the Baltic Sea Region (EUSBSR) is the first macro-regional strategy in Europe. The strategy was endorsed by the European Council in 2009 following a communication and an action plan from the European Commission. In the field of energy, it identifies, i.a., the following sub-objectives:

- clear water in the sea;
- reliable energy markets;
- improving the global competitiveness of the Baltic Sea Region;
- adapting to change, risk prevention and management.

The work of the EUSBSR is thematically divided into Policy Areas (PA), each of which develops between two and four activities. For offshore wind energy, the most relevant is PA Energy. Amongst others, Action 4: *Increasing the share of renewable energy including marine renewable energy* has been identified under PA Energy, under the framework of which it is planned to have work on integrating renewable electricity into the electricity system continue, as well as to explore opportunities for

cooperation in specific areas such as, for example, the development of offshore wind potential in the region, as well as the investment in and management of the electricity grid.

The planned project is consistent with the provisions of the EUSBSR.

European Green Deal

The European Commission's Communication of 11 December 2019 on the European Green Deal (COM(2019) 640 final) is the European Union's wide-ranging action plan to achieve zero net greenhouse gas emissions by 2050.

The plan identifies the necessary investments and actions for sectors of the European economy, including:

- investing in environmentally friendly technologies,
- supporting industry in innovation,
- introducing cleaner, cheaper and healthier forms of private and public transport,
- decarbonisation of the energy sector,
- ensuring buildings are more energy efficient,
- working with international partners to improve global environmental standards.

One of the actions planned under the European Green Deal is to reduce the EU's dependence on external energy sources. The European Commission has identified wind energy as the dominant power generation technology by 2050, envisaging the installation of up to 450 GW of offshore wind energy. Installations in the Baltic Sea region could reach 85 GW by 2050. The planned project fits directly into the provisions of the European Green Deal.

8th Environment Action Programme

This is another EU document (adopted by the Council of the European Union on 29 March 2022) that indicates the EU's environmental policy objectives until 2030, taking into account the European Green Deal. The document aims to accelerate the green transition in a fair and diverse way. Its long-term goal – 'A good quality of life within the limitations of our planet' – was already determined in the 7th Environment Action Programme.

The eighth update of the Programme identifies six priority thematic objectives: reducing greenhouse gas emissions, adapting to climate change, a growth model that delivers more benefits to the planet than losses, zero emissions, protecting and restoring biodiversity, and reducing the greatest environmental and climate pressures from production and consumption. It pays particular attention to ensuring that the conditions of the EU's climate and environmental policies are effectively implemented.

The planned project is in line with the environmental objectives of the Programme.

2.2. NATIONAL DOCUMENTS

The planned investment directly pursues the objectives described in the national documents cited below. These objectives relate in various ways to, i.a., avoiding emissions of harmful gases, increasing the share of energy from renewable energy sources (RES) in energy production, and increasing the level of energy security.

Maritime Policy of the Republic of Poland until 2020 (with the 2030 perspective)

The policy adopted by the Council of Ministers on 17 March 2015 specifies that the real potential for offshore wind energy development in Poland, which can bring the greatest benefits to the Polish energy balance and the Polish economy, is 6 GW of installed OWF capacity by 2030, with 1 GW in 2020, and subsequent 2 GW by 2025. According to the report 'Potential of offshore wind energy in Poland' (2022), commissioned by the Polish Wind Energy Association, the potential of this sector is much higher and may ultimately reach 33 GW, with an expected average annual energy production of

130 TWh. The creation of conditions for the construction of offshore wind farms was identified as a measure to improve energy security.

The planned project is in line with the directions of Poland's maritime policy.

Energy Policy of Poland until 2040 (PEnP 2040)

The Polish Energy Policy until 2040, approved by the Council of Ministers on 2 February 2021, indicates that the implementation of offshore wind energy, together with the implementation of nuclear energy and increasing the role of distributed and civic energy, will be the primary way to decarbonise the energy sector. According to the provisions of the Policy, offshore wind farms will play a special role in achieving at least a 23% share of RES in the gross final energy consumption in 2030.

The objective of the state energy policy is to create conditions in which energy security will be ensured while keeping economy competitive, securing energy efficiency, and reducing the environmental impact of the energy sector. The specific objectives, on the other hand, cover the entire energy supply chain – from energy generation to sales. Poland's energy transformation will be based on three pillars, including Pillar II: Zero-emission energy system, which includes investment in offshore wind energy as an element.

The proposed investment is consistent with the goals and objectives of Poland's Energy Policy until 2040.

The current international situation affects many aspects related to energy policy and makes it necessary to take immediate and decisive steps, but also to review long-term policy assumptions. Therefore, on 29 March 2022, the Council of Ministers adopted assumptions for the update of the Energy Policy of Poland until 2040 – *Strengthening energy security and independence*, submitted by the Minister of Climate and Environment.¹

The assumptions take into account the developments regarding further diversification of supply and ensuring the development of renewable energy sources. The goal is for around half of electricity generation to come from renewable sources by 2040. Boosting the development of RES in all sectors will respond to the challenges of independence and sovereignty. At the same time, it will take into account the improved quality of life resulting from a better environment. The planned project is included in the assumptions of the PEnP 2040 update.

Strategic environmental impact assessment of the draft Energy Policy of Poland until 2040

In the Forecast, the authors highlight, i.a., the development of offshore wind farms promoted in PEnP 2040, and define the potential for disturbance to the marine environment through:

- periodic increases in suspended solids, nutrients and organic matter,
- an increase in turbidity and a decrease in water transparency,
- the deterioration of aerobic conditions in the area of the works.

The document indicates that the greatest impact of offshore wind farms will be associated primarily with their construction, when the marine environment will be disturbed. During exploitation, it will primarily concern the exclusion of exploited marine areas from use (shipping, fishing, water sports). In the case of offshore wind farms, transformation of the seabed surface will occur.

National Environmental Policy 2030 (PEP 2030)

The National Environmental Policy 2030 (hereinafter: PEP 2030, M.P.2019.794) is the most important strategic document in the area of environment and water management. The main objective of the document is set out in the Strategy for Responsible Development: developing the potential of the environment for the benefit of citizens and businesses. Specific objectives were formulated on the basis of trends observed in the area of the environment and cover issues such as: improving environmental

¹ <https://www.gov.pl/web/klimat/zalozenia-do-aktualizacji-polityki-energetycznej-polski-do-2040-r>

quality and environmental security, sustainable management of environmental resources, climate change mitigation and adaptation, and disaster risk management.

The indicators for the implementation of the objectives of the National Environmental Policy concern the quality of environmental components, such as, i.e., the status of water bodies, forest cover, the dynamics of greenhouse gas emissions, etc.

The document assumes that the development of photovoltaics and offshore wind farms will play a key role in achieving the set target in the electricity sector.

Strategic Environmental Impact Assessment of the National Environmental Policy 2030

The topic of offshore wind farms is the subject of the analyses and strategic plans of action set out in the Strategic Environmental Assessment of the PEP 2030. Their implementation will result in the need to monitor the exceedance of the applicable noise exposure limit at a distance from the noise source, both during the construction and operation of these installations.

National Sea Water Protection Programme (NSWPP)

The NSWPP was adopted by the Regulation of the Council of Ministers of 11 December 2017 on the adoption of the National Sea Water Protection Programme (Journal of Laws of 2017, item 2469), while the update of the environmental objectives for marine waters was adopted by the Regulation of the Council of Ministers of 25 February 2021 (Journal of Laws of 2021, item 569). The documents were developed as part of the implementation of the provisions of the Marine Strategy Framework Directive (MSFD). The action programmes contained in the NSWPP aim to restore and maintain the good ecological status of the Baltic Sea. The programme sets out a path towards achieving the environmental objectives set out in the *Set of Environmental Objectives for Marine Waters*. The document contains a number of actions that aim to achieve a good ecological status of the Baltic Sea, primarily targeting fisheries and nature conservation.

The planned project is located in the sub-area 27 Open Waters of the Eastern Baltic Proper (Fig. 2.1), also referred to as the Eastern Gotland Basin according to HELCOM, and also referred to as such in the Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters published by the Chief Inspectorate of Environmental Protection (CIEP) in 2024.

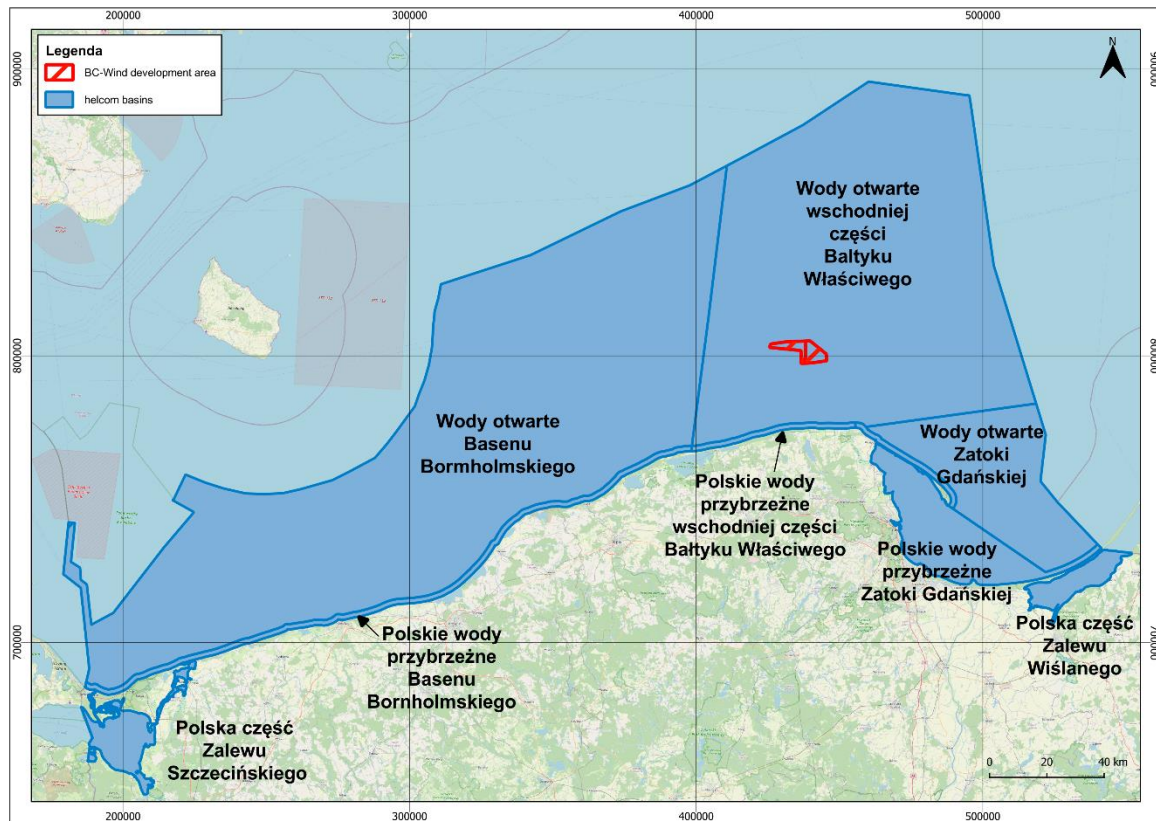


Fig. 2.1 Location of the marine part of the planned project against the background of the NSWPP sub-areas (MSFD planning areas)

Source: own compilation based on the National Sea Water Protection Programme, 2017 (Journal of Laws of 2017, item 2469)

An update of the sea water protection programme (pol. aPOWM) is currently being proceeded. In accordance with the Water Law, the Minister responsible for water management has agreed on the final draft of the update with, i.a., the Minister of Agriculture and the Minister of Environment. The document received the required approval of the members of the Council of Ministers. The next formal step was to submit the results of the completed project to the European Commission in the form of a special report. The European Commission has six months to issue its opinion on the submitted report. After this period – in the absence of a negative opinion – the document will be adopted in the country in the form of a regulation of the Council of Ministers. In June 2023, a draft regulation appeared on the list of legislative and programme work of the Council of Ministers to update the Programme for the Protection of Sea Waters in Poland. The regulation was to be adopted by the Council of Ministers in the third quarter of 2023.²

Strategy for Responsible Growth until 2020 (with the 2030 perspective)

This strategy responds to the provisions of the EU's Europe 2020 Strategy, which states that the modernisation of generation sources and innovative solutions in the economic sector, together with the development of dispatchable capacity from renewable sources, will contribute to the reduction of greenhouse gas emissions. The Strategy states that RES sources are mostly uncontrollable sources. Continuous subsidisation of RES causes serious distortions in the functioning of energy markets, driving up energy prices. Therefore, the Strategy identifies i.a. the following as necessary:

- ensuring that RES sources can balance and interact with other sources (not constrained by natural forces);
- an evolutionary process of change.

² <https://www.gov.pl/web/premier/projekt-rozporzadzenia-rady-ministrow-w-sprawie-programu-ochrony-wod-morskich>

Development Plan for Meeting Current and Future Electricity Demand for 2018-2027

Prepared by Polskie Sieci Elektroenergetyczne S.A. (PSE). In the section on potential directions of transmission grid development ensuring the reliability of the power system, analytical work on the construction of offshore transmission grids was indicated. Among the envisaged system effects of the development of the extra-high voltage grid is the preparation of the capacity to connect and evacuate the installed capacity of wind farms at a level allowing to meet the share of RES in the country's energy balance. The document also presents various scenarios for the connection of OWFs.

National Programme for the Development of a Low-Carbon Economy

The document identifies the need for a greater diversification of the energy mix, and names mainly the coastal region as a location for wind farms. It also determines that the modernisation and expansion of the national electricity system is required to meet the requirements of the RES market. It is estimated in the document that the maximum productivity of OWFs on the PMA is 12 GW of installed capacity and 48-56 TWh of energy per year. Realistic investment plans until 2030 are 6 GW. The document states that for the development of offshore wind energy in Poland, it is necessary, i.e., to:

- conduct analyses on the legitimacy of offshore wind farm development in Poland;
- develop offshore electricity grids.

National Energy and Climate Plan for 2021-2030 (NECP)

The NECP was adopted by the European Affairs Committee at its meeting on 18 December 2019. It sets climate and energy targets for 2030 consisting of, i.e., reducing greenhouse gases, increasing the share of RES in energy consumption, and increasing efficiency and reducing coal in electricity generation. The plan presents assumptions and targets, as well as policies and actions to implement the 5 dimensions of the energy union, i.e.:

- energy security,
- an internal energy market,
- energy efficiency,
- decarbonisation,
- research, innovation and competitiveness.

Its assumptions and targets indicate, i.e., an anticipated increase in the share of renewable energy sources in gross final energy consumption to around 32% in the electricity sector. The planned project is in line with the main objectives of energy policy: energy security, energy efficiency and decarbonisation.

2.3. REGIONAL DOCUMENTS

Pomorskie Voivodeship Development Strategy 2030

Adopted by the Sejmik of Pomorskie Voivodeship with Resolution No. 107/221/21 of 12 April 2021, it is a basic strategic document setting out the directions for the development of the Pomorskie Voivodeship. The strategy sets three strategic objectives: Sustainable Security, Open Regional Community and Resilient Economy. These are specified by 12 operational objectives. The planned project contributes to Operational Objective 1.2 'Energy Security' by using the potential of the sea basins for the development of renewable energy. The Pomeranian Voivodeship is presented as being highly dependent on external electricity supplies. The development of this sector may result in the creation of numerous jobs, which is referred to, i.e., in the operational objective 1.2 'Energy Security' mentioned above (in the context of constructing new elements of the energy system), as well as objective 3.1 'Competitive Position' (in terms of using the shipyard potential).

The Regional Strategic Programme for Energy and the Environment (2018) is one of the essential tools for the implementation of the Pomeranian Voivodeship Development Strategy 2030. The

programme considers the development of low-carbon energy sources as one of its priorities, including the creation of conditions for the development of offshore wind energy.

2.4. PLANNING DOCUMENTS

Pomeranian Voivodeship Spatial Development Plan 2030

It was adopted with Resolution No. 318/XXX/16 of the Pomeranian Regional Assembly of 29 December 2016. In terms of spatial policy, it focuses, i.a., on increasing electricity production and transforming the region into a national leader in renewable energy production. Among the spatial policy measures and projects in the Pomeranian Voivodeship Spatial Development Plan (PVSDP), the following are listed: ‘...construction of transmission and distribution networks and substations for the purpose of power derivation from new system and renewable energy sources (wind farms, including offshore...) (...) extension of the 400/110 kV Żarnowiec substation for the possibility of connection of offshore wind farms to the National Power System (NPS)...’. The Pomeranian Voivodeship Spatial Development Plan 2030 outlines a vision for a spatial transformation of the region. One of the elements of the vision is the thesis that as a result of the installation of large nuclear, coal and OWE sources in the area of the voivodeship, and thanks to the development of distributed energy, the security of energy supply in Northern Poland will be improved and the voivodeship will become energy self-sufficient. It is also indicated that the ports of Łeba, Ustka and Władysławowo should have shipyard areas open for activities related to the development of marine areas (e.g. a logistics and service and maintenance centre for OWFs).

Spatial development plan for Polish maritime areas with a scale of 1:200000 (MSPPSA)

The Maritime Spatial Plan of Polish Sea Areas (MSPPSA) was adopted by the Regulation of the Council of Ministers of 14 April 2021 on the adoption of a spatial development plan of internal sea waters, territorial sea and the exclusive economic zone, with a scale of 1:200000 (Journal of Laws of 2021, item 935, as amended). The planned project is consistent with the findings of the MSPPSA. It is located entirely within the **POM.46.E** basin, for which the primary function is renewable energy generation.

As set out in the Plan:

- the erection of artificial islands and structures for the generation of wind energy is only possible in dedicated areas with the primary function of generation of renewable energy – §6, *paragraph 6, subparagraph 1 of the General Conditions*³;
- ‘Renewable energy generation’ means the generation, processing, transmission and storage of renewable energy in Polish maritime areas, in particular from wind, wave, sea currents, the sun and marine organisms (biogas), including the erection of structures necessary for the generation and transmission of energy with associated infrastructure and structures for the purpose of processing and storage of energy – §1, *paragraph 3, point 10 of the General Conditions*.

There are no sub-areas in the **POM.46.E** basin. The planned project is consistent with the provisions of the MSPPSA. The table below (Tab. 2.1) shows the characteristics of the basin in which the planned project will be located.

³ Annex 1 to the Regulation of the Council of Ministers of 14 April 2021

Tab. 2.1 Characteristics of the area of the MSPPSA in which the BC-Wind OWF will be located

		Primary function	Permissible functions	Provisions on the location of the OWF in the basin	Public purpose investments
Acreage			1) aquaculture; 2) scientific research; 3) cultural heritage; 4) technical infrastructure; 5) exploration and identification of mineral deposits and extraction of minerals from deposits; 6) fishing; 7) artificial islands and structures; 8) transport; 9) tourism, sport and recreation.	for artificial islands and structures: (a) the erection of artificial islands, installations and devices used for the purpose of extracting hydrocarbons shall be prohibited in the entire basin, (b) the following activities shall be limited in the entire basin: - the erection of artificial islands, installations and devices in such a way as to jeopardise the effectiveness of spawning and rearing of juvenile commercial fish and taking into account the need to safeguard the functioning of fish spawning grounds, - the erection of structures for the purpose of aquaculture to locations that do not interfere with linear elements of technical infrastructure; renewable energy generation: (a) an area designated for the extraction of energy from wind by means of offshore wind turbines. Internal and external technical infrastructure are integral elements of the project, (b) at the commencement of a project involving the erection of artificial islands and structures, it is required to have received a decision made by a territorially appropriate director of the maritime office that prohibits fishing and navigation in the area affected by the construction, as well as a safety zone of 500 metres around the area, valid for the duration of the construction, (c) during the exploitation phase of offshore wind turbines, restrictions on fishing and navigation shall be required, introduced by a decision made by a territorially appropriate director of the maritime office in the safety zones established for each structure and in places that threaten the safety of the internal technical infrastructure; other: - once the linear elements of the technical infrastructure have been laid, the establishment of the a safety zone around them by a territorially appropriate director of the maritime office, where anchoring will be prohibited with the exception of emergency anchoring, and associated with installation and maintenance work, will be required.	Implementation of investments in the area of transmission infrastructure for electricity produced in offshore wind turbines;
	46.E	E - Procurement of renewable energy			

Source: own elaboration based on the detailed findings of the MSPPSA

The location of the BC-Wind OWF against the conditions of the MSPPSA is shown by Fig. 2.2.:

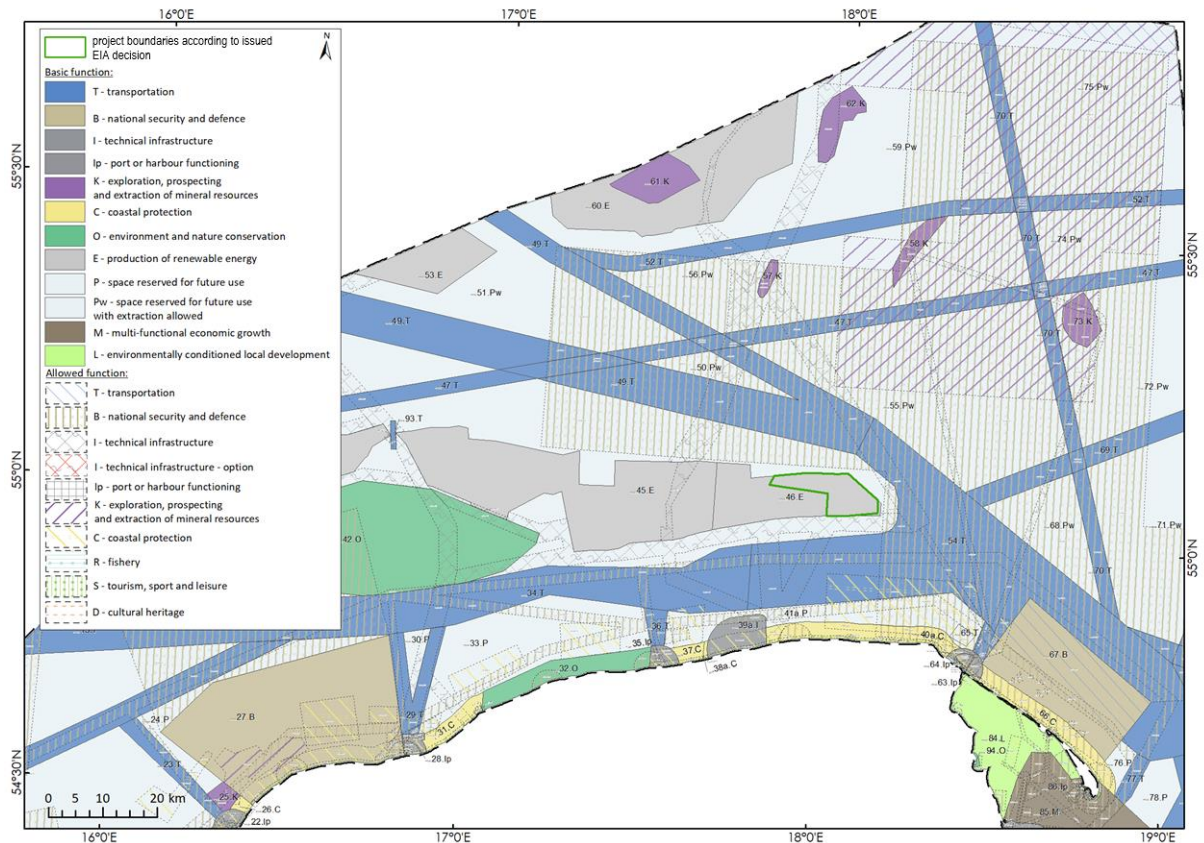


Fig. 2.2. Location of the BC-Wind OWF against the conditions of the MSPPSA

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 65

On the basis of the completed planning analysis, it was concluded that the BC-Wind OWF to be implemented in the BC-Wind Development Area complies with the current spatial development plan for the Polish maritime areas at all stages of the project's lifecycle.

Conditions arising from the findings of the MSPPSA in the vicinity of the BC-Wind OWF:

The immediate vicinity of the study area is designated:

- On the southern, eastern and northern side, the BC-Wind OWF is bordered by the POM.16.Pw Reserve for future development with extraction permitted. Within this basin, the infrastructural sub-area of 16.201.I was designated, which is intended, i.e., for the purpose of the laying and maintenance of linear elements of technical infrastructure – the external connection infrastructure of offshore wind farms. However, in accordance with the General Conditions, connection infrastructure may be routed outside these sub-areas in situations where routing in the designated sub-areas is not possible for environmental, technological, economic or national security reasons.
- On the western side, the BC-Wind OWF borders the rest of the POM.46.E Renewable energy extraction area, i.e. the offshore wind farm planned in the second phase.

The nearest water body with the 'transport' function – POM.54.T – is located to the south and east of the study area. These have been delineated taking into account the previously indicated requirement to maintain a 2 Mm buffer zone between structures and areas with the 'transport' function. To the north is the designated basin of POM.40.T, which is a continuation of 54.T – for this basin, the distance is greater than the required distance.

In the immediate vicinity, no areas with the primary function of 'defence and national security' were designated; however, the sub-area of 16.923.B was designated for the Polish Navy training grounds (P-15, P-16, P-18, P-19). In accordance with the conditions of the MSPPSA, a change to their

existing state of development requires an opinion of the Minister of National Defence, while during the period of activities carried out by the Polish Armed Forces, other functions may be prevented in those sub-areas.

The closest sub-area designated for the Royal Navy fairway is the 56.926.B, located to the south of the area.

The 16.201.I sub-area is brought to the 46.E.1 area in the draft plan, intended for the laying and maintenance of linear elements of technical infrastructure – external connection infrastructure for offshore wind farms.

2.5. SUMMARY OF FINDINGS OF STRATEGIC AND PLANNING DOCUMENTS AND COMPLIANCE WITH THE ENVIRONMENTAL OBJECTIVES SET BY THESE DOCUMENTS

The planned project complies with the expectations of a number of policies and strategies, particularly those concerning environmental protection (reduction of pollutant emissions), sustainable development (use of renewable energy sources) and energy security (independence from external energy sources). **The planned investment fits in with the objectives of the analysed strategic documents in force and complies with the conditions of the MSPPSA.**

The environmental objectives for marine areas are primarily defined in documents developed as part of the implementation of the provisions of the Marine Strategy Framework Directive: the compliance of the planned project with the environmental objectives established in these documents is addressed in the chapter on the impact of the planned project on marine waters, *Subchapter 9.3.4 Impact on the state of the marine environment of the construction and exploitation phases according to the MSFD*. The assessment shows that the planned project does not jeopardise the possibility of achieving the set environmental objectives.

3. CHARACTERISTICS OF THE PLANNED PROJECT

3.1 INTRODUCTORY INFORMATION, LOCATION AND BASIC TECHNICAL PARAMETERS

3.1.1 Introductory information on the project

The planned project involves the construction of the BC-Wind offshore wind farm with a total installed capacity of up to 500 MW. The planned OWF will be located in the Polish exclusive economic zone (EEZ). The scope of the project includes three main phases: construction, exploitation and decommissioning. The entire investment will consist of the following elements:

- 39 wind turbines each consisting of a nacelle with rotors, a tower and foundations or support structures placed on the seabed (with a maximum of 34 planned to be constructed, with the other 5 remaining backup locations);
- 1 offshore substation⁴;
- internal power and telecommunications lines of approx. 100 km.

A total of 46 locations on the seabed were surveyed during a detailed geotechnical investigation, of which a maximum of 39 will be selected. Current market trends indicate the selection of more powerful turbines, i.e. with an approx. capacity of 15 MW, and therefore the target number of turbines will be smaller, with a maximum of 34. However, due to the precautionary principle, the adopted impact analysis is for 39 turbines, including the so-called backup locations. The analysis was based on an array of 39 turbines selected from the 46 sites surveyed. The analysed layout of 39 turbines is representative of different seabed types, and for the purpose of analysis of key marine environmental issues such as underwater noise, locations representing worst case conditions were selected so that scenarios worse than those that will actually occur are covered by the analysis. The layout of the selected 39 turbines analysed in this Report may be slightly modified, however this will not result in an impact increase.

This chapter describes the characteristics of the project based on the most up-to-date parameters that result from the preliminary stage of design work, using the sub-studies carried out for the purposes of the project documentation as the main source of data. The main sources of data on the project are listed in Chapter 1.3.3.

This enables a change from the envelope approach on which the 2021 EIA Report was based, to specific design solutions. The EIA Report carried out for the purposes of the environmental decision procedure, during which the environmental decision was issued, was based on the concept of an envelope description of the project. This was due to the lack of a specific choice of technology.

The changes in the description of the project are mainly related to the specification of the Applicant Proposed Variant (APV), resulting from the progress of the design works, including the preliminary development of the farm development plan – the location of up to 39 wind turbines and the offshore substation, as well as the approximate routes of the cable routes, have been determined. In the case of the OSS, a backup location has also been identified, which is included in this EIA Report. The spare OSS location is planned to be used only in case of technical (design or implementation) problems. A possible relocation of the substation will not cause additional negative impacts. In addition, the use of a structure mounted on the outside of the monopile to carry the cables from the seabed to the substation (a J-tube cage) is being considered. The total diameter of the monopile including the additional structure would be up to approx. 24 m.

The location of the analysed set of 39 wind turbines within the BC-Wind OWF, along with the location of the cable routes, is shown in the figure below (Fig. 3.1).

⁴ two locations have been included in this update of the Report: a primary location and a backup location, which will be used in the event of technical (design or implementation) problems

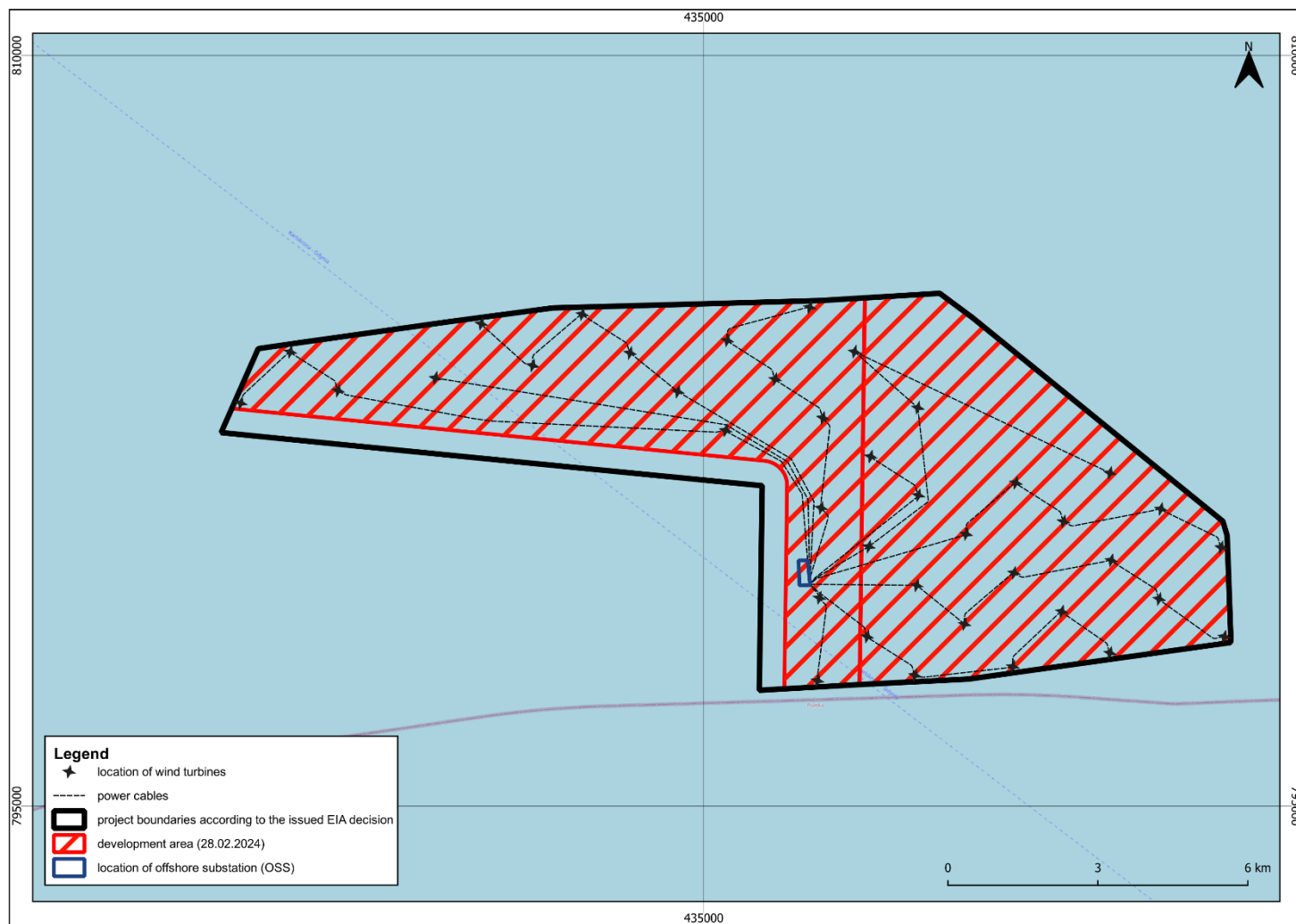


Fig. 3.1 Preliminary proposal of locations of a set of 39 offshore wind turbines and offshore substation within the BC-Wind OWF

Source: own elaboration

Based on geological data, three possible methods of cable-laying were identified, i.e. ploughing, mechanical cutting and jetting, with the choice depending on the type of sediment present along the route. It is also acceptable to lay cables directly on the bottom and then cover them with aggregate or concrete mattresses, or use another kind of mechanical protection.

Analyses carried out by the investor made it possible to select a foundation method. It is planned to use monopile foundations, both for all wind turbines, and the offshore substation. In case the installation of this type of foundations is technically impossible, which can only concern a few planned wind turbines and the substation, the Investor also permits the use of jacket type (truss) foundations. A possible change to this type is not relevant to the impact analysis as the foundation type used for the analysis is the one with the greater environmental impact, i.e. bored/driven large diameter piles.

The presented changes are the subject of both the project description and the basis for the environmental impact assessment.

The specification of the parameters did not cause a change in the type of project technology used and did not affect the implementation of the project as a whole.

The subject of the application for the amendment of the decision on environmental conditions of 16 September 2022, ref: RDOŚ-Gd-WOO.420.50.2021.KSZ.AM.10., issued by the Regional Director for Environmental Protection in Gdańsk for the project entitled BC-Wind Offshore Wind Farm, is the planned change in the parameters of the project.

Below is a table of the proposed parameter changes to the DEC.

Tab. 3.1. Summary of the basic parameters of the BC-Wind OWF contained in the DEC, and the requested changes

Name of the facility or definition of the parameter	Unit	Value/data in the DEC	Current parameters of the project
Total installed power (maximum)	MW	500	500
Number of wind turbines (maximum)	pcs	41	39*
Construction height with rotor (maximum)	m	330	300
Rotor diameter (maximum)	m	280	250
Clearance between rotor working area and water surface (minimum)	m	20	20
Number of offshore substations (maximum)	pcs	2	1
Number of other building structures (maximum) – non-productive infrastructure	pcs	4	4
Foundation diameter – gravity (maximum)	m	60	will not be used
Foundation diameter – monopile	m	12	approx. 11.5**
Bottom area occupied by a single gravity foundation (maximum)	m ²	2826	will not be used
Bottom area occupied by a single monopile foundation with a protective layer	m ²	-	approx. 2600
Length of cable routes inside the OWF (maximum)	km	188	approx. 100
Method of foundation of wind turbines	-	gravity, monopile, truss, tripod	monopile, in a few cases possibly truss
Foundation method for the OSS	-	-	monopile, truss

* ultimately, the Investor is planning to build 34 wind turbines, however the DEC amendment also includes 5 backup locations

** the total diameter of the monopile including an added cable installation (a J-tube cage) is approx. 24 m

Source: Investor data

In summary, the amendment to the DEC includes a narrowing of the envelope approach, i.e.:

- a reduction in the number of planned wind turbines from 41 to 39 units (with a maximum of 34 planned to be implemented, the remaining units being backup locations),
- a reduction in the height of the wind turbines from 330 m to 300 m,
- a reduction of the rotor diameter from the current 280 m to 250 m,
- a reduction in the number of offshore substations from 2 to 1,
- a reduction in the length of the cable routes from 188 km to approx. 100 km,

- a determination of one type of foundation – monopile (optionally truss for the OSS and, in rare cases, wind turbines).

The use of a truss instead of a monopile foundation may occur in case of difficult ground conditions and problems with sinking the monopile to the assumed depth; the use of a truss foundation is associated with driving piles with a much smaller diameter compared to the monopile technology.

Investment proceedings for OWFs take many years, often exceeding 10 years counting from the decision to start preparations for the investment to the commencement of its construction. During this time, the technologies used in the field of OWFs undergo significant changes, the main target of which is to reduce the environmental impact by increasing the efficiency of power generation from a single wind turbine, and reducing the total number of wind turbines necessary to achieve the assumed capacity of the OWF. In this case, the parameters of the investment had to be described in such a way that in the future it will be possible to take advantage of technological progress, and use solutions that are not inferior to the existing ones.

The envelope concept meant that when assessing the selected parameter and the feasibility of different technical solutions, an environmental impact assessment was made for the potentially most environmentally burdensome solution. At the current stage of the project's development, solutions have already been selected that made it possible to narrow down the considered technologies and focus on the most likely ones. On this basis, the assessment of the impact on various components of the environment was verified in the further part of the Report, including on the basis of new modelling performed on the realised parameters of the project.

3.1.2. Location of the project

The planned project will be located in the Polish EEZ, north of the municipalities of Choczewo and Krokowa, at a distance of 22.6 km from the coastline. The boundaries of the planned project remain unchanged from those for which the decision on environmental conditions was obtained (Fig. 3.1).

The project boundaries (understood as the development area) established in the DEC take into account the preservation of a 4-km-wide bird corridor between the BC-Wind OWF and the Baltic Power OWF and 2 NM from the designated seaways. However, at the current stage, the development area has been further reduced by a buffer of 500 m from the boundary with the area of the future OWF (area 46.E.1).

3.1.3. Basic parameters of the project

The planned project includes the following elements:

- a maximum of 39 wind turbines each consisting of a nacelle with rotors, a tower, and foundations or support structures placed on the seabed (with a maximum of 34 planned to be implemented, the remaining being backup locations);
- one offshore substation⁵;
- approx. 100 km of internal power and telecom lines.

The detailed range of project parameters for the variant selected for implementation (WWR 2024) is shown in the table below:

Tab. 3.2. Summary of key parameters of the project in the variant selected for implementation

Parameter	Unit	Value
Total installed power (maximum)	MW	500
Number of wind turbines (maximum)	-	39*
Rotor diameter (maximum)	m	250
Clearance between rotor working area and water surface (minimum)	m	20

⁵ two locations have been included in this update of the Report: a primary location and a backup location to be used in the event of technical problems (design or implementation)

Parameter	Unit	Value
Height of structure including rotor (maximum)	m	300
Number of substations (maximum)	-	1
Foundation diameter (monopile)	m	approx. 11.5**
Bottom area occupied by a single foundation (monopile with protective layer (maximum)	m ²	approx. 2600
Length of cable ducts for internal installation (maximum)	km	approx. 100

* ultimately, the Investor is planning to build 34 wind turbines, however the DEC amendment also includes 5 backup locations

** the total diameter of the monopile including an added cable installation (a J-tube cage) is approx. 24 m

Source: own elaboration

The electricity generated by the wind turbines is transmitted to an offshore substation via internal cables laid on the bottom. At the offshore substation, the electricity is converted to a higher voltage, resulting in less energy loss during transport. The energy is then transmitted onshore via so-called export cables with a capacity of 220 or 275 kV, which connect the offshore substation to the onshore substation (export cables are not assessed in this Report). From the onshore substations, electricity is connected to the national grid.

3.1.4. Water body occupancy during the construction and exploitation phases of the project

The area covered by the decision on environmental conditions is the area within which all the offshore facilities of the BC-Wind OWF will be placed (fig. 3.1). The development area of the BC-Wind OWF as covered by the obtained DEC is 86.28 km², while the development area of the BC-Wind OWF at the current design stage is 78.71 km², which is a difference of 7.57 km². This is a result of the 500 m offset of the BC-Wind OWF Development Area from the boundary of the wind farm (46.E.1), which is to be implemented in phase II.

The geodetic coordinates of the current development area, narrowed down from the development area indicated in the DEC, are provided below:

Tab. 3.3. Geodetic coordinates of the development area (in the WGS-84 system)

Point no.	Latitude N	Longitude E
	Λ	Φ
1	55.0949847222	17.8415836111
2	55.0960004176	17.8524786464
3	55.0961037778	17.8535891194
4	55.1004598806	17.9021068222
5	55.1031515417	17.933709
6	55.1043316861	17.9827896556
7	55.1051821944	18.0176595778
8	55.1057692806	18.0313673611
9	55.0362829611	18.0314014944
10	55.0353214942	18.007925178
11	55.0607076414	18.0079301282
12	55.072386505	18.0078561245
13	55.0726849609	18.0077651794
14	55.0729792224	18.007639394
15	55.0732679521	18.0074793393
16	55.0735498375	18.007285742
17	55.0738235974	18.0070594814
18	55.0740879874	18.0068015853
19	55.0743418057	18.0065132254
20	55.0745838985	18.006195712
21	55.0748131654	18.0058504878

22	55.0750285641	18.0054791217
23	55.0752291155	18.0050833016
24	55.0754139079	18.0046648264
25	55.0755821011	18.0042255983
26	55.0757329306	18.0037676138
27	55.0758657106	18.0032929547
28	55.0759798376	18.0028037789
29	55.0760747927	18.0023023101
30	55.0761501442	18.001790828
31	55.0762055495	18.0012716581
32	55.0762407567	18.0007471605
33	55.0790211962	17.942014141
34	55.0829483003	17.8590532077
35	55.0841584453	17.8336117518
36	55.0949847222	17.8415836111
37	55.0362830111	18.0315014944
38	55.1057735611	18.0314673417
39	55.1067760796	18.0548730341
40	55.105348542	18.0583201052
41	55.100144273	18.0703811149
42	55.0935640432	18.0848740671
43	55.0865611776	18.1002935438
44	55.0802900869	18.1140934778
45	55.0733849511	18.1292796501
46	55.0664841689	18.1444633525
47	55.0640532041	18.1458109946
48	55.0639479736	18.1458692132
49	55.0501202123	18.1470359017
50	55.0452900172	18.1474434195
51	55.0447039473	18.1473255404
52	55.0375483849	18.065451499
53	55.0362830111	18.0315014944

Source: Investor data

The development area should be understood as the area within which all elements of the project will be located, that in the case of wind turbines is delimited by the range of the rotors, and not only the area which can be used for foundation-laying for the wind turbines.

It should be noted that the area covered by the DEC is not the same as the development area – the development area is currently smaller in comparison to the DEC boundaries. Covering a larger area with the DEC application resulted from the need to ensure the possibility to optimise the location of the project's elements and adopted technical solutions at the design stage, e.g. due to the necessity to bypass identified terrain obstacles, or to take into account the requirements resulting from the obtained decisions and permits.

The utilised seabed area, per monopile and including the protective layer of a stone cover, is 2600 m², while the total area of seabed occupied for all 39 turbines is 101400 m², which constitutes 0.13 % of the development area.

The area of direct seabed intervention associated with the preparation and cleaning of the seabed and the excavation will only occupy a strip of approx. 25 m in width, and will amount to a total of approx. 2.5 km² for all cable routes, which constitutes 3.18% of the development area. The estimated

average trench width per cable will only be approx. 7.5 m. In addition, small sections of the bottom will be occupied periodically for the purpose of vessel anchoring.

3.2. DESCRIPTION OF TECHNOLOGY, CONSTRUCTION ORGANISATION AND CONDITIONS OF USE

Wind turbines are installations for converting the kinetic energy of the wind into electrical energy by powering a generator with a wind-activated rotor. The mechanical energy of the rotating rotor is converted in the generator into a low-voltage alternating current, which is usually transformed to medium-voltage and then high-voltage for further transmission.

Wind farms located offshore, due to the conditions caused by their location, are built as complexes of individual wind turbines connected by cables supplying energy to an offshore substation, from which electricity is transported by an export cable to an onshore substation (fig. 3.2).

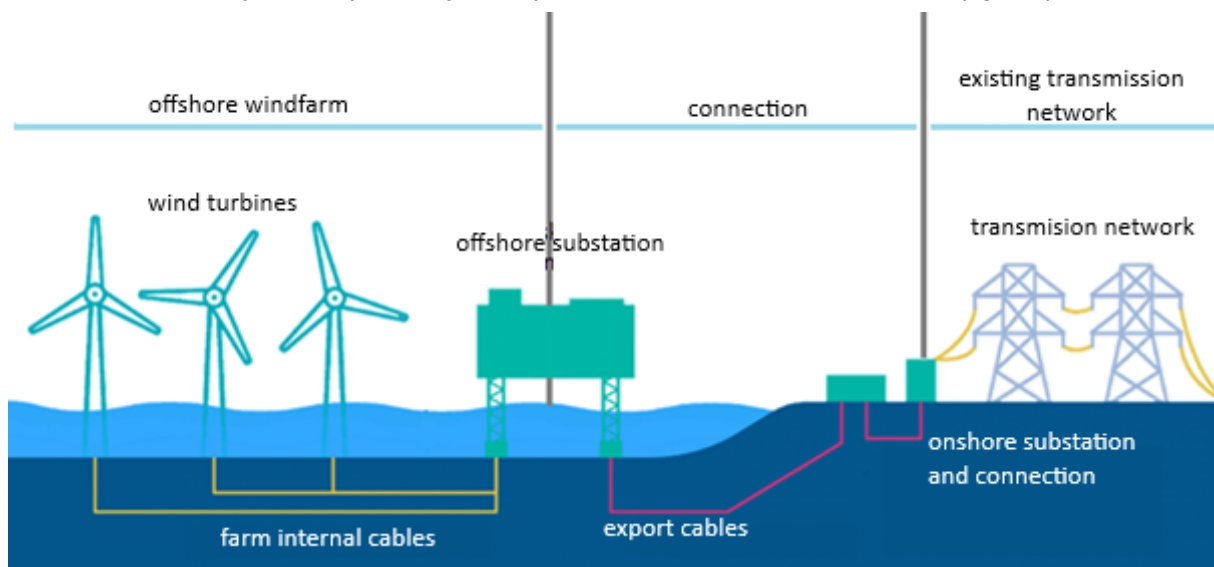


Fig. 3.2. Diagram of an offshore wind farm with transmission infrastructure

Source: EIA Report for BC-Wind, MEWO, p. 67

Wind turbines do not require the supply of other fuels and raw materials to generate electricity. Their proper operation does not cause environmental pollution. The demand for electricity in small amounts only occurs in cases of windless weather. The demand for raw materials and energy, as in the case of other energy installations, is related to the construction and installation process of the structural elements of individual wind farm components (materials used to produce fuel and other materials required during the construction phase), the operation of the service units, and decommissioning (fuels and materials).

An offshore wind farm consists of four essential components that are functionally and structurally interconnected:

- wind turbines;
- foundations or support structures;
- connection infrastructure;
- an offshore substation.

The individual components of an OWF are described below.

3.2.1. Wind turbines

The wind turbine is an essential component of a wind farm. Within it, three main structural elements can be identified that have a specific function: the tower, the nacelle, and the rotor (fig. 3.3).

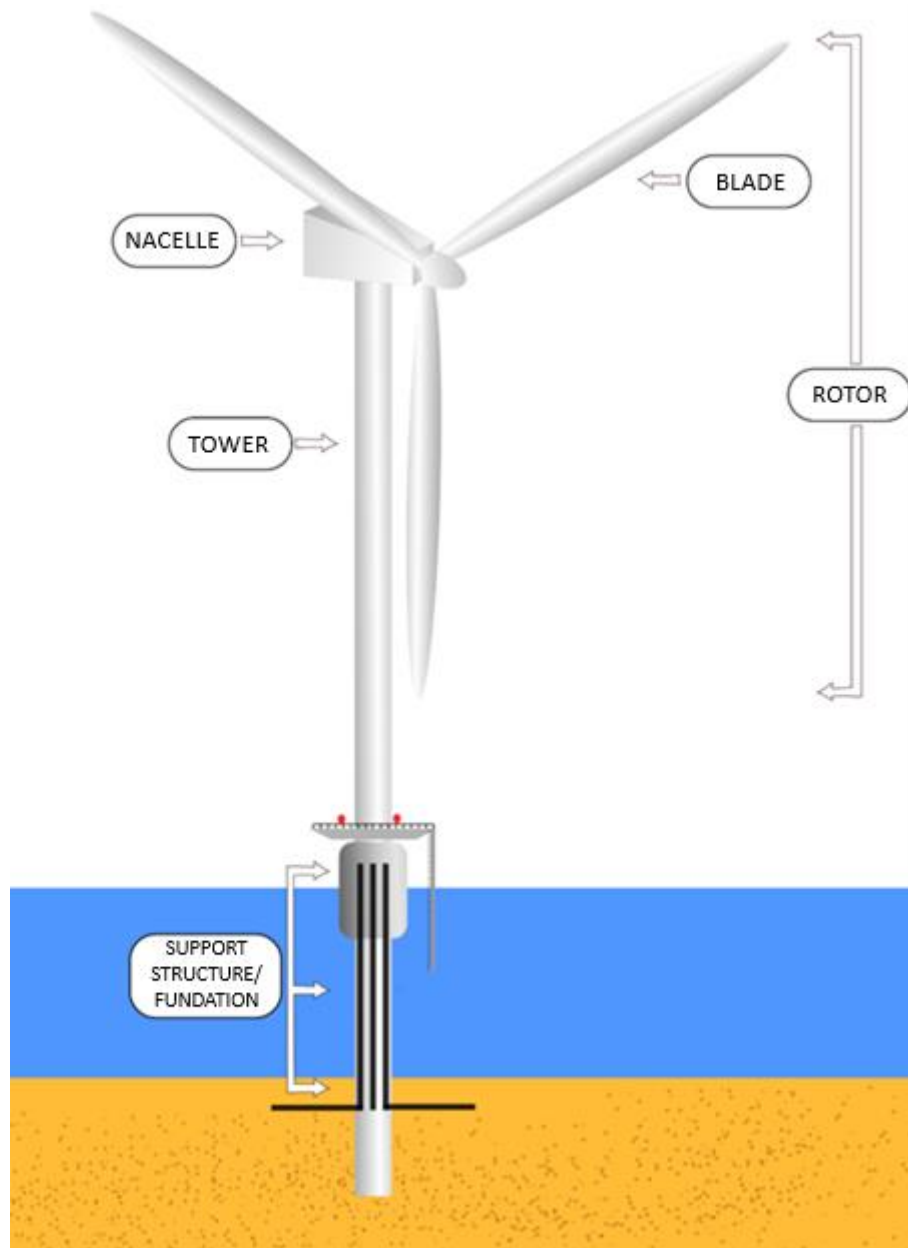


Fig. 3.3. Schematic of an offshore wind turbine, including the support structure

Source: EIA Report for BC-Wind, MEWO, p. 68

The tower is the structural element that connects the nacelle and the support structure or the foundation. Typically, it is a steel tube that tapers upwards. Its size and weight are adapted to the specific project and depend on the parameters of the other elements of the wind power plant, the type of support structure or foundation, and the environmental conditions at the site. Towers currently used in OWFs reach a height of more than 100 m and a mass of more than 100 tonnes.⁶ In addition to its primary load-bearing function, the tower provides a base for routing wind turbine control cables, power cables and other installations and equipment necessary for the proper functioning of the entire installation. In addition, the tower can be equipped with both internal and external platforms, allowing service crews to access both the nacelle and components of the tower itself.

The nacelle is a key component of a wind turbine. It consists of drivetrain elements and an enclosure that protects it from the weather (fig. 3.4). The drivetrain ensures that the rotational energy

⁶ Lantz E., Roberts O., Nunemaker J., DeMeo E., Dykes K., Scott G.

from the rotor is converted into electricity. The basic components of the system are a turbine, a rotating shaft (which may include a gearbox), and a generator. The generator generates electricity through electrical induction by placing the moving elements in a magnetic field. In the case of a gearless turbine, the rotational movement of the rotor is transmitted directly to the generator. This solution is characterised by a lower failure rate of the entire system.

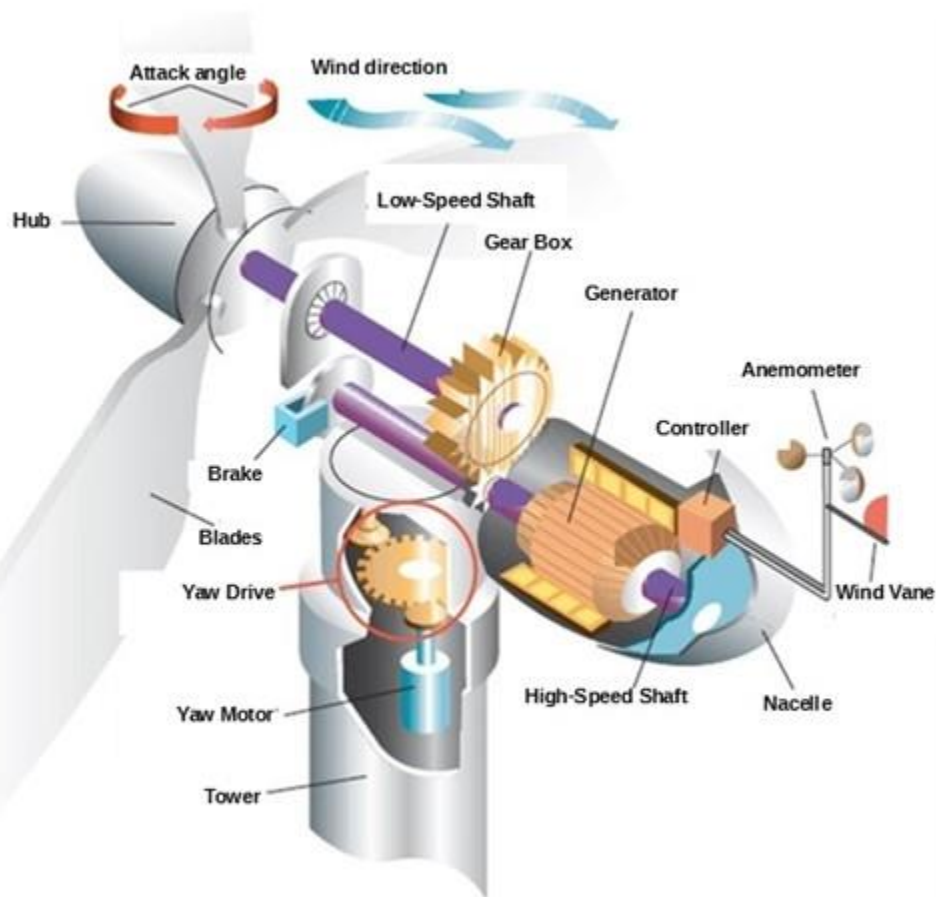


Fig. 3.4. Diagram of the nacelle with a geared drive system

Source: Source: EIA Report for BC-Wind, MEWO, p. 69

Wind turbine nacelles can also be equipped with a helipad or places enabling personnel to be picked up or dropped off. The nacelle is usually constructed ashore, transported as a whole, and mounted on the wind turbine tower.

The last essential component of the wind turbine is the **rotor**, which comprises the blades and the hub. The rotor, as a result of the wind, performs a rotational movement capturing and transferring its energy to the other components of the nacelle. The blades are made of composite materials (glass fibre, carbon fibre, epoxy or polyester resins). They are equipped with electrical discharge protection systems. The size of the rotor largely determines the power output of the wind turbine. In current rotor designs, the longest blades for SHPPs reach lengths of more than 100 m (e.g. for the Haliade-X 12 MW turbine).

3.2.2. Support structures with foundations

A non-floating wind turbine tower is mounted on a support structure or foundation that is permanently tied to the seabed. In the installation process, the substructure with its foundation is erected first, followed by the wind turbine. The essential tasks of the support structure or foundation are to provide:

- the appropriate rigidity and robustness of the wind power plant;
- support for the cable installations;
- a connection of the wind turbine to the bottom;
- an efficient installation of a wind power plant.

The selection of an appropriate type of support structure or foundation depends, on the one hand, on the size and mass of the wind power plant and, on the other hand, on the environmental conditions prevailing at the location of the OWF, including, above all: the depth of the body of water and the geological conditions of the seabed. Other environmental conditions (waves, currents, icing, biotic values) and the economic aspect are also important factors when selecting the appropriate type of support structure or foundation.

A large diameter pile was chosen as a permanently bottom-bound support structure for the facilities of the BC-Wind OWF. There is also a possibility of using a truss structure for single wind turbines and/or the OSS in exceptional circumstances. The use of a truss foundation instead of a monopile foundation may occur in the case of difficult ground conditions and problems with sinking the monopile to the assumed depth; the use of a truss foundation is associated with a lower foundation depth (Fig. 3.5).



Fig. 3.5. Selected types of support structures with foundations that are permanently bottom-bound: A – truss, B – monopile

Source: Leite O.B., 2015, *Review of design procedures for monopile offshore wind structures*, Mestado Integrado Em Engenharia Civil 2014/2015, Departamento de Engenharia Civil, Porto – revised

The monopile foundation (a large diameter pile) is the preferred solution at the current stage of the BC-Wind OWF investment process and is also the most commonly used support structure for OWFs. It is a simple steel structure manufactured from cylinders welded together. The length of the structure can reach over 80 m. The diameters of XXL monopiles can reach up to 12.5 m in diameter, with monopiles of a diameter of approx. 11.5 m to be used on the BC-Wind OWF. Installation of these types of foundations involves driving or boring them into the bottom to a suitable depth. A transition piece is

placed on the part of the foundation or support structure reaching above sea level, on which the wind turbine tower is then installed. It is also possible to install the wind tower directly onto the foundation.

The advantages of the large-diameter pile include low bottom occupancy, simplicity of construction and installation, and versatility of application. The disadvantages of this type of foundation include the limited possibilities of removal from the seabed at the end of the OWF exploitation phase, as well as the impact of underwater noise on marine animals associated with driving the structure into the seabed.

The placement of the aforementioned foundation in the seabed necessitates the use of stone rubble, crushed rock or boulders as a cover layer to prevent scouring (fig. 3.6).

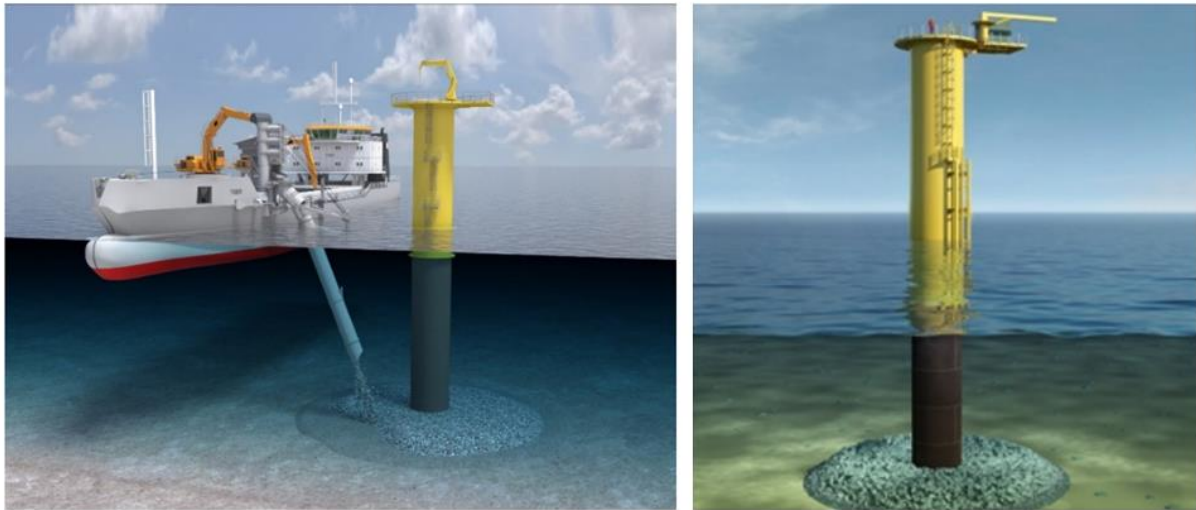


Fig. 3.6. Application of stone rubble around a monopile

Source: Leite O.B., 2015, Review of design procedures for monopile offshore wind structures, Mestado Integrado Em Engenharia Civil 2014/2015, Departamento de Engenharia Civil, Porto – revised

The width of the rubble strip depends on the chosen supporting structure and is usually several times the diameter of the monopile. In the case of the C-Wind OWF, it was assumed that the total occupation of the bottom under a single monopile with a protective layer will not exceed 2600 m².

Truss foundations consist of multiple elements welded together. The base of this structure is square or triangular in shape and is fixed by either piling the foundation legs to the bottom (with much smaller diameters than monopiles – up to approx. 3 m) or sited on suction buckets. Distances between foundation legs can reach 40 m.

The advantages of trusses over other types of support structures include their lighter weight, wider range of applications (not only in terms of water depth, but also geological conditions) and smaller need for protection against sediment scouring in their vicinity. This is well-known technology, having been widely used in the oil and gas extraction industry. In addition, foundations of this type can be used for other structures within the offshore wind farm with greater mass, such as substations (e.g. the 400 MW, 3200 t BorWin1 substation in the North Sea). The disadvantages include the complex design, requiring many components to be welded together, more difficult transport, and a more complicated foundation process on the seabed.

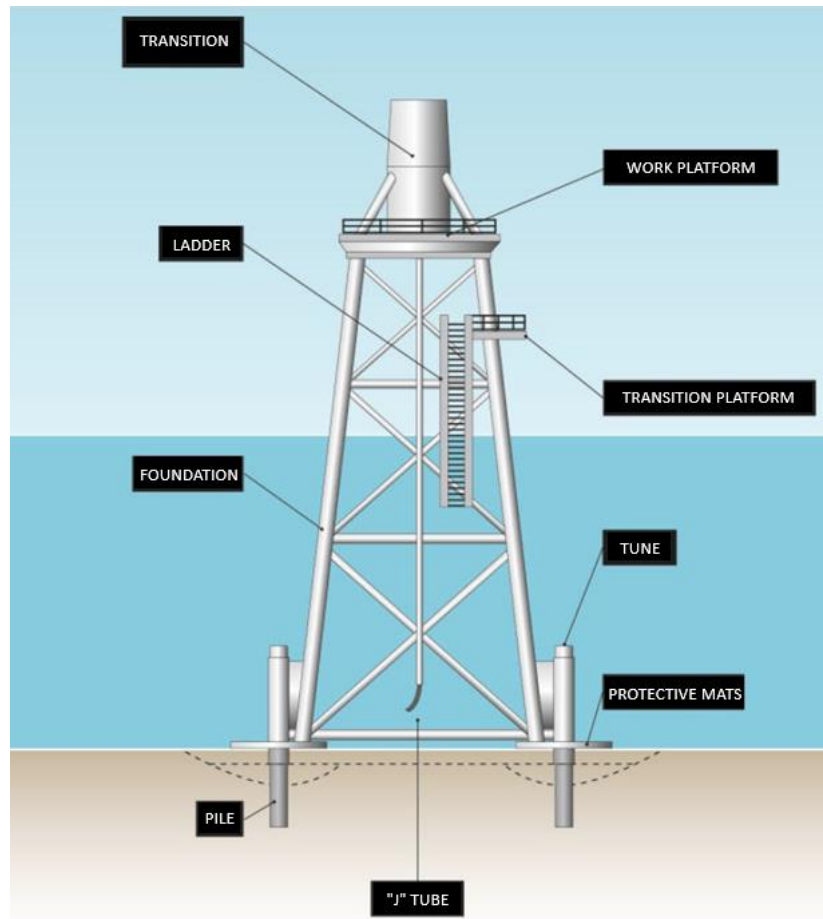


Fig. 3.7. Example of a truss foundation

Source: EIA Report for the Baltic Central II OWF, 2021

3.2.3. Connection infrastructure

The connection infrastructure of the OWF includes:

- an electricity network (internal cables);
- substations.

The internal cables of the OWF (inner-array cables or inter-array cables) connect the wind turbines to the substations located within the OWF.

The internal cables most often operate at 33/66 kV, which is the common standard for offshore wind power. The most commonly used cables are three-core cables, i.e. consisting of three insulated conductors (copper or aluminium), often also fitted with optoelectrical cables. Single-core cables are also available.

OWF internal cables are mainly extruded cables, of which three types can be distinguished, depending on the type of insulation:

- EPR – the insulator is ethylene-propylene rubber; the dielectric losses in this type of cable are greater than in polyethylene-based cables, which limits its use to an operating voltage of 150 kV, but it is flexible and resistant to external conditions, and has an operating temperature of up to 90°C (130°C in emergency conditions);
- polyethylene – the insulator is polyethylene, which is characterised by low dielectric losses, it can be used in high voltage cables; the operating temperature of cables with this insulator is limited to 80°C;
- XLPE (cross-linked polyethylene) – the insulator is polyethylene, which undergoes a cross-linking process analogous to rubber vulcanisation; the polymer chains cross-link to form a lattice structure; this type of cable can be used for voltages up to 500 kV, and is characterised by an operating temperature of up to 90°C.

An example of a three-wire cable is shown in the figure below:



1. a conductor (copper or aluminium) for the transmission of electricity
2. embossed shield coating
3. XLPE (cross-linked polyethylene) insulation – may also be EPR (ethylene propylene rubber)
4. semi-conductive screen
5. shield made of copper wire with a moisture swelling agent (prevents longitudinal movement of moisture in case of damage)
6. laminated aluminium shell
7. optoelectrical cables (optional) for data transmission
8. polypropylene refills
9. binding bands
10. propylene substrate for reinforcement
11. reinforcement of the galvanised steel wire wrapping the cable to protect it from mechanical damage
12. propylene outer sheath with bitumen compounds

Fig. 3.8. Construction of a three-wire AC cable

Source: Baltic Power Offshore Wind Farm Environmental Impact Report, 2020

Due to the development of wind power plants with increasing nominal capacity, 66 kV is increasingly being used. Wind turbine manufacturers directly indicate in the specifications of some power plants that 66 kV transformers will be used. This includes the MHI Vestas V164-10.0 wind power plant (for the MHI Vestas V164-9.5 MW, the manufacturer indicates 33 or 66 kV options) and the GE Haliade-X 12 MW wind power plant.

At this stage of the implementation of the project, the cable is assumed to be buried at an average depth of approx. 2-3 m below the seabed surface. Three technologies are being considered for the purpose of burial/submersion of the power cable, the extent of which will be determined by the geological conditions of the seabed, i.e.:

- water jetting,
- mechanical cutting,
- ploughing.

It is also acceptable to lay cables directly on the bottom and then cover them with aggregate or concrete mattresses, or use another kind of mechanical protection.

Soil scouring (water jetting) involves forcing pressurised seawater to the desired depth under the bottom surface (Fig. 3.9). Subsoil scouring occurs through a combination of high-flow/low-pressure water jets (e.g. to fluidise and move granular sediments) and low-flow/high-pressure water jets (e.g. to

cut and move clay lumps). In the resulting excavation, the cable collapses under its own weight into the fluidised sediment and is self-buried.⁷

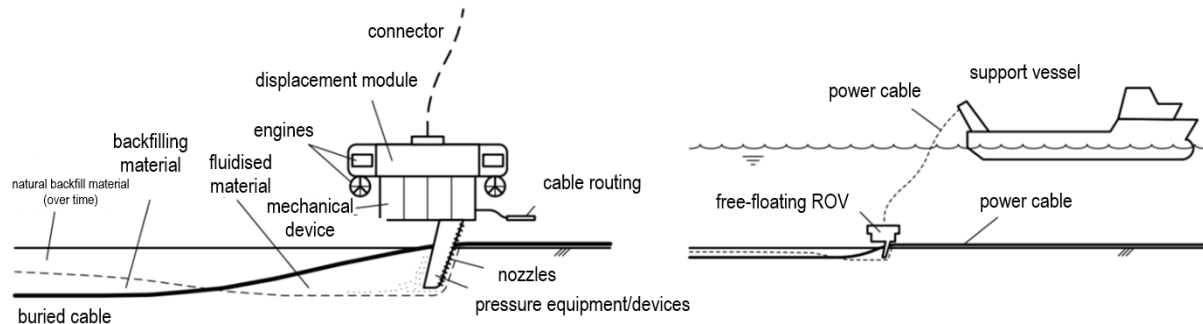


Fig. 3.9. Cable burial using the soil scouring method

Source: DNV 2014

Mechanical cutting involves the excavation of a trench using self-propelled equipment armed with cutting wheels or chains, equipped with buckets to transport the excavated material (Fig. 3.10)⁸. As the trench is excavated, a narrow slot is created in the ground, into which the cable is lowered. The mechanical cutting method may require additional trench backfilling operations, depending on the depth of cover required.

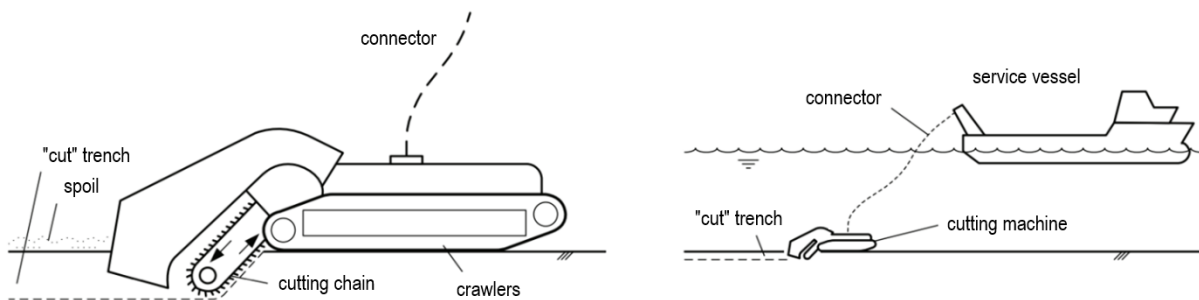


Fig. 3.10. Cable burial using the mechanical cutting method

Source: DNV 2014

Ploughing involves a vessel pulling a plough, with the plough blade cutting through the bottom to create a furrow in the marine sediment (Fig. 3.11). The plough lifts a wedge of sediment, creating a temporary trench in which it places the cable at the desired depth. The cable is then backfilled with material that falls spontaneously to the bottom with the forces of gravity after the plough has passed.⁹

⁷ DNV 2014

⁸ DNV 2014

⁹ DNV 2014 – *Subsea Power Cables in Shallow Water Renewable Energy Applications*, February 2014, Recommended Practice, DNV-RP-J301, Det Norske Veritas AS

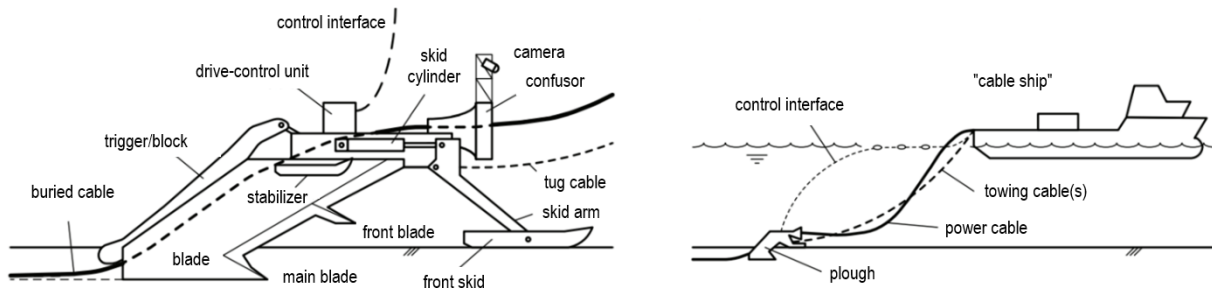


Fig. 3.11. Cable burial using the ploughing method

Source: DNV 2014

In areas where there will be limited opportunities to bury the cable using the technology described above, i.e. in fields of boulders, pebbles or gravel, or on a very hard seabed with insufficient sediment thickness where excavation may not be feasible or economical, the cables will be laid on the seabed (in the case of a hard seabed) or on the gravel bedding (in the case of boulder fields), and then protected e.g. with a stone cover, the thickness of which will be approx. 0.5 m immediately above the cable (Fig. 3.12), concrete mattresses, or another kind of mechanical protection.

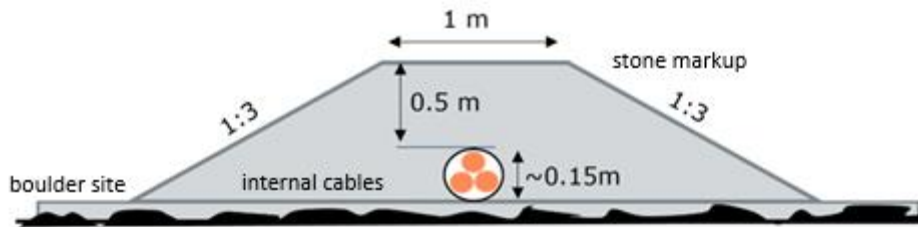


Fig. 3.12. Protection of internal cables using a stone cover

Source: Construction Permit Design for BC-Wind Project, Cable Burial Risk Assessment Report

It is estimated that between approx. 1.9 m³ and approx. 4 m³ of stone will be used per running metre of cable, with the smaller volume relating to cable protection on a very hard seabed, and the larger volume applying to protection in boulder areas.¹⁰

3.2.4. Offshore electrical substation

Electrical substations (fig. 3.13. are used to transform and transmit the energy generated by wind turbines to the land in the most efficient way. This process can include increasing voltage, providing reactive power compensation, and converting the current from alternating to direct. The following types of can be distinguished among them:

- substations;
- AC/DC and DC/AC converter stations.

The task of the **electrical substations** is to match the voltage of the current from the wind turbines (usually 33/66 kV) with the required transmission voltage (up to 400 kV), with the result being reducing losses, increasing transmission power, or enabling a reduction in the conductor cross-section in the cables.

Basic components of a substation **may** include:

- transformers – the basic element used for the conversion of current voltage;
- auxiliary transformers – used to provide power to station equipment;
- grounding transformers – used to achieve an artificial zero point in resistor-grounded networks or compensated networks;
- high- and medium-voltage switchgear – used for connecting, interrupting and distributing electrical circuits;
- standby generators – used to provide power in case of failure;
- chokes and capacitors for reactive power compensation;

¹⁰ Investor data: Construction Permit Design for the BC-Wind Project, Cable Burial Risk Assessment Report

- AC filters – elements responsible for passing or blocking signals within a specific frequency range or containing specific harmonics.

Most stations are unmanned, but service stations equipped with social space and necessary facilities for the crew are also used.



Fig. 3.13. Example offshore electrical substation sited on a monopile

Source: <https://www.sercel.com/en/news/offshore-substation-monopile>

The substation will be installed on a support structure, similar to wind turbines. It is assumed that it will be a monopile or a truss structure. The BC-Wind OWF will be served by a single collective substation, and equipped with several transformers. Export cables and a fibre-optic connection will be run from the substation.

The weight of the substation will be approx. 2500 to 3000 t. The possible dimensions of the station are: approx. 40 m in width, approx. 45 m in length, and approx. 20 m in length, the antenna included.

Security systems, e.g. sonar systems, may be deployed within the substation area for safety reasons. The necessity of installing underwater hydrological observation systems for the area around offshore substations is conditioned by the implementation of the law on safety procedures for offshore wind farms. Pursuant to Article 3 point 2 of the Act on Crisis Management of 26 April 2007 (Journal of Laws of 2023, item 122, consol.), offshore wind farms in Poland count amongst critical infrastructure – as equipment and installations included in the national electricity supply system. In turn, the implementation of the solutions contained in the Directive (EU) 2022/2557 of the European Parliament and of the Council of 14 December 2022 on the resilience of critical entities (hereinafter the CER Directive) will require a redefinition of the current regulations on critical infrastructure, including the implementation of appropriate safeguards for this infrastructure.

The security system involves deploying e.g. 2-4 sonars in the environment around the OSS, as well as their equipping (with cables). The system is intended to enhance the ability to detect and record

the activity of remotely operated underwater vehicles, divers or unwanted manned vehicles approaching the station and submarine cables.

3.2.5. Metering and research platforms

As part of the implantation of the BC-Wind OWF, it is also (optionally) possible to construct a platform not directly related to the generation of electricity, i.e. a metering and research platform. It is a facility that is small in size, with installed metering and research apparatus, as well as instruments for the purpose of the recording and transmission of data.

The construction of neither a metering and research platform nor a housing and maintenance platform is currently a part of the Investor's plans; however, this might change at a stage of obtaining further agreements and permits. For this reason, this Report only takes into account its possibility.

3.3. DESCRIPTION OF THE DIFFERENT PHASES OF THE PROJECT

Due to the location of the planned investment, to be entirely executed in the maritime area, all activities connected to it, in all phases of its course, will be conducted in the mode of maritime operations, taking into account their specific conditions and characteristics. Deliveries to and from the OWF Area will be performed using various types of vessels:

- construction-installation vessels – large, specialised vessels, with an advanced level of safety, equipped with dynamic positioning systems (with varying degrees of security), which do not require anchoring during their work; such vessels often have the possibility of being fully stabilised in a chosen position during their operations, through a system of supports propped on the seabed;
- transport vessels – multipurpose or specialised vessels adapted for the transport of large structures (e.g. foundations or support structures, towers, propellers), often equipped with dynamic positioning systems;
- transport barges (platforms) – vessels used to transport large structural components to the installation site, generally without their own propulsion, using pushers or tugs;
- pushers and tugboats – auxiliary vessels used to service larger vessels, transport barges or to transport large structural elements (e.g. foundations or support structures for wind power plants) from the ports to the site themselves;
- service vessels – usually smaller vessels, used to transport OWF service personnel or exploitation materials, adapted for mooring to wind power towers or accompanying platforms and enabling safe movement of people and handy equipment to OWF structural elements.

In certain cases, especially during the exploitation phase of the OWF, helicopters may be used to transport service teams, or in emergency situations.

Activities related to the transport of large-scale OWF structural elements must be carried out from ports that meet certain requirements, i.e. in particular:

- sufficient length and capacity of the quay to allow for the installation, storage and loading of OWF structural elements;
- adequate depth of harbour basins to allow large construction vessels to operate in them.

It is assumed that the estimated size of the area used as a storage and potential pre-assembly area for OWF structural elements should be approximately 20 ha. The quay, where loading these elements onto ships is possible, should be at least about 300 m long and have an adequate bearing capacity.

At the current stage of development of the BC-Wind OWF project, ports such as Gdynia, Gdańsk, Sassnitz-Mukran, Szczecin-Świnoujście, Rønne, Rostock, Aalborg, Karlskrona and Klaipeda are considered for possible installation ports. The closest port with a complete and in use infrastructure for offshore wind energy activities is the port of Rønne in Denmark (on the island of Bornholm). The closest Polish port that can serve as an installation port is the port of Gdynia.

During the exploitation phase of the BC-Wind OWF, it will be possible to use smaller ports, located at a shorter distance from the planned project area than the ports indicated above. The service base of the BC-Wind OWF will be located in Władysławowo.

According to Art. 24 point 1 of the Act of 21 March 1991 on maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 2019, item 2169, as amended), the competent director of the maritime office will be able, by order, to establish safety zones around all OWF constructions or around sets of such constructions located at a distance of no more than 1000 m from each other, adapted to the type and use of artificial islands, installations and devices or their sets, extending no further than 500 m from each point of their outer edge, unless a different extent of the zone is permitted by generally accepted international standards or recommended by a competent international organisation. In the issued order, the competent director of the maritime office shall specify the conditions for movement within the established zones, including, in particular, restrictions on navigation, fishing, water sports, or diving and underwater work.

Information on activities during the construction phase of the OWF, the establishment of safety zones around the structural elements of the OWF, as well as the total or partial decommissioning of the OWF will be made public in the official publications of the Hydrographic Office of the Navy.

During each phase of the BC-Wind OWF project, applicable legal requirements and good practices on waste and wastewater handling issues will be applied. Different hazardous materials will be used during the different phases of the BC-Wind OWF project. Their list and assumed estimated generation quantities are presented in Chapter 8.16, in which the different phases are described.

All vessels involved throughout the project will comply with the requirements and regulations under the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), including, in particular, the procedures contained in the 'Oil pollution prevention plans'.

In addition, for the BC-Wind OWF installations, in the event that dry transformers cannot be used by the Investor, spill containment measures will be used to prevent the spillage of hazardous substances (e.g. sumps for any spilled transformer oil), as well as measures to deal with the consequences of any spillage of hazardous substances (e.g. sorbents). Oily waters generated during the works will be collected and subjected to separation to achieve oil concentrations below 15 ppm, and the oil extracted from the separation process will be stored and transferred onshore to specialised disposal companies.

Other waste, including other hazardous waste, will be dealt with in the same way – it will be sorted, collected in specially marked and secured containers, transported onshore, and handed over to specialised companies for disposal.

3.3.1. Construction phase

The construction phase of an OWF project is the phase that requires the mobilisation and involvement of the largest number of vessels, equipment and human resources. It is necessary to create a complex supply chain process of both goods and specialised services in various areas: manufacturing, transport, construction, assembly and installation. In addition, the implementation of this phase will require precise coordination of the various activities, taking into account the specific conditions resulting from the implementation of the investment in the maritime area. The transport of equipment and personnel during the construction phase will be by water or air. This phase will include four areas of activities related to:

- the preparation of the seabed prior to the construction of foundations or support structures for individual OWFs (wind turbines, platforms); the type of actions applied will result from the geological conditions in the places of foundation and the type of foundations used;
- the transport and foundation of the OWF foundations or support structures in the seabed;
- the transport and installation of wind turbine components and the substation;

- laying the internal cable connections linking the various OWF structures.

Depending on the strategy adopted for the execution of the investment, the aforementioned activities may be carried out in a sequential or parallel manner.

It is assumed that the construction phase will be completed in the shortest possible time and will last approx. two years (from 2027 to the end of 2028). However, it is possible that the construction time may be extended if there are delays in deliveries or, e.g., the contracting of units.

The preliminary schedule assumes the following sequence of construction and installation works:

- installation of foundations (Q3 and Q4 2027),
- installation of the OSS (Q3 2027),
- installation of cables inside the farm (Q1 and Q2 2028),
- installation of wind turbines (Q2 and Q3 2028),
- commissioning (Q4 2027).

This preliminary schedule is still subject to change in terms of the planned timing of the various elements of the construction phase and their duration, but at this stage, it gives an idea of the timescale and planned sequence of activities.

It is tentatively planned that one piling session will last up to approx. 2 days, including picking up the pile from the quay, bringing the vessel to the selected location, positioning the vessel, piling, and returning to port. The piling itself may take several hours depending on the power of the unit, the diameter of the pile, and the geotechnical conditions.

Foundations will be installed in the bottom at a maximum of two locations at the same time so as not to exceed the permissible cumulative underwater noise levels set out in the DEC. The location of the foundations will depend on the availability of piles on the quay, as well as the availability of vessels.

Towers, and then wind turbines will be installed on the completed foundation.

Prior to the OWF construction phase, it will be necessary to organise an onshore area (construction and storage yards), where the initial assembly of wind power plant components will be performed and the OWF structural elements will be stored. This area will be located within port or shipyard infrastructure existing at the time of the execution of the project, with direct or very good access to the quay dedicated for the loading and unloading of vessels participating in the construction process and subsequent maintenance of the OWF. From this area, individual OWF elements will be transported with vessels to the area of their foundation or installation. The organisation of such a site within the boundaries of the existing port or shipyard infrastructure will not significantly affect their existing operation.

Transport routes (sea and land)

Maritime transport will be decisive and the impact of land transport should be minimal. Land transport will take place using existing transport solutions. It is possible that assembly or production of large-scale components will take place in port or shipyard areas. Maritime traffic, on the other hand, will take place in areas where there has been little or no traffic to date. Depending on the choice of sourcing concepts, sourcing ports and service ports, the transport system will involve transshipment work and ship traffic on routes port – OWF – port, or between ports.

The number of specialised marine operations associated with the construction phase of the BC-Wind OWF is proportional to the number of facilities installed and constructed in the OWF Area, including the length of the installed electricity networks. Therefore, the number of operations and their impacts (e.g. fuel consumption, transport-related emissions) will be smaller for the APV than for the RAV.

3.3.2. Exploitation phase

The exploitation phase of the BC-Wind OWF will start when the wind turbines start generating electricity, and is expected to last up to 35 years. The service base of the BC-Wind OWF will be located in Władysławowo.

Maintenance works will generate much less vessel traffic than the construction phase, and mainly small and medium-sized vessel traffic. Three exploitation variants are possible:

- use of the offshore station – small vessel traffic within the OWF will take place between the station and individual wind turbines. To secure the operation of the station, cyclical transport of supplies and cyclical replacement of station crew and service personnel will be required. The estimated number of trips will minimally result in an increase in shipping for the main navigation routes and will marginally result in an increase in shipping for the service port;
- use of medium-sized vessels – service bases, which will perform periodical service duty in the OWF Area and make cyclic trips to service ports in order to replenish supplies, replace service personnel or crew. Changes in shipping traffic will occur as in the case above;
- use of small vessels making voyages between the service port and the OWF Area, and as a part of the rapid response daily operating cycle. The estimated number of voyages will significantly increase the volume of navigation along the navigation routes and in the ports.

The number of specialised marine operations associated with the exploitation phase of the BC-Wind OWF will be directly proportional to the number of facilities installed and constructed in the area of the OWF, including the length of the installed electricity grids.

There is a potential possibility to use the Marine Power Station for rescue operations. The handling of these activities, in accordance with applicable regulations and procedures, will be on the side of the Maritime Rescue Coordination Centre (MRCC) in Gdynia, with the use of specialised helicopters stationed in Gdynia or Darłowo. The Investor does not plan for the use of helicopters in the normal operation of the BC-Wind OWF at any stage of the planned project.

3.3.3. Decommissioning phase

At the end of the exploitation phase of the BC-Wind OWF, estimated at a period of approx. 35 years, it will be necessary to decommission it, i.e. dismantle all of its facilities. In technical terms, the decommissioning phase is the reverse of the OWF construction phase. In reverse order to the construction phase, individual OWF components will be removed and transported to disposal sites.

The number of specialised marine operations associated with the decommissioning phase of the BC-Wind OWF is proportional to the number of facilities installed and constructed in the OWF area, including the length of the installed electricity grids.

At the development stage of the EIA Report, it was assumed that the entirety of the infrastructure of the BC-Wind OWF would be removed from the marine area except for the monopiles anchored in the seabed, which would be cut or further driven in until seabed level is reached. This approach is intended to restore environmental conditions to the state they were in before the commencement of the OWF project. The results of the monitoring of this and other OWFs located in the PMA, as well as other data collected over several decades, will enable the determination of the potential of the support structures as artificial reefs and the change in the functioning of the marine environment in their area. In the event that positive effects on the environment resulting from their presence are found to outweigh the effects of the restoration of the natural state, it will be possible to revise the original assumptions for the implementation of the decommissioning phase. Such a possibility was acknowledged by the Regional Director for Environmental Protection in Gdańsk in the decision on environmental conditions for the project 'Baltic Power Offshore Wind Farm' (decision of 17 September 2021, ref.: RDOŚ-Gd-WOO.420.42.2020.AJ.21), who in point 2.8 of the aforementioned decision permitted keeping some of the facilities located in or on the seabed if they constitute a habitat for valuable communities of marine organisms. The extent of the infrastructure elements that could be kept should be agreed upon with the

competent environmental and maritime authorities, and preceded by year-long surveys of benthos and ichthyofauna.

In the case of the decommissioning of the BC-Wind OWF, the generation of waste is mainly associated with the physical disposal of the used elements of the BC-Wind OWF, and the operation of the vessels used during the decommissioning.

3.4. ENERGY, WATER AND RAW MATERIAL DEMAND

Construction phase

During construction work, electricity will be consumed mainly for the needs of vessels and lighting. Due to its specific nature, the planned project will be implemented with the use of ready-made equipment, components and construction products. The following table shows the estimated quantities of basic materials and raw materials that will be used during the construction phase of the planned project.

Tab. 3.4. *Estimated quantities and types of raw materials, basic materials, fuel and water required for the construction of the planned project*

Water, raw materials, basic materials, fuel	Description	Estimated quantities
Water	Social purposes – approx. 200 people; average use on site – 50 l/person/day ¹¹	10 m ³ /day
Oils, lubricants, other assembly materials	Used to assemble turbines and the offshore substation	10 tonnes
Fuel	Marine equipment and vessels	15m ³ /vessel/day

Source: own elaboration

The water will be used mainly by the workers, for welfare purposes. It is estimated that approx. 17 vessels will be used for the construction of the OWF. In addition, approx. 100 km of submarine cable with a total weight of approx. 5000 Mg and steel for the construction of foundations and cables will be used for the construction of the connections. It is assumed that the construction phase will be completed in the shortest possible time and will last between 2 and 3 years – a maximum of 5 years.

The most important factor shaping energy demand and consumption is the choice of the type of structures built in the OWF Area and the organisation of construction, followed by the choice of one of the methods of OWF operation. The energy required and consumed in the construction of an OWF constitutes of almost 100% fuel used for the purposes of transportation, handling and installation of the components of the wind turbines and other OWF structures.

Unlike commercial shipping, specialised vessels adapted for the construction and operation of industrial offshore structures have a different operational profile. This is primarily due to the need to carry out complex maritime operations (transshipments, dynamic positioning operations), which are not related to the distance sailed, but to a certain number of operating hours. Estimating planned fuel consumption is therefore dependent on a very large number of variable factors and practically always subject to significant error.

The average fuel consumption values for the different vessel types are shown in the table below:

Tab. 3.5. *Average fuel consumption for different vessel types*

Size of the vessel	Purpose	Average fuel consumption (diesel) [kg·h ⁻¹]	Nominal daily operating time [h]
Small vessels	Minor supplies, staff transport, same-day service, emergency action – for each phase	50-200	8-10

¹¹ Regulation of the Minister of Infrastructure of 14 January 2002 on determining the average water consumption standards (Journal of Laws of 2002 No. 8, item 70)

Size of the vessel	Purpose	Average fuel consumption (diesel) [kg·h ⁻¹]	Nominal daily operating time [h]
Medium-sized vessels	Procurement, support for construction work, towing work, stationary multi-hour service – for each phase	500-2000	12-18
Large vessels	Procurement, storage, construction work – mainly for the construction and decommissioning phases	2500-5000	12-24

Source: EIA Report for BC-Wind, MEWO, p. 69

The number of specialised marine operations associated with the construction, exploitation and decommissioning phases of the BC-Wind OWF is proportional to the number of facilities installed and constructed in the OWF Area, including the length of the power cables installed.

Exploitation phase

During the exploitation phase, the demand for water, raw materials, basic materials, fuel and energy will result from the operation of the OWF. Given the nature of the planned project, there will be maintenance works during operation that will require fuel consumption.

In addition, at the time of periodic maintenance work, the planned project will generate the need for the use of replaceable, consumable materials in the exploitation phase, and the work will be carried out in accordance with the adopted maintenance plan.

Decommissioning phase

In the case of decommissioning of the planned project, it is assumed that similar processes will be used as for the construction phase. Water, energy and fuel consumption will be associated with vessels and workers. Decommissioning will require a crane and vessels to transport the power plant components. The turbines will be dismantled and disposed of, and all parts classified as waste will be managed in accordance with waste management regulations.

3.5. ANTICIPATED TYPES AND QUANTITIES OF POLLUTION DURING THE CONSTRUCTION PHASE

The construction of the BC-Wind OWF will be the source of:

- periodic air emissions from vessels;
- periodic underwater noise emissions from vessels (continuous noise) and when making monopiles (impulsive noise);
- the generation of waste and wastewater as a result of construction.

In addition, works associated with seabed intervention, i.e. the excavation of a number of trenches intended for cables inside the farm, will be a source of pollution.

Atmospheric emissions

During the construction phase, there will be unorganised emissions in the form of exhaust gases (carbon oxides, nitrogen, sulphur and hydrocarbons) and dust associated with the operation of ships and construction machinery, as well as the transport of equipment, materials and people. Due to the limited time of emission, any emitted concentrations of gases and dust will be insignificant and will not result in exceeding the permissible levels resulting from the Regulation of the Minister of Environment of 24 August 2012 on levels of certain substances in the air (Journal of Laws of 2021, item 845, consol.), and will also meet the requirements of the Act on prevention of marine pollution from ships of 16 March 1995 (Journal of Laws of 2020, item 1955, consol., as amended).

Atmospheric emissions are discussed in more detail in Chapter 8.8 of this Report.

Continuous and impulse noise emissions

The construction phase will be associated with the emission of continuous noise associated with the movement of vessels and impulsive noise associated with the foundation of the BC-Wind OWF facilities.

For the purposes of the assessment of impulsive underwater noise emissions, a remodelling of sound sources and underwater noise propagation was performed for this Report. This is described in more detail in Chapter 8.9 of this Report and the modelling results in Appendix 3 (Volume III).

The results of the remodelling indicate the need to use a Noise Reduction System (NRS), which will be selected as part of the design work from among currently used solutions, such as: single and double air curtains, noise barriers and cofferdam systems, as well as any other technologies that become available during the preparation stage of the project. An essential condition determining the selection of specific NRS solutions will be, as per the DEC, not to exceed the following values within 11 km of the piling site:

- 140 dB re 1 $\mu\text{Pa}^2\text{s}$ SELcum and weighted by the HF function (HF weighting function for marine mammals with high sensitivity to high frequency sounds – harbour porpoise);
- 170 dB re 1 $\mu\text{Pa}^2\text{s}$ SELcum and weighted by the PW function (PW weighting function for pinniped marine mammals – seals);
- 186 dB re 1 $\mu\text{Pa}^2\text{s}$ SELcum, unweighted, for fish.

Piling within the scope of works in the area of the BC-Wind OWF will be organised by the Investor in such a way so as to fulfil the condition of conducting at most two simultaneous pilings. If more OWF projects are executed in parallel, the Investor, in consultation with other investors, will also organise works so that the above requirement is fulfilled. Taking into account that a similar condition had been imposed on other investors and that it will most likely be imposed in the next environmental procedures for the OWF, the issue of meeting this condition will also apply to other investors, which will force the execution of works to be limited to two simultaneous foundations.

Generation of waste and wastewater

Waste and wastewater generated during the construction phase will be properly stored and secured onboard vessels in accordance with the anti-pollution plan of each vessel, prepared in accordance with the requirements of the Act of 16 March 1995 on the prevention of pollution from ships (Journal of Laws of 2020, item 1955, consol., as amended), and will then be taken to port reception facilities and managed in accordance with the applicable port waste and cargo residues from ships management plan (Regulation of the Minister of Infrastructure of 21 December 2002 on port waste and cargo residues from ships management plans (Journal of Laws of 2002, No. 236, item 1989, as amended).

It is assumed that the construction phase will be carried out as quickly as possible, in accordance with current standards and the recommendations of the turbine and cable manufacturer, and under ongoing supervision. In this context, the listed emissions with the application of environmental protection solutions will be of a short duration and of local scope.

Chapter 9.13 presents the estimated amounts of waste generated during the construction phase of the BC-Wind OWF.

3.6. ANTICIPATED TYPES AND AMOUNTS OF POLLUTION DURING THE EXPLOITATION PHASE

Electromagnetic field (EMF)

The process of operating the OWF will be a multi-year undertaking. Offshore wind power plants will be connected to offshore substations by power and teletechnical networks. It is assumed that the total length of all cable routes where cables will be laid in the OWF Area will be no longer than 100 km. Cables buried in the seabed are optimised to emit a residual electric field. The possible magnetic component of the EMF is minimised by running individual cables as close as possible (for individual phases for AC or flow directions for DC). In the case of DC cables, the range of EMF interactions is

reduced the closer the individual conductors of the line are routed (there are virtually no interactions in a composite cable). In the case of AC cables, the use of a composite cable reduces the magnetic field, but it can remain at levels that generate an electric field in seawater. The remedy for this is to bury the cable in sediment, which in itself does not reduce the effects of EMF interactions, but by separating the cables from the seawater, makes the impact much smaller. According to measurement data of submarine cables, the emission of electromagnetic fields from submarine cables is negligibly small.¹²

Heat emission from power cables

As the electric current flows through the cable, it causes the cable to heat up, caused by power losses to the resistance, according to Joule's law. As the temperature of the cable rises above the ambient temperature, heat dissipation into the surrounding environment begins. Accurate quantification of the transferred heat is difficult as there occur phenomena of heat conduction, heat dissipation and heat radiation, subject to different physical laws.¹³

The amount of heat emission depends on:

- the way the cable is laid and the depth of its burial,
- bottom sediment properties (permeability, porosity, thermal conductivity/resistivity, temperature distribution of sediment in the vertical profile, thermal diffusivity of sediment),
- marine environmental conditions (water temperature, speed of water movement over the bottom).

The minimum burial depth should be determined based on the type of sediment (its thermal conductivity) and the type of electricity network (size and type of loads, thermal characteristics). For the purposes of this Report, the average depth of cable burial was assumed to be 2-3 m.

3.7. PHASING OF THE PROJECT

Considering:

- the minimisation of the risk of not meeting the timeframe indicated in the Act of 21 March 1991 on maritime areas of the Republic of Poland and maritime administration (Journal of Laws of 1991 No. 32, item 131, as amended) for the maintenance in force of PSzW No. OWF/7/12 for C-Wind Sp. z o.o. and OWF/4/13 for B-Wind Sp. z o.o.;
- the economic optimisation of the overall project;
- the ability to comprehensively contract essential services and supplies;
- the restrictions on access to essential services and supplies (specialised vessels, port infrastructure and other components in the supply chain) due to the possible implementation of similar investment projects in the offshore wind sector by other actors,

The Applicant permits the project to be implemented continuously as well as in phases.

¹² Gill A.B., Hutchison Z. L., Desender M., *Electromagnetic fields (EMFs) from subsea power cables in the natural marine environment*, Royal Institution, London 2023

¹³ Rakowska A., Grabowski A., Stiller J., 2006

4. VARIANTS CONSIDERED FOR THE PLANNED PROJECT WITH JUSTIFICATION FOR THEIR SELECTION

The analysis of alternatives for the planned project is presented below. It takes into account the variants which formed the basis of the environmental impact assessment conducted during the DEC application procedure, and confronts them with the variant currently selected for implementation. The variant selected for implementation, the confirmation of which the Applicant applies for in the current DEC amendment application, was formulated as a result of the update and specification of the parameters of the previous variant proposed by the Applicant for which the DEC had been issued, made as a result of the clarification and selection of the parameters that had been previously analysed and assessed using the envelope concept, appropriate to the current stage of development of the BC-Wind OWF project.

As this report was prepared for the purposes of the amendment to the DEC, the 2021 EIA Report provided a reference point both in terms of the basis for comparing the alternatives, as well as the principles for conducting the environmental impact assessment.

The analysis of options carried out in this Report considers two variants:

- the variant proposed by the Applicant and approved by the DEC as the most environmentally beneficial variant – then named the APV (2021), and currently considered the Rational Alternative Variant – RAV 2024;
- the variant resulting from the specification of parameters of the APV (2021), which was confirmed by the DEC – now treated as the variant selected for implementation (WWR 2024).

The APV (2021) is a reasonable and environmentally acceptable alternative.

Both analysed variants of the project presented in this Report are technically feasible and fit within the parameters indicated by the previously obtained permits, i.e. PSZW No. OWF/7/12 (amended by the decision of May 10, 2022, ref.: DGM-3.530.23.2022) and PSZW No. OWF/4/13 (amended by the decision of May 10, 2022, ref.: DGM-3.530.22.2022). The analysed variants do not pose the risk of significant negative impacts on the environment, including the subjects of protection of Natura 2000 sites, their integrity, and the coherence of their network.

Maximum values were assumed for each of the variants. This assumption allows the environmental impact assessment to be carried out with a large margin of safety, as the maximum individual parameters will always be taken into account for the assessment, even if they do not actually occur together.

The project was characterised through identifying the following parameters for each variant:

- the maximum total installed capacity of the OWF – the final value will be derived through optimisation from the point of view of environmental, technological and economic conditions or other factors – the total power value is unchanged from the 2021 EIA Report;
- the maximum total number of wind power plants – a parameter resulting from the maximum installed capacity of the OWF and the assumed size of wind turbines; it is possible to use wind turbines of different size and capacity within the OWF – the number of wind turbines is reduced in comparison to the 2021 EIA Report;
- the maximum rotor diameter of the wind turbine – a parameter defining the diameter (size) of the rotor – the diameter of the rotor is reduced in comparison to the 2021 EIA Report;
- the minimum clearance between the rotor working area and water surface – a parameter defining the distance between the outline of the rotor working area and the level of the water surface – this parameter is unchanged from the 2021 EIA Report;
- the maximum height of the wind turbine structure including the rotor – a parameter determining the maximum height of the wind turbine structure, from the surface of the water to the outline of the working area of the rotor – the maximum height of the structure is reduced in comparison to the 2021 EIA Report;

- the maximum length of cable routes of the internal installation of the OWF – a parameter specifying the total length of cable routes in which internal cables will be laid, connecting individual wind power plants with substations – the maximum cable length is significantly reduced in comparison to the 2021 EIA Report as it is based on actual wind power plant locations that were able to be determined at the current stage of development of the BC-Wind OWF.

4.1. VARIANT APPROVED BY THE DEC (CURRENTLY THE RAV 2024)

The approved variant is the most favourable variant environmentally, according to the issued decision on environmental conditions (hereinafter: the DEC), issued on 16 September 2022, ref.: RDOŚ-Gd-WOO.420.50.2021.KSZ.AM.10.

The appraisal of the approved variant included in the 2021 EIA Report was based on the concept of an envelope description of the project and thus an envelope assessment. The envelope concept meant that in the case of different technical solutions being possible, the environmental impact of the potentially most burdensome solution was assessed for the selected parameter. It was assumed that if the most burdensome solution did not have a significantly negative impact on the environment, then other solutions, being less burdensome, would also be acceptable. Therefore, the approved option permitted, i.e., four foundation techniques for the support structures: a large diameter pile, truss structure, tripod and gravity foundation.

The basic parameters of the APV (the approved variant) are shown in the table below:

Tab. 4.1 Summary of key parameters of the BC-Wind OWF for the variant approved by the DEC (currently the RAV 2024)

Parameter	Unit	RAV 2024
Maximum installed power	MW	500
Maximum number of wind turbines	pcs	41
Maximum rotor diameter	m	280
Minimum clearance between rotor working area and water surface	m	20
Maximum height	m above sea level	330
Number of offshore electrical substations	pcs	2
Number of other structures (non-productive infrastructure)	pcs	4
Maximum length of cable routes inside the OWF	km	188

Approved foundation methods	large diameter pile, truss structure, tripod and gravity foundation

Source: environmental decision issued on 16 September 2022, ref.: RDOŚ-Gd-WOO.420.50.2021.KSZ.AM.10, as well as the 2021 EIA Report and Investor data

4.2. VARIANT SELECTED FOR IMPLEMENTATION (WWR 2024)

The variant selected for implementation by the Investor is a variant based on a modification of the variant approved by the DEC, adapted to the current development stage of the BC-Wind OWF. The parameters of the turbines, their number, as well as limited foundation technologies were modified. The technical parameters of the variant selected for implementation (which is affected by the requested amendment to the DEC) are presented in the table below (Tab. 4.2).

The variant selected for implementation ensures that the project's objective of producing electricity is achieved to the maximum extent possible, while optimising construction costs.

For the variant selected for implementation, it is planned to use monopile-type foundations in all support structures, i.e. under power plants and substations. If it is not technically possible to install this type of foundation, it is planned to use a truss (jacket) type of foundation.

Tab. 4.2 Summary of key parameters of the variant selected for implementation (WWR 2024)

Parameter	Unit	WWR 2024
Maximum installed power	MW	500
Maximum number of wind turbines	pcs	39*
Maximum rotor diameter	m	250
Minimum clearance between rotor working area and water surface	m	20
Maximum height	m above sea level	300
Number of offshore electrical substations	pcs	1
Number of other structures (non-productive infrastructure)	pcs	4
Maximum length of cable routes inside the OWF	km	100

* with a maximum of 34 planned to be constructed, with the other 5 remaining backup locations

Approved foundation methods	large diameter pile, truss structure

Source: own elaboration based on Investor data

At the current stage of development, the locations of the 39 wind turbines and an offshore electrical substation, as well as the resulting cable placement, have been determined. Geotechnical investigation was carried out for 46 sites, from which the 39 sites were selected and assessed in this Report as part of the WWR 2024 variant, with a maximum of 34 power stations likely to be implemented. Some (few) of the 39 locations within the current development area may be changed during design or construction, which is treated as a non-significant change under the Offshore Act.

The variant selected for implementation is described in Chapter 3 of this Report by clarifying the technology and parameters and detailing selected information.

4.3. SUMMARY OF PARAMETERS OF THE ANALYSED VARIANTS

The table below (Tab. 4.3) summarises the key parameters of the project for both variants analysed in this EIA Report.

Tab. 4.3 Summary of key parameters of the BC-Wind OWF for the variant approved by the DEC and the variant selected for implementation

Parameter	Unit	Variant approved by the DEC	Variant selected for implementation
Maximum installed power	MW	500	500
Maximum number of wind turbines	pcs	41	39*
Maximum rotor diameter	m	280	250
Minimum clearance between rotor working area and water surface	m	20	20
Maximum height	m above sea level	330	300
Number of offshore electrical substations	pcs	2	1
Number of other structures (non-productive infrastructure)	pcs	4	4
Maximum length of cable routes inside the OWF	km	188	100
Approved foundation methods	-	large diameter pile, truss structure, tripod, gravity foundation	large diameter pile, truss structure

* with a maximum of 34 planned to be constructed, with the other 5 remaining backup locations

Source: own elaboration

4.4. COMPARISON OF VARIANTS

The comparison between the variant approved by the DEC (currently the RAV 2024) and the variant selected for implementation (WWR 2024) is presented below.

Both variants will result in environmental impact of the same nature, however the WWR 2024 will cause effects of a lesser magnitude due to the reduced scope of the project, as evidenced by:

- the reduced number of wind turbines,
- the reduced rotor diameter, and thus the height of the entire structure,
- the significant reduction of the length of cable routes inside the OWF (resulting from the placement of the wind turbines being determined at the current stage of development)¹⁴,
- the exclusion of gravity foundation technology from the approved foundation methods.

The construction and exploitation of a reduced number of wind turbines under the WWR 2024 consequently means a diminished impact on the environment in comparison to the RAV 2024, as a result of:

- the construction and decommissioning phases taking a shorter time,
- a reduced number of hazardous crane and marine operations,
- reduced consumption of construction and operational materials.

The significant difference in the construction phase between the two variants relates to a reduction in dispersed suspended solids, which is associated with the complete exclusion of gravity foundation technology under the WWR 2024, as well as the reduction in the length of cable routes from approx. 188 km under the RAV 2024 to approx. 100 km under WWR 2024.

During the exploitation phase of the OWF project, the smaller number of wind turbines under the WWR 2024 will require fewer maintenance and operational activities compared to the RAV 2024, and this will also result in a diminished impact on the environment.

The WWR 2024, compared to the RAV 2024, will impact the environment less when considering collision risk between migratory birds and wind turbine structures. The results of the performed collision modelling indicate that in most cases, the risk is higher under the RAV 2024, and in no case is it lower. With that said, it is worth noting that the lower collision rate did not change the significance of the impact – it remains at the same level for both WWR 2024 and the RAV 2024, despite the lower collision rate shown by the modelling.

Taking into account the long-term nature of this impact (the exploitation phase is assumed to last several decades), these differences can also provide an important indication that the WWR 2024 is the environmentally preferable option compared to the RAV 2024.

To summarise the above, it should be stated that the basic parameters differentiating the two considered variants are the number of wind power plants, the rotor diameter, the type of foundation and the length of the cable routes. They determine, consequently, the scale of impacts on the individual elements of the environment.

When comparing the two variants, including in particular the resulting possible environmental impacts, it is important to indicate that the WWR 2024 is the most environmentally favourable option.

4.5. JUSTIFICATION FOR THE APPLICANT PROPOSED VARIANT

The variant selected for implementation meets the investment assumptions of the project and at the same time allows a better economic result to be achieved by using a smaller number of power plants and more realistic turbine parameters. At the same time, reducing the number of power plants, shortening the length of cable routes inside the farm and the choice of foundation technology for the support structures will result in smaller environmental impact and shorter construction time.

¹⁴ wind turbine locations may be corrected in the course of further design work

5. PREDICTED ENVIRONMENTAL EFFECTS OF NOT UNDERTAKING THE PROJECT

Failure to implement the project to construct and exploit the BC-Wind OWF may occur in two cases, i.e.:

- the abandonment of offshore wind power entirely within the PMA, with the consequent need to source energy from existing or other sources;
- the abandonment of the 500 MW BC-Wind OWF project and the simultaneous development of other OWFs within the Polish EEZ.

These options are fundamentally different. The first one would mean, in the multi-year perspective, abandoning the use of an alternative source of electricity of significant power (e.g. the BC-Wind OWF alone would cover about 1.3% of the national demand for power), which would require compensation in the form of operating conventional sources of similar power, with emissions of gaseous and dust pollutants from fuel combustion (coal or lignite), production of about 20% of combustion waste in relation to the amount of fuel combusted, and indirectly with the effects of climate change in fossil fuel extraction areas.

An important rationale for the investment is the potential avoidance of emissions of hazardous substances into the atmosphere. Assuming a capacity utilisation of 48.91% and 35 years of operation, an OWF with a capacity of 500 MW can produce 84.98 TWh or 302.4 PJ of electricity, which would make it possible to avoid emissions of over 57 million Mg of CO₂, over 40000 Mg of SO₂, approx. 40000 Mg of nitrogen oxides and approx. 1700 Mg of dust.¹⁵

As an effect of the first option, there will be local benefits associated with the abandonment of offshore development. A lack of investment in offshore wind energy (wind power plants, power cables, substations) in practice will mean that the complex impacts associated with the construction, exploitation and decommissioning of these elements of the OWF will not occur within several decades. It also means no limitations in the accessibility of these areas for the existing and potentially new users, i.e.: in the areas of navigation, fishing, tourism and possible exploitation of hydrocarbons (oil and gas from under the seabed).

The second option will mean the construction of other OWF in other waters, with a difficult-to-estimate set of impacts on the marine environment and on the human activities occurring there (shipping, hydrocarbon exploitation, fishing, marine tourism). However, this option has the advantage of reducing the impacts of domestic fossil fuel extraction and the combustion of these fuels in conventional power plants. At the same time, while reducing the share of conventional power generation, there will be an opportunity, in line with trends in the European power industry, to deepen the integration of Poland's national high-voltage transmission systems with Germany, Denmark and Sweden.

For each of the two options identified above, the predicted impacts on abiotic and biotic elements will not occur, to varying scales and extent. These elements will be subject to existing impacts resulting from existing pressures on the marine environment.

¹⁵ The National Centre for Emissions Management (KOBIZE), 2022

6. CURRENT USE OF THE WATER BODY IN THE AREA OF THE PLANNED PROJECT

6.1. SHIPPING

The BC-Wind OWF Area is characterised by a moderate level of use in terms of shipping (Fig. 6.1).

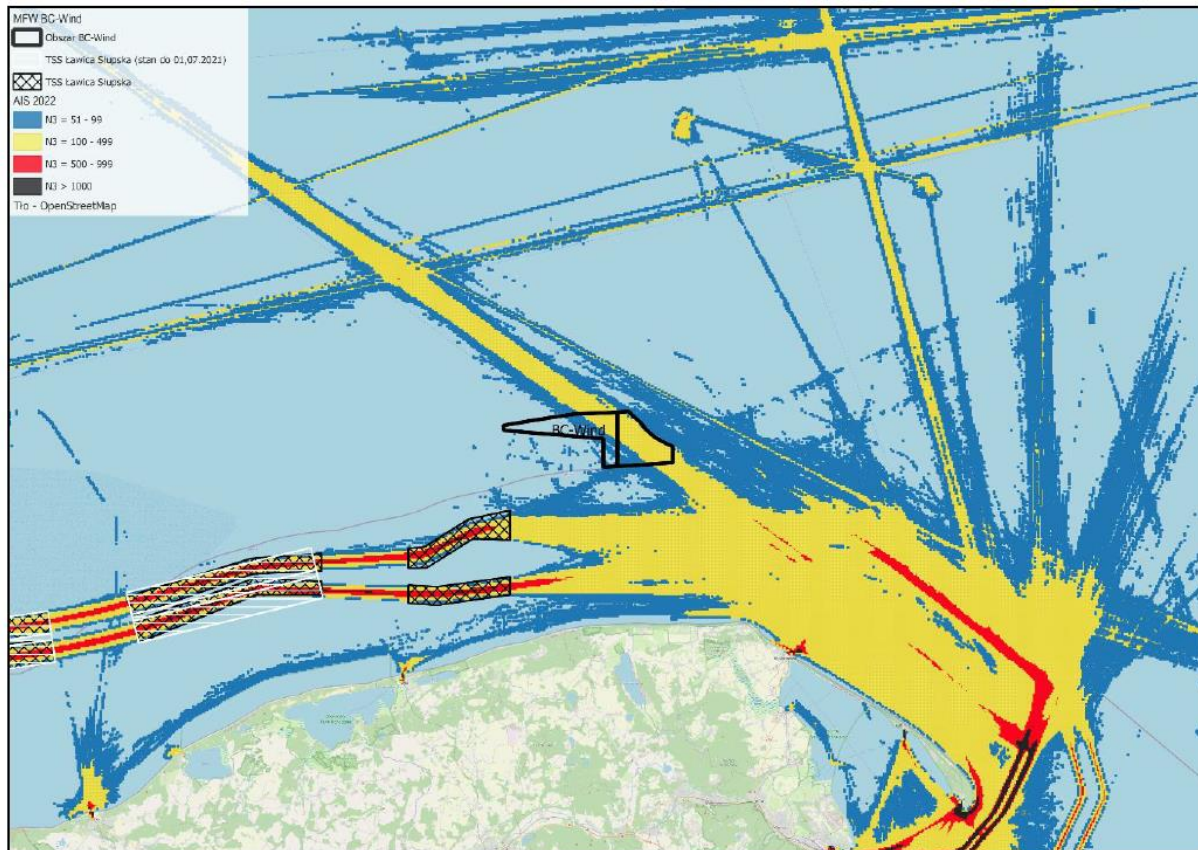


Fig. 6.1. Map of vessel traffic in 2022 based on AIS-PL

Source: Navigational analysis, 2023

The usual shipping route connecting the ports of the Gulf of Gdańsk with the Bornholm Strait currently runs through the BC-Wind OWF Area, used mainly by tankers and commercial vessels (bulk carriers). In 2013, 398 vessels used this route (commercial – 53%, tankers – 17.5%, other – 22%).¹⁶ AIS data indicates that between 2018 and 2019, vessels made more than 1000 journeys per year along this route through the area of the OWF. This route has been a component of the Polish Maritime Administration's planned deep-water route D of strategic importance (for large tankers and gas carriers) for many years. Due to the location decisions issued for the construction of the OWF (PSzW), the Maritime Office in Gdynia, as part of the work on the draft of the Maritime Spatial Plan of Polish Sea Areas, modified the course of this route. This route, following the approval of the MSPPSA, bypasses the BC-Wind OWF Area from the east. The proposed change in the course of the route results in its slight lengthening, which will to some extent translate into negative phenomena in proportion to the change in the length of the route, i.e.: an increase in costs and extension of navigation time, an increase in emissions (CO₂, CO, SO₂, NO_x), and an increase in the probability of failures and accidents (assuming that this probability is proportional to the distance travelled).

To the south of the BC-Wind OWF Area runs the second most intensively used customary shipping route leading from the Danish straits to Polish, Lithuanian and Russian ports in the southern Baltic Sea. In 2013, it was used by 6686 vessels (tankers – 16.7%, merchant vessels – 44.4%,

¹⁶ Zaucha J., Matczak M., *Conditions for the pilot project of the spatial development plan of the transboundary area of the Southern Middle Bank. Gdańsk 2011*

passenger vessels – 1%, special vessels – 6.7%, other vessels – 30.6%).¹⁷ AIS data indicates that between 2018 and 2020, vessels made approx. 26000 journeys along this route. The route has a traffic separation system based on two sections: Łeba-Rowy and Ustka-Jarosławiec, referred to as the Słupska Bank Traffic Separation Scheme (TSS Ławica Słupska).

To the north of the BC-Wind OWF Area runs the usual shipping route connecting Klaipeda with ports in the southern Baltic Sea – mainly Świnoujście and Sassnitz-Mukran. The main users of this route are freight-rail ferries (Mukran-Klaipeda) and cargo ships. In 2013, 893 vessels used the route (tankers – 1.5%, commercial – 38.5%, fast ferries – 23%, other – 32%).¹⁸ AIS data indicates that between 2018 and 2020, vessels made approximately 8000 trips along this route. The BC-Wind OWF Area is used to a small extent by recreational vessels.

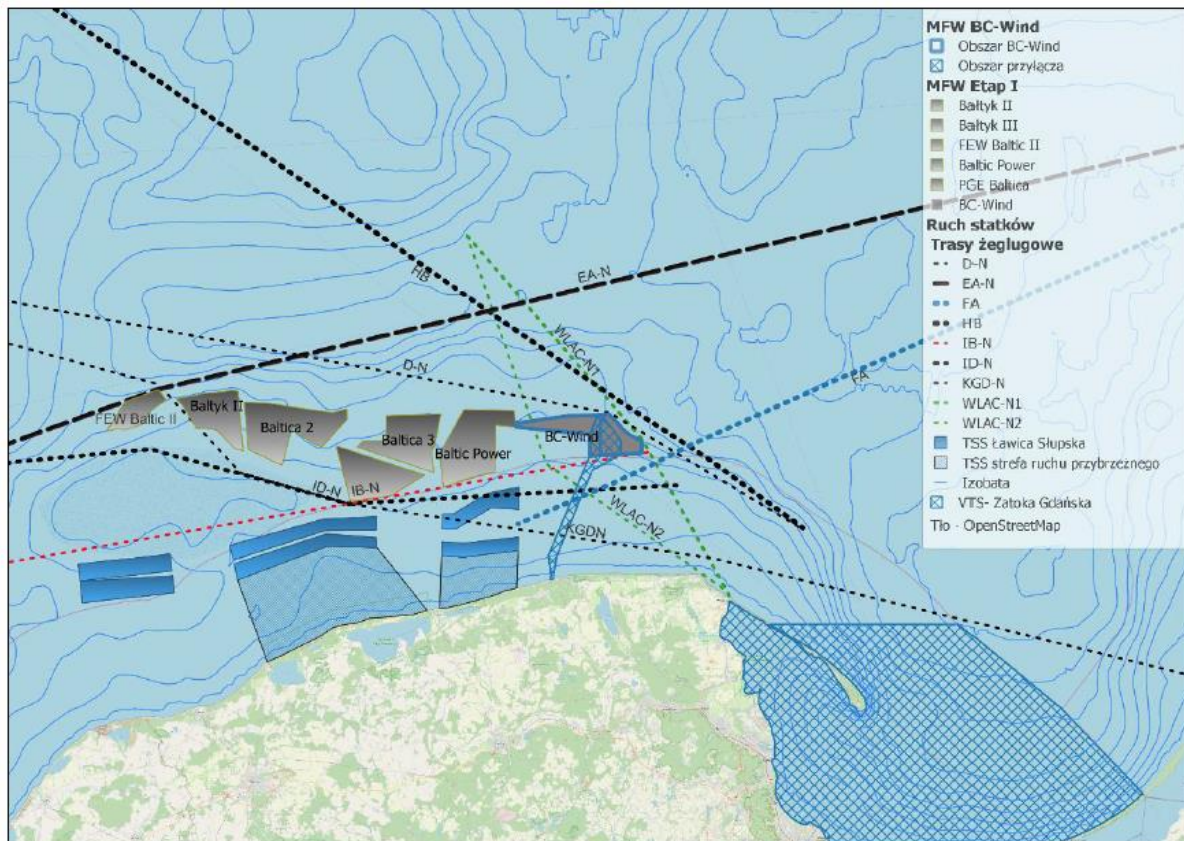


Fig. 6.2. Changes in shipping routes in the BC-Wind OWF Area

Source: MSPPSA, Navigational analysis, 2023

6.2. FISHING

There are fishing-related activities in the BC-Wind OWF Area. Until 2019, one of the most important commercially exploited species was cod, but in mid-2019 a ban on directed fishing for cod was introduced in the eastern Baltic Sea, including ICES areas 25 and 26. This ban was renewed in subsequent years until 2023. For this reason, the analysis of fisheries is presented in two periods: 2015-2019 and 2020-2023.

¹⁷ Zaucha J., Matczak M., Conditions for the pilot project of the spatial development plan of the transboundary area of the Southern Middle Bank. Gdańsk 2011

¹⁸ Zaucha J., Matczak M., Conditions for the pilot project of the spatial development plan of the transboundary area of the Southern Middle Bank. Gdańsk 2011

6.2.1. Commercial fish catches in 2015-2019

The characterisation of fishing in 2015-2019 was based on data from fishing vessel catch reports taking into account the fishing location (fishing square or geographical position), fish species, month the fishing took place, fishing gear and vessel size (<12 m and ≥12 m units).

The 12 m criterion was adopted to distinguish vessels that may be classified as small-scale fisheries <12 m in accordance with the provisions of Council Regulation 508/2014. The data from the catch reports may differ from the landings (final) data, but reliance on them was necessary due to the need to carry out a geographical distribution of fishing activity (landings reports do not contain precise location data of catches). Any differences are negligible and should not affect the inferences made. The analysis is based on two sets of catch data: from 2015-2019 and from 2020-2023, when the year-round ban on directed cod fishing was in force. The value of catches was calculated by multiplying the average annual first-sale prices of each fish species by the weight of fish caught. As the most detailed information on the catches of the fishing fleet is available for areas of fishing squares (an area of approx. 400 km²) not overlapping with the BC-Wind OWF Area, in order to determine the impact of the investment on fisheries in the area of the OWF itself with the greatest possible accuracy, the following was taken into account:

- for fishing vessels over 12 m in length equipped with a Vessel Monitoring System (VMS), the quantity of catches on a given day, allocated to a fishing square or the area of the OWF, based on the proportion of the number of position reports from the vessel reported in the fishing square or the area of the OWF itself to the total number of VMS reports on a given day;
- for fishing vessels under 12 m, for which no VMS data are available, the information on catches in the area of the Baltic square was used, while the estimation of catches in the area of the OWF was carried out by taking into account the relative share of the area the OWF will occupy to the total area of the fishing square. This is a simplification that ignores the possible variation in catch rates within a given square (e.g. due to depth or bottom type), but is the only one possible in order to more accurately reference where the fish are caught.

The area of the BC-Wind OWF is located unevenly within two fishing squares: O8 and P8 (Fig. 6.3., Tab. 6.1).

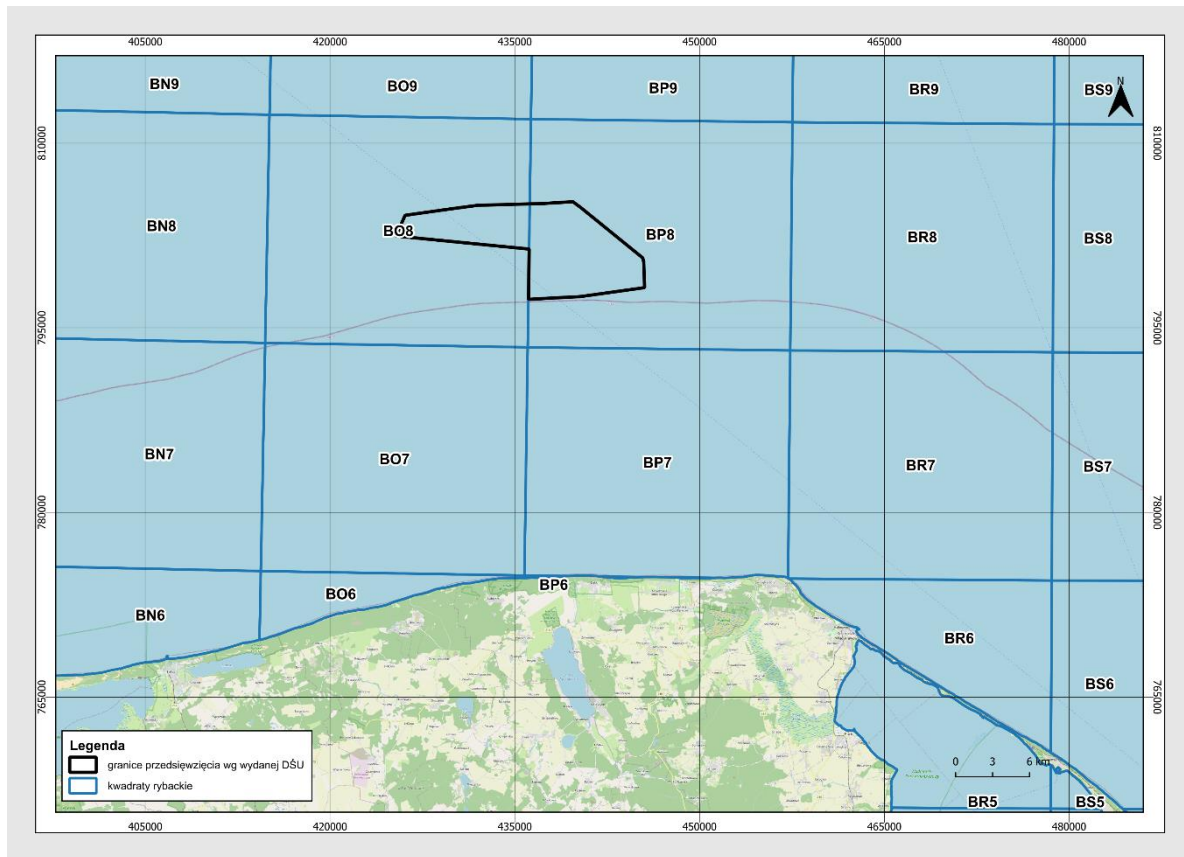


Fig. 6.3. Location of the BC-Wind OWF Area against the background of fishing squares

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 165

Tab. 6.1. The size of the area occupied by the BC-Wind OWF area (1 NM) in the individual fishing squares used for the calculation of the catch of vessels of up to 12 m

Fishing square	Area of the fishing square occupied by the area of the OWF (1 NM) [%]
O8	7.47
P8	15.08
Total	11.27

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 166

Volume and value of fish catches

The average annual volume of fish catches in the area of the two analysed squares in 2015-2019 was 865 tonnes, which represented only 0.6% of the volume of Polish Baltic catches realised by Polish fisheries in this period. The value of catches in the area of the two analysed squares amounted to approximately 1.3 million PLN, which represented 0.6% of the total value of completed landings from Polish catches in the Baltic Sea.

The estimated (calculated for vessels <12 m in length, based on the proportion of the area occupied by the OWF in each fishing square and based on VMS data for vessels ≥12 m in length) catch volume realised in the BC-Wind OWF area in 2015-2019 averaged 174 tonnes, with a value of 238 thousand PLN.

The area of the analysed squares is characterised by low fishing productivity. The average catch per km² realised in the area of the two fishing squares in 2015-2019 was approx. 1100 kg/km² with a value of 1.5 thousand PLN. This represented only 36% (33% in value) of the average productivity of the Polish maritime areas (PMA), which amounted to 3000 kg/km² during the years analysed, with a worth of 4.6 thousand PLN/km². The Baltic P8 square has a significantly higher productivity – 2000 kg/km² (2.4 thousand PLN/km²) – than the O8 square – 220 kg/km² (0.6 thousand PLN/km²). Of the 123 Baltic

Sea squares lying within the PMA (in part or in whole), square P8 ranked a distant 55th in terms of catch per km² area.

The average share of fish caught in 2015-2019 in the area of the squares located in the area of the planned project in relation to the Polish total catch in the Baltic Sea was 0.6%, and for the area limited only to the area of the OWF – 0.11%. Analysing the relative importance of the area of fishing squares to be partly occupied by the BC-Wind OWF Area as a place for fishing vessels located in different ports, it can be seen that only for the vessels from Władysławowo it has a noticeable, although still marginal, importance (1.6%) – Tab. 6.2. For vessels registered in the other ports, catches in the area of the two analysed squares can be considered insignificant, their relative magnitude exceeding 1% for none of them (on average in 2015-2019). Similarly, the importance of the area analysed in terms of value was low in 2015-2019 (Tab. 6.3).

Tab. 6.2. Average volume [t] of catches in fishing squares O8, P8 in 2015-2019 in relation to total Polish catches in the Baltic Sea, by port of registration of fishing vessels and their size

Port	Fishing squares O8, P8			BC-Wind OWF Area			Baltic Sea	Share [%]	
	<12 m	≥12 m	Total	<12 m	≥12 m	Total		In fishing squares	In the area of the OWF
Władysławowo	3.6	706.4	710.1	0.5	154.7	155.3	43894.8	1.6	0.4
Ustka	2.1	98.6	100.8	0.2	11.6	11.8	16664.3	0.6	0.1
Hel	0.6	23.8	24.3	0.0	2.0	2.1	12375.4	0.2	0.0
Łeba	0.0	18.3	18.4	0.0	2.6	2.6	2766.2	0.7	0.1
Jastarnia	0.0	6.0	6.0	0.0	1.0	1.0	6081.9	0.1	0.0
Świnoujście	1.3	0.3	1.5	0.1	0.0	0.1	3951.9	0.0	0.0
Kołobrzeg	1.3	0.0	1.3	0.2	0.0	0.2	37659.1	0.0	0.0
Other	1.4	1.2	2.5	0.2	0.5	0.7	19030.8	0.0	0.0
Total	10.2	854.6	864.9	1.3	172.4	173.7	142470.6	0.6	0.12

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 166

Tab. 6.3. Average value [thousand PLN] of catches in fishing squares (O8, P8) and in the BC-Wind OWF Area in 2015-2019 in relation to the average value of Polish catches in the Baltic Sea by port of registration of fishing vessels and their size

Port	Fishing squares O8, P8			BC-Wind OWF Area			Baltic Sea	Share [%]	
	<12 m	≥12 m	Total	<12 m	≥12 m	Total		In fishing squares	In the area of the OWF
Władysławowo	15.4	838.7	854.1	2.3	197.3	199.7	47566.5	1.8	0.4
Ustka	33.7	154.1	187.7	3.1	16.4	19.5	26930.5	0.7	0.1
Hel	4.6	29.4	34.0	0.5	2.6	3.1	11947.1	0.3	0.0
Łeba	0.2	72.2	72.3	0.0	10.2	10.2	4965.4	1.5	0.2
Jastarnia	0.0	6.0	6.0	0.0	0.9	0.9	7468.4	0.1	0.0
Świnoujście	2.6	1.0	3.5	0.2	0.0	0.2	7041.4	0.1	0.0
Kołobrzeg	3.1	0.0	3.1	0.5	0.0	0.5	49664.6	0.0	0.0
Other	10.6	7.8	18.3	1.4	2.3	3.7	49530.7	0.0	0.0
Total	70.1	1109.0	1179.1	8.1	229.7	237.8	205340.3	0.6	0.12

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 167

The volume and value of fish catches in the different fishing squares where the BC-Wind OWF Area is located varies. As can be seen in the figures (Fig. 6.4., Fig. 6.5.), the number of catches in the analysed squares varied from year to year, with a noticeable decreasing trend in square O8. This was primarily a result of the deteriorating condition of the cod stock, which was particularly evident in the coastal zone. By contrast, catches in square P8 fluctuated, as a result of the variable activity of vessels fishing for pelagic fish in the square area.

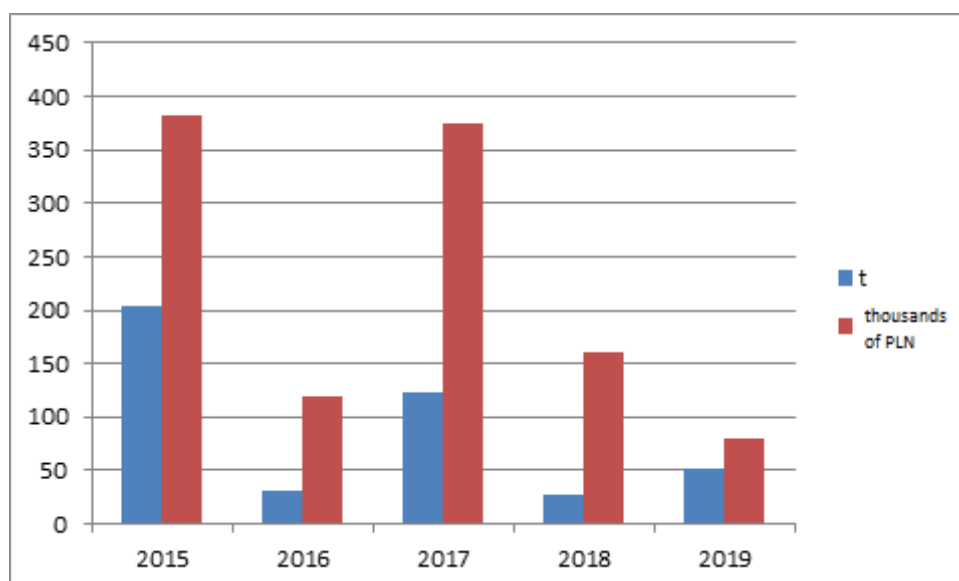


Fig. 6.4. Volume [t] and value [PLN] of catches in fishing square O8

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 168

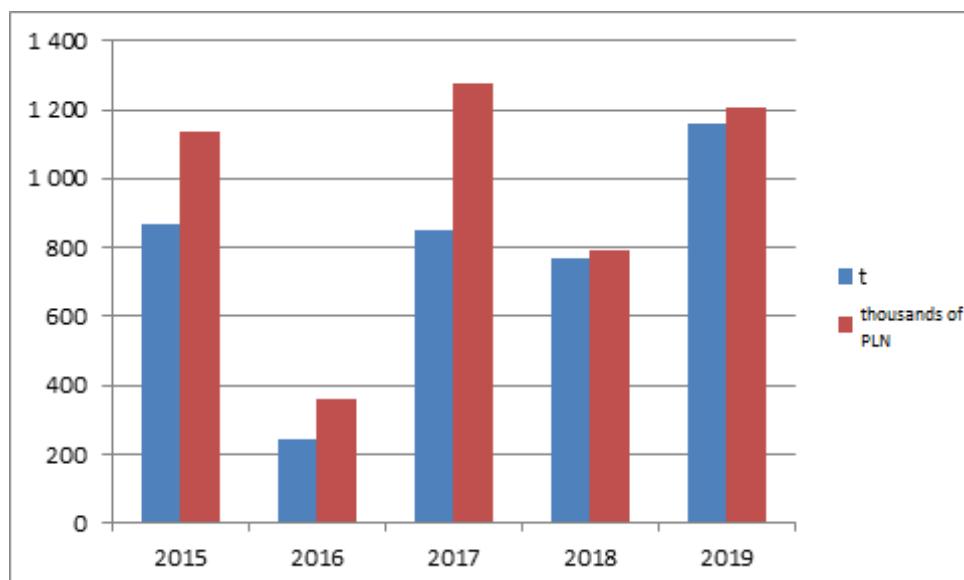


Fig. 6.5. Volume [t] and value [PLN] of catches in fishing square O8

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 168

The main fish species caught in the area of the two analysed squares in 2015-2019 were herring and sprat (Tab. 6.4), contributing 65% and 31% to the total catch volume and 61% and 20% to the value of fish caught, respectively (Fig. 6.6.). The remainder was accounted for by catches of other fish, where trout, salmon and flounder dominated.

Tab. 6.4 Volume and value of catches in fishing squares O8 and P8 in 2015-2019, by major species

Species	Fishing parameter	Year				
		2015	2016	2017	2018	2019
Cod <i>Gadus morhua</i>	Volume [t]	53.5	15.7	17.8	7.8	4.6
	Value [thousand PLN]	241.8	75.3	88.6	39.3	23.8
Herring <i>Clupea harengus</i>	Volume [t]	898.8	184.0	835.1	292.9	585.3
	Value [thousand PLN]	1153.4	256.8	1160.3	325.5	710.5
Sprat <i>Sprattus sprattus</i>	Volume [t]	106.8	58.0	102.0	467.7	619.4
	Value [thousand PLN]	99.5	54.1	90.7	356.6	549.1
Other	Volume [t]	12.7	16.2	19.6	25.9	0.6
	Value [thousand PLN]	27.0	94.7	313.0	232.3	3.4

Species	Fishing parameter	Year				
		2015	2016	2017	2018	2019
Total: volume [t]		1071.8	273.9	974.5	794.3	1209.9
Total: value [thousand PLN]		1521.7	480.9	1652.6	953.7	1286.8

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 168

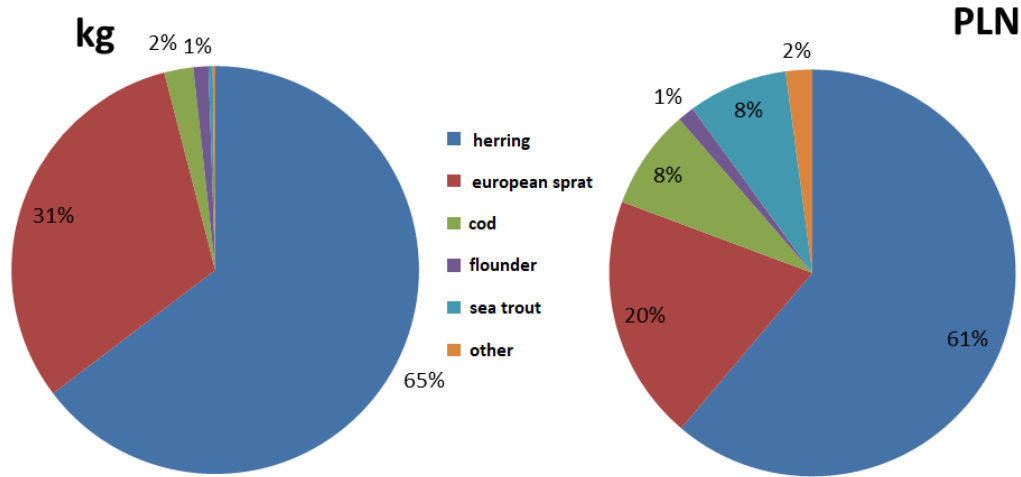


Fig. 6.6. Species structure of the catch in the area of fishing squares O8 and P8 in 2015-2019

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 169

During the analysed period, the vast majority of catches, both in terms of quantity and value, were made by fishing vessels ≥ 12 m in overall length (Tab. 6.5). This was due to both the numerical advantage of large vessels and their greater fishing capacity. The share in the volume and value of catches of this group of vessels in 2015-2019 exceeded, with the exception of 2018, 90%.

Tab. 6.5 Volume and value of catches in fishing squares O8, P8 in 2015-2019, by length of fishing vessels

Fishing parameter	Vessel group by length [m]	Year				
		2015	2016	2017	2018	2019
Volume [t]	<12	24.5	5.2	15.2	6.2	0.2
	≥ 12	1047.3	268.7	959.3	788.2	1209.7
Value [thousand PLN]	<12	87.0	31.3	56.2	174.4	1.5
	≥ 12	1434.7	449.6	1596.4	779.2	1285.1
Total volume [t]		1071.8	273.9	974.6	794.4	1209.9
Total value [thousand PLN]		1521.7	481.0	1652.6	953.6	1286.7

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 169

The significantly different value of catches in 2018 from the average (174000) in the <12m group of vessels was due to an incidental increase in the activity of vessels fishing for salmonids (mainly sea trout) with longlines in the squares area. In other years, catches of these fish were marginal. Changes in catches of vessels ≥ 12 m in length showed high variability between 2015 and 2019, fluctuating between 450 and 1600 tonnes. The observed changes did not reflect the overall changes in the Baltic catches of either herring or sprat (the two most important species caught), which would indicate the influence of random factors on the changes in the observed values.

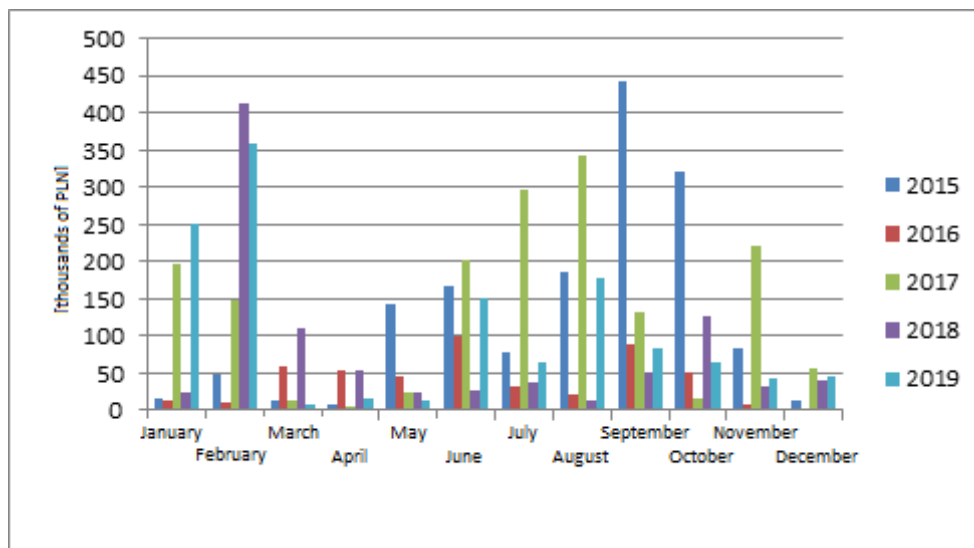
The table below (Tab. 6.6) shows the results of calculated value of catches in each fishing square and the value of catches realised in the BC-Wind OWF Area. As mentioned earlier, for vessels <12 m, the value of catches in the area of the OWF was calculated in proportion to the area to be occupied by the area of the OWF in a given fishing square, while for vessels ≥ 12 m it was calculated on the basis of VMS data. The average value of catches of <12 m vessels in 2015-2019 was 8.1 thousand PLN, and that of ≥ 12 m vessels was 229.7 thousand PLN. As mentioned earlier, the observed changes in catch volumes over the analysed years were random.

Tab. 6.6 Value of catches in fishing squares P8, O8 in 2015-2019 and estimated value of catches in the BC-Wind OWF Area

Vessel group by length [m]	Fishing square	Value of catches in fishing squares [thousand PLN]					Estimated value of catches in the area of the BC-Wind OWF [thousand PLN]					Average	
		2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	Fishing square	BC-Wind OWF
<12	O8	12.9	2.6	34.3	111.3	1.5	1.1	0.2	3.0	9.6	0.1	32.5	2.8
	P8	74.1	28.7	21.8	63.0	-	10.7	4.2	3.2	9.1	-	37.5	5.4
Total		87.0	31.3	56.2	174.4	1.5	11.8	4.4	6.1	18.7	0.1	70.1	8.2
>12	O8	370.0	116.7	340.1	48.6	77.7	92.5	6.4	73.3	5.1	19.4	190.6	39.3
	P8	1064.7	332.9	1256.2	730.6	1207.4	288.5	70.2	276.2	68.7	191.8	918.4	179.1
Total		1434.7	449.6	1596.4	779.2	1285.1	381.0	76.6	349.5	73.8	211.1	1109.0	218.4
Total		1521.7	481.0	1652.6	953.6	1286.7	392.8	81.0	355.6	92.5	211.3	1179.1	226.6

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 170

The analysis of the monthly variability of fish catches in the BC-Wind OWF Area is important from the point of view of the Investor's planning of the construction works and the possible inclusion of as little interference with fisheries as possible. The performed analysis shows a significant variability and spread in monthly catch values. Between 2015 and 2019, they ranged from 0.6 thousand PLN (December 2016) to as high as 440 thousand PLN (September 2015). Due to the relatively small number of fish caught in both squares, the monthly variability of catches was influenced by the involvement of individual vessels. In the analysed years, approx. 50% of the catch volume was realised by only 3-4 fishing vessels, thus the overall catch achieved in the squares may have been determined by individual vessel captains' decisions on where to fish. Nevertheless, the analysis of the 2015-2019 data allows a certain seasonality of catches to be observed. The average monthly value of catches was 98 thousand PLN. Below this average was the value of catches in the spring months (March-May) and in November and December (Fig. 6.7.). The highest relative value of catches in 2015-2019 was recorded in February (17%) and August and September at 13% each (Fig. 6.8.).

**Fig. 6.7.** Monthly value of catches [thousand PLN] in the area of squares O8, P8 in 2015-2019

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 171

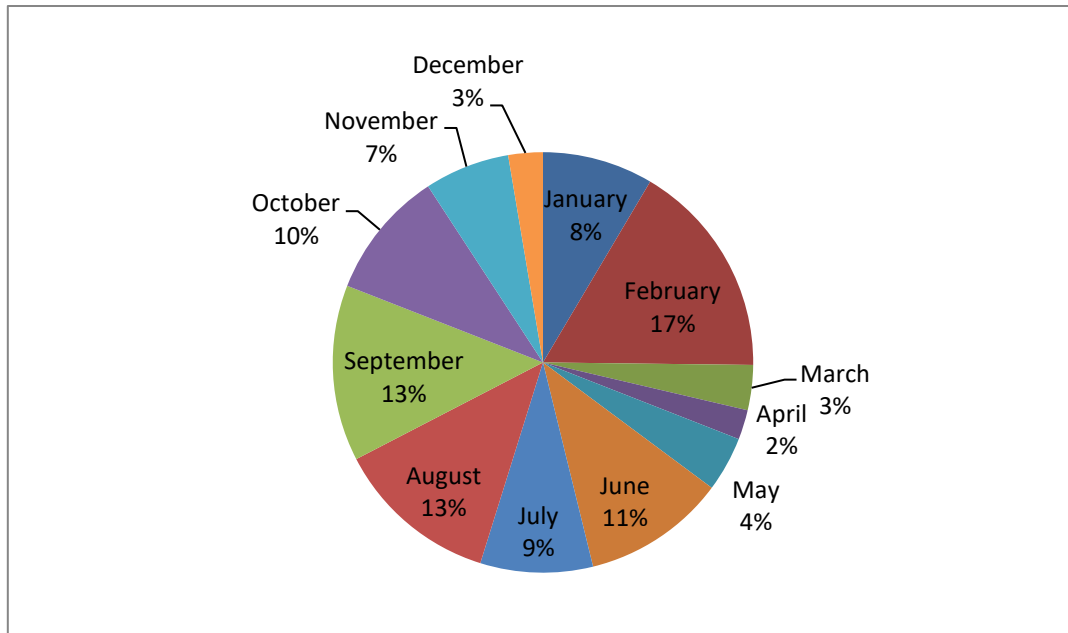


Fig. 6.8. Relative value of catches in the area of squares O8 and P8 by month in 2015-2019

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 171

Pelagic trawls were overwhelmingly used in the catch in the BC-Wind OWF Area in 2015-2019. With the exception of 2018, they accounted for more than 80% of the total catch value in the remaining years (Fig. 6.9.). The main species caught with this gear were herring and sprat.

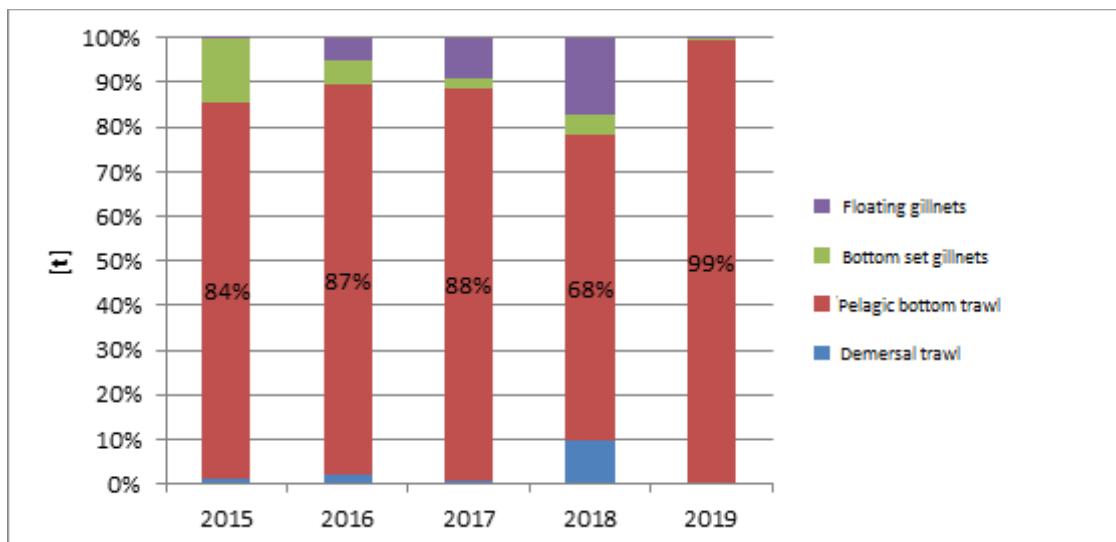


Fig. 6.9. Volume of catches by individual gear in the area of fishing squares O8, P8 in 2015-2019

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 172

Amount of fishing effort

In 2015-2019, 57, 46, 55, 63 and 41 vessels out of a total of 810, 812, 797, 777 and 786 active fishing vessels fishing in the Baltic Sea (inside and outside the Polish economic zone) were fishing in the area of fishing squares O8, P8, respectively. The predominant share was of fishing vessels ≥ 12 m in length, averaging close to 90% throughout the analysed period.

The total fishing effort (measured in terms of fishing days) from 2015 to 2019 in the area of the two squares ranged from 468 days in 2017 to 214 days in 2019. The vast majority – almost 90% of the effort volume measured in fishing days – was concentrated in the P8 square (characterised by greater water depth than in the area of the O8 square). The relative importance of the area of the two squares

in the total fishing effort of Polish fishing vessels fishing in the Baltic Sea in 2019 (approx. 65 thousand days) was negligible – approx. 0.3%.

6.2.2 Commercial fish catches in 2020-2023

The characterisation of fishing for the period 2020-2023, as for the previous period, was made on the basis of data from fishing vessel catch reports taking into account the place of the catch (fishing square or geographical position), fish species, the month of the catch, fishing gear and vessel size (<12 m and ≥12 m units). Catch data (the volume and value of catch) obtained from FMCs was also analysed, divided by ports of return of Polish fishing vessels and fishing squares. The proportion of catches in the area of the BC-Wind OWF was determined based on the proportion of the occupied area of fishing squares. This data was related to the total Polish catches in the Baltic Sea (by ports of registration of fishing vessels), while the value of the catch was calculated on the basis of the annual average prices of the main species and fish groups, obtained from MIR PIB and included in the publication.

Vessels returning to the port of Władysławowo had the largest share of catches in the analysed squares in the analysed period (over 197 tonnes/year, 86% of catches in squares O8 and P8). The share of catches in the analysed squares in the total catch reported for the port of Władysławowo was 1.56%. The total catch in square O8 was 16.73 tonnes of fish/year, while the catch in square P8 was much higher – 211.74 tonnes of fish/year. However, the combined share of catches in both squares in the total vessel catch for the Baltic Sea ports analysed was only 0.42%. The significance of the area occupied by the planned BC-Wind OWF is even lower, reaching 0.06% of the total weight of Polish catches in the Baltic Sea.

Tab. 6.7 Average volume [t] of catches in fishing squares O8, P8 and in the area of the BC Wind OWF in 2020-2023 (by port of return of fishing vessels), in relation to total Polish catches in the Baltic Sea (by port of registration of fishing vessels)

Port	Fishing squares O8, P8 catch t/year			In the area of the BC-Wind OWF, catch t/year	Baltic Sea – total catch t/year for the port	Share of catches in squares O8 and P8 (%)	Share of catches in the BC-Wind OWF Area (%)
	O8	P8	Total				
Darłowo	0.00	0.33	0.33	0.05	114.21	0.29	0.04
Hel	0.00	8.66	8.66	1.31	34119.71	0.03	0.00
Łeba	1.43	0.00	1.43	0.11	293.99	0.49	0.04
Ustka	0.08	17.34	17.41	2.62	6865.76	0.25	0.04
Władysławowo	11.95	185.41	197.36	28.85	12621.17	1.56	0.23
Nexo	3.27	0.00	3.27	0.24	*	*	*
Total	16.73	211.74	228.47	33.18	54014.85	0.42	0.06

* catch data for landings at the port of Nexo (Bornholm) is not included in the compilation of the total volume and value (PLN) of catches for Polish catches in the Baltic Sea, by port and species composition for the period 2020-2023, as this dataset includes ports of registration of Polish fishing vessels

Source: own calculations based on CMR data

In the value of catches in the analysed fishing squares, vessels returning to the port of Władysławowo also had the largest share in the analysed period (over 280220 PLN/year; 88% of the value of catches in squares O8 and P8). However, the share of catches in the analysed squares in the total value of catches reported for the port of Władysławowo was only 0.7%. In total, fish worth 26470 PLN/year were caught in square O8, while catches in square P8 were worth 290580 PLN/year. The total share of the value of catches in both squares in the total value of vessel catches for the analysed ports in the Baltic Sea was only 0.19%. The significance of the area occupied by the planned BC-Wind OWF is even smaller and amounts to 0.03% of the total value of Polish catches in the Baltic Sea.

Tab. 6.8 Average value [thousand PLN] of catches by port of return of fishing vessels in fishing squares (O8, P8) and in the area of the BC-Wind OWF in 2020-2023 in relation to the average value of Polish catches in the Baltic Sea by port of registration of fishing vessels and their size

Port	Fishing squares O8, P8 value 1000 PLN/year			In the area of the BC-Wind OWF, a value of PLN 1000/year	Baltic Sea – total value of PLN 1000/year for the port	Share of values in squares O8 and P8 (%)	Share of value in the BC-Wind area (%)
	O8	P8	Total				
Darłowo	0.00	0.63	0.63	0.10	423.24	0.15	0.02
Hel	0.00	7.80	7.80	1.18	105701.72	0.01	0.00
Łeba	3.55	0.00	3.55	0.27	1024.20	0.35	0.03
Ustka	0.12	20.92	21.04	3.16	21927.28	0.1	0.01
Władysławowo	18.99	261.23	280.22	40.81	39762.63	0.7	0.10
Nexo	3.81	0.00	3.81	0.28	*	*	*
Total	26.47	290.58	317.05	45.80	168839.07	0.19	0.03

* catch data for landings in the port of Nexo (Bornholm) is not included in the compilation of the total volume and value (PLN) of catches for Polish catches in the Baltic Sea, by port and species composition for 2020-2023, as this dataset includes ports of registration of Polish fishing vessels

Source: own calculations based on data from CMR and MIR PIB

The presented data shows a decrease in the importance of the analysed area for fisheries in 2020-2023 compared to the 2015-2019 period. For fishing squares O8 and P8, the share in the value of catches decreased by more than 3 times, while for the BC-Wind OWF Area it decreased by 4 times.

Between 2020 and 2023, a total of nearly 912.8 tonnes of fish belonging to 7 species were caught in fishing squares O8 and P8 (Tab. 6.9). In addition, a catch of 195 Atlantic salmon and 1 sea trout was reported. In fishing square O8, a total of only 66.3 tonnes of fish were caught during the period in question. Herring accounted for the largest share of the catch (86%), followed by sprat and flounder (6% each), while cod by-catch accounted for less than 2% of the catch weight. A total of nearly 846.5 tonnes of fish were caught in fishing square P8 during the period in question. Herring also had the largest share of the catch (62%), followed by sprat at 38%. Other species had a marginal share in the catch. The number of salmonids (mainly Atlantic salmon) caught in the two squares in question was very low – 111 and 85 respectively, with only 2020 and 2021 caught.

The proportion of species was similar to that recorded in the 2015-2019 fishing catches, when herring (65% of the catch by weight) and sprat (32%) were the most abundant in both fishing squares, with a slightly higher proportion of cod (2.3%) than in 2020-2023. These results indicate a lack of significant cod fisheries in the analysis area of fishing squares O8 and P8.

Tab. 6.9 Volume and species composition of commercial catches in fishing squares O8 and P8 from 2020 to 2023

Fishing square/species	2020		2021		2022	2023	Total years of 2020-2023	
	Catch by live weight (kg)	Catch (units)	Catch by live weight (kg)	Catch (units)	Catch by live weight (kg)	Catch by live weight (kg)	Catch by live weight (kg)	Catch (units)
BO8	26320	56	23300	55	6470	10230	66320	111
Sand eel (YEZ)						18	18	
Cod	1155						1155	
Atlantic salmon		56		55				111
European flounder	4100						4100	
Sprat	3090				53	840	3983	
Herring	17825		23 300		6400	9372	56897	
Turbot	150						150	
Other*					17		17	
BP8	419146	70	99 205	15	208608	119520	846479	85
Cod	20		25			5	50	

Atlantic salmon	16	69	30	15			46	84
European flounder	160						160	
Sprat	217449		19 600		56024	29460	322533	
Herring	201501		79 550		152584	90055	523690	
Sea trout		1						1
Total	445466	126	122 505	70	215078	129750	912799	196

* Marine fishes not elsewhere specified

Source: own elaboration

The catches of the main commercially exploited species (expressed in kg) in the fishing squares in question were made almost exclusively by units over 12 m in length – the contribution of smaller fishing units was marginal (0.16%). Units less than 12 m in length accounted for a slightly larger share (14%) of salmonid catches (expressed in units) – Tab. 6.10. Also in 2015-2019, units over 12 m in length accounted for the vast majority of fish catches expressed in kg (98.8%), and the share of smaller units was small (1.2%), but higher than in the following years of 2020-2023. This data indicates a clear advantage of larger units in the fishery exploitation of the area, especially after the introduction of the ban on directed cod fishing. The reduction in the proportion of vessels under 12 m in the last two years (2022-2023) may also have been influenced by the abandonment of salmonid fishing in the area.

Tab. 6.10. Volume of commercial catches in fishing squares O8 and P8 (combined) from 2020 to 2023 by vessel length class

Unit length ranges	2020		2021		2022	2023	Total years of 2020-2023	
	Catch by live weight (kg)	Catch (units)	Catch by live weight (kg)	Catch (units)	Catch by live weight (kg)	Catch by live weight (kg)	Catch by live weight (kg)	Catch (units)
Under 12 m	66	8	30	20		1300	1396	28
Above 12 m	445400	118	122475	50	215078	128450	911403	168
Total	445466	126	122505	70	215078	129750	912799	196

Source: own elaboration

The analysis of the volume and value of economic catches in fishing squares O8 and P8 (combined) from 2020 to 2023 against the catches of the Polish fishing fleet in the PMA showed the low importance of the area as a fishery (Tab. 6.11). Catch volumes in individual years ranged from 122.89 tonnes to 446.16 tonnes, corresponding to between 0.12% and 0.4% of the catch in the PMA. Similarly, the value of annual catches ranged from 161.6 thousand PLN to 479.1 thousand PLN, corresponding to a share in the value of catches in the FMP of between 0.10% and 0.34%. A total of 913.88 tonnes of fish (0.24% of catches in the PMA) with a value of 1268000 PLN (0.19% of the value of catches in the PMA) were caught in fishing squares O8 and P8 during the period in question. The average annual catch in squares O8 and P8 between 2020 and 2023 was 228.5 tonnes, while the average annual value of the catch was approx. 317 thousand PLN. The values presented are lower than those recorded in 2015-2019, when an average annual catch of 864.9 tonnes of fish worth 1179 thousand PLN was caught. The share of the area in question in the catches of the Polish fishing fleet in the PMA was also higher between 2015 and 2019 and averaged 0.6% of the catch volume and value per year. Therefore, it can be concluded that the importance of the area in question for fisheries in the last 4 years significantly (more than 3 times) decreased compared to the previous period (2015-2019), and remains at a marginal level.

Tab. 6.11 Volume and value of commercial catches in fishing squares O8 and P8 (combined) from 2020 to 2023 by species. Catch values calculated on the basis of average prices of species or groups

in a given year

Species	2020		2021		2022		2023		Total years of 2020-2023	
	Catch by live weight (kg)	Thousand PLN	Catch by live weight (kg)	Thousand PLN	Catch by live weight (kg)	Thousand PLN	Catch by live weight (kg)	Thousand PLN	Catch by live weight (kg)	Thousand PLN
Cod	1175	8.155	25	0.209			5	0.048	1205	8.411
European flounder	4260	5.623							4260	5.623
Sprat	220539	187.458	19600	18.816	56077	62.245	30300	45.753	326516	314.273
Herring	219326	276.351	102850	141.933	158984	303.659	99427	215.757	580587	937.700
Other	859	1.512	415	0.593	17	0.032	18	0.044	1309	2.181
Total	446159	479.098	122890	161.551	215078	365.936	129750	261.601	913877	1268.187
% by weight and value of catches in the PMA	0.40	0.34	0.12	0.10	0.25	0.22	0.17	0.14	0.24	0.19

Source: own elaboration

The relative value of economic catches in the fishing squares in question, O8 and P8, amounted to a total of approx. 1268 thousand PLN in 2020-2023, averaging 317 thousand PLN/year. The value of catches was highest in September (32%), followed by October (22%) and November (15%). In total, the period from September to November accounted for 69% of the catch value. Lower values were recorded from February to April (in the range of 7-10%). Catch values were low in December, January and May, while June, July and August were not fished during the period (Fig. 6.10). In the earlier period (2015-2019), catches were more evenly distributed over time, with fishing in all months and September to November accounting for 30% of catch values. The winter months (January and February) also accounted for a significant share, with a total of 25%. The average annual value of catches was significantly higher in 2015-2019 (1179 thousand PLN/year), despite lower unit prices per kilogram of fish. The results presented here show that the importance of the analysed area of fishing squares O8 and P8 for fishing is small and decreasing in the following years. According to the latest data, the autumn period is characterised by relatively higher intensity and higher value of catches.

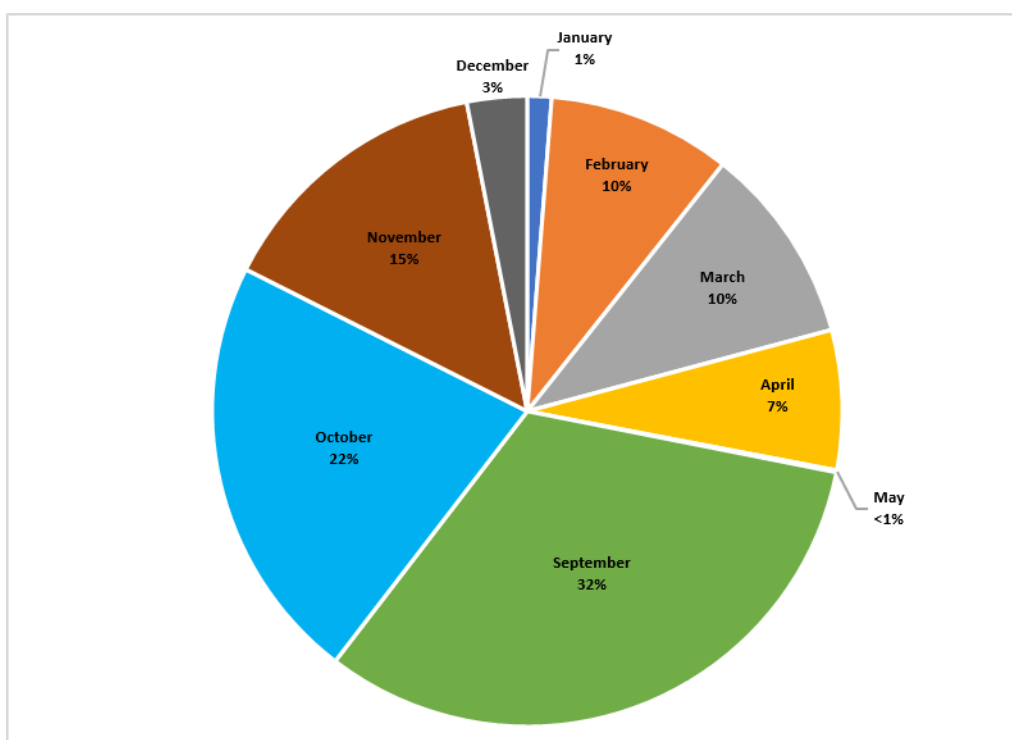


Fig. 6.10. Relative value of catches in the area of squares O8 and P8 by month from 2020 to 2023

Source: own compilation based on CMR data

As pelagic species (herring and sprat) were by far the predominant species in the 2020-2023 fishery – the fishing gear used during this period were almost exclusively pelagic otter trawls (Fig. 6.11.1). A small share of set gillnets (used, i.a., for salmonids) and otter bottom trawls were marked only in 2020 and 2023. Compared to the earlier period (2015-2019), a further increase in the share of pelagic trawls is apparent, which predominated strongly over other gear in as early as 2019.

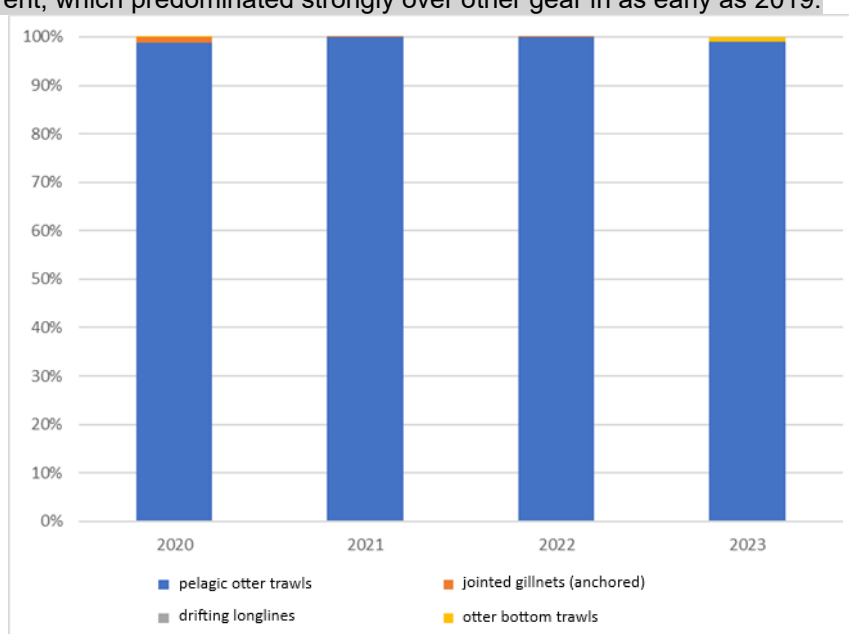


Fig. 6.11. Proportion (%) of catches by gear in the area of fishing squares O8, P8 from 2020 to 2023

Source: own compilation based on CMR data

In the area of fishing squares O8, P8, between 2020 and 2021, 30 and 17 vessels were fishing respectively. The number of vessels has therefore decreased compared to 2015-2019, when between 41 and 63 vessels were fishing in the area annually. A higher number of vessels, as in the previous

period, was recorded in square P8 than in square O8. The amount of total fishing effort (measured by the number of fishing days) between 2020 and 2023 in the area of the two fishing squares in question ranged from 87 days in 2020 to 30 days in 2023. As in 2015-2019, the majority – between 70% and 93% of the fishing effort volume was concentrated in square P8 (characterised by greater water depth than in the area of square O8). The relative importance of the area of the two squares in the total fishing effort of Polish fishing vessels fishing in the Baltic Sea in 2020-2023 was negligible. The share of fishing effort in the square in question in the total fishing effort was about 0.2% in 2020 and 0.06%-0.07% in the remaining years. This data confirms the marginal importance of the analysed area for fisheries.

6.3. OTHER DEVELOPMENTS

There are no structures permanently fixed to the seabed in the area of the BC-Wind OWF. There are also no licences for exploration, appraisal and production of hydrocarbons from offshore deposits. The exploration and prospecting concessions existing in the area until a few years ago expired in 2016 and have not been renewed as of the date of submission of this EIA Report.

7. CHARACTERISATION OF THE STATE OF THE MARINE ENVIRONMENT

7.1. LOCATION AND SHAPE OF THE BASIN BOTTOM

The BC-Wind Area is located to the east of the Słupsk Bank, approx. 22.6 km north of Dębki. The BC-Wind Area (1 NM) covers a section of the bottom with a water depth varying from 27.7 m to 65.3 m, with the area within the boundaries of the PSzW permits no. MFW/7/12 and MFW/4/13 covering a section of the bottom with a water depth varying from 31 m to 61.6 m, and the development area covering a section of the bottom with a water depth varying from 30 to 62.2 m. The depth increases in the northeastern direction (fig. 7.1).

Based on the analysis of bathymetric data, the relief of the seabed was identified. Analysis of the sonar data allowed for the interpretation of the features of the seabed. On this basis, using the data from the surface sample analyses and taking into account the general knowledge on the BC-Wind Area (1 NM)^{19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32}, a map of the seabed types was created (fig. 7.2).

Within the studied BC-Wind Area (1 NM), three distinct seabed landform types in terms of structure and relief character were distinguished (fig. 7.2):

- kame terraces,
- abrasive-accumulative plains,
- accumulative plains.

¹⁹ Dadlez R., *Przekroje geologiczne, utwory przedkenozoiczne*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000. Tab. X.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

²⁰ Dadlez R., *Szkic tektoniczny*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000. Tabl. III.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

²¹ Gudelis V.K., Yemelyanov J.M. (ed.), *Geology of the Baltic Sea.* Wydawnictwa Geologiczne, Warsaw 1982

²² Kramarska R., Krzywiec P., Dadlez R., *Mapa geologiczna dna Bałtyku bez utworów czwartorzędowych, 1:500 000.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Gdańsk-Warszawa 1999

²³ Köller J., Koppel J., Peters W. (eds.), *Offshore wind energy. Research on environmental impacts.* Springer-Verlag, Berlin-Heidelberg 2006

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²⁶ Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

²⁷ Pikies R., *Morfogeneza dna*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku, 1:500 000, Tab. XXIV.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

²⁸ Petersen I.K., Christensen T.K., Kahlet J., Desholm M., Fox A.D., *Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. Report request. Commissioned by DONG energy and Vattenfall A/S.* National Environmental Research Institute, Ministry of the Environment, 2006

²⁹ Pikies R., Jurowska Z., *Objaśnienia do mapy geologicznej dna Bałtyku w skali 1:200 000, arkusz Puck, Słupsk. PIG-PIB,* Warszawa 1995

³⁰ Uścińowicz S., *Miaższość czwartorzędu*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000, Tab. XIII.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

³¹ Uścińowicz S., Zachowicz J., *Mapa geologiczna dna Bałtyku w skali 1:200 000. Arkusz Łeba, Słupsk. Państwowy Instytut Geologiczny.* Wydawnictwa Geologiczne, Warszawa 1988

³² Uścińowicz S., Zachowicz J., *Objaśnienia do mapy geologicznej dna Bałtyku w skali 1:200 000. Arkusz Łeba, Słupsk. Państwowy Instytut Geologiczny.* Wydawnictwa Geologiczne, Warszawa 1991

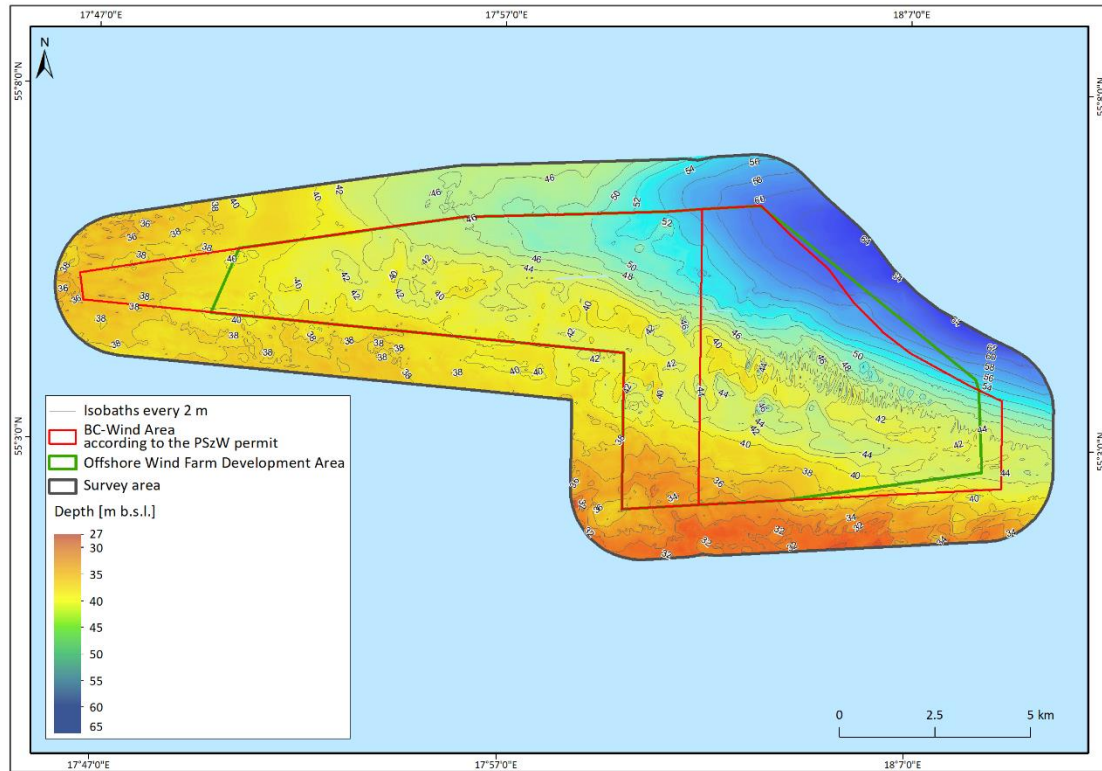


Fig. 7.1 Bathymetric map of the BC-Wind Area

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 103

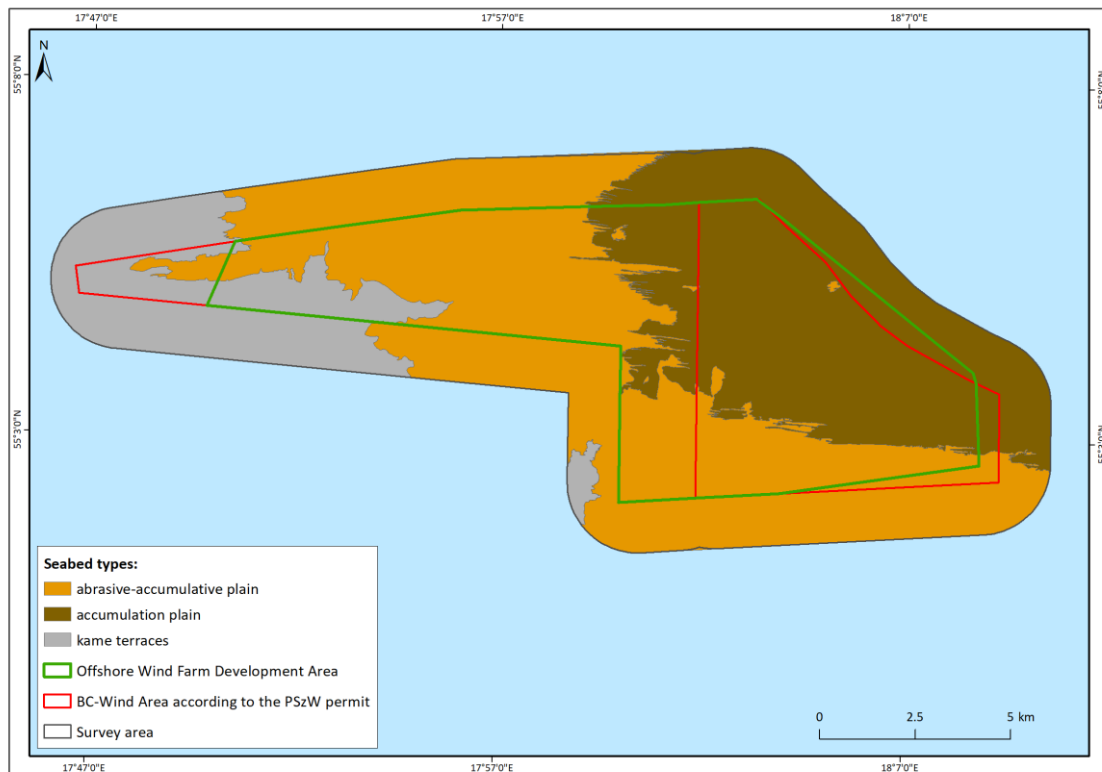


Fig. 7.2 Map of the BC-Wind Area seabed landform types

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 104

Kame terraces

The area of the seabed with the most varied relief and structure was identified as an area of kame terraces (fig. 7.2). It covers the western and southwestern part of the BC-Wind Area with depths ranging from 27.6 m to 42 m below sea level. The seabed is varied, with numerous hills up to 2-3 m (a maximum of 4 m) above the surrounding seabed. These are generally hills composed of post-glacial sediment. They can be interpreted as elements of hill moraines or forms of rift accumulation, which were formed during the slide of the Vistula glacial ice sheet. Seabed slopes are usually up to 2-3°, sometimes more than 20° – this applies only to the slopes of the kame terraces, and clay outcrops.

Abrasive-accumulative plain

The central part of the BC-Wind Area is covered by an abrasive-accumulative plain (fig. 7.2). The plain covers the seabed with depths ranging from approx. 28.8 to approx. 60.9 m below sea level. The seabed is relatively level with minor denivelations (1-2 m) associated with the presence of sand accumulations on the surface of the clay and clay outcrops. There are deposits of boulder on the seabed, as well as gravel. The slope of the seabed in the area of the abrasive-accumulative plain is 2-3°.

Accumulative plain

This is an area of the seabed with little variation in relief. The area covers the eastern and northeastern parts of the analysed area, with water depths ranging from 37.8 to approx. 64.4 m below sea level. The seabed is relatively flat with small, insignificant denivelations of up to 2 m. Sand waves were identified in the southern part of the accumulative plain (fig. 7.2). In the area of the sand waves, the seabed denivelations reach up to 8 m. The proximal slopes of the waves slope towards the west and the distal slopes, towards the east. Sand wave crests have a N-S course. Sand waves reach heights of 2-3 m, and in some places up to 8 m. The length of the waves is 40-60 m, 80-100 m in some places, with a maximum of 150 m. The slopes of the bottom of the accumulative plain are about 2°, in places more than 20° – this applies only to the distal slopes of the sand waves.

Detailed data on the seabed forms of the analysed area, obtained on the basis of the conducted surveys, is included in Appendix 1 to the EIA Report.

7.2. GEOLOGICAL STRUCTURE, BOTTOM SEDIMENTS, RAW MATERIALS AND DEPOSITS

According to data present in literature^{33, 34, 35, 36, 37, 38, 39, 40, 41, 42}, quaternary sediments overlying Palaeogene and Neogene sediments were recognised in the seabed structure of the BC-Wind Area (1 NM). Below the Palaeogene and Neogene sediments, Permian and Triassic sediments were

³³ Dadlez R., *Przekroje geologiczne, utwory przedkenozoiczne*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000. Tabl. X.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

³⁴ Gudelis V.K., Yemelyanov J.M. (ed.), *Geology of the Baltic Sea.* Wydawnictwa Geologiczne, Warsaw 1982

³⁵ Kramarska R., Krzywiec P., Dadlez R., *Mapa geologiczna dna Bałtyku bez utworów czwartorzędowych, 1:500 000.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Gdańsk-Warszawa 1999

³⁶ Köller J., Koppel J., Peters W. (eds.), *Offshore wind energy. Research on environmental impacts.* Springer-Verlag, Berlin-Heidelberg 2006

³⁷ Kramarska R., *Osady powierzchni dna*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000, Tab. XXV.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

³⁸ Kramarska R., Przedziecki P., Uścińowicz S., Zachowicz J., *Przekroje geologiczne (I)*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000, Tab. XXIV.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

³⁹ Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

⁴⁰ Pikies R., *Morfogeneza dna*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku, 1:500 000, Tab. XXIV.* Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

⁴¹ Uścińowicz S., Zachowicz J., *Mapa geologiczna dna Bałtyku w skali 1:200 000.* Arkusz Łeba, Słupsk. Państwowy Instytut Geologiczny. Wydawnictwa Geologiczne, Warszawa 1988

⁴² Uścińowicz S., Zachowicz J., *Objaśnienia do mapy geologicznej dna Bałtyku w skali 1:200 000.* Arkusz Łeba, Słupsk. Państwowy Instytut Geologiczny. Wydawnictwa Geologiczne, Warszawa 1991

distinguished, and are found only in the southern and southeastern part of the study area. Silurian sediments occur beneath Permian and Triassic sediments, and, in the northern and western parts of the BC-Wind Area (1 NM), directly beneath Palaeogene and Neogene sediments.

Sub-quaternary sediments

The oldest, identified on the basis of seismoacoustic data analysis, is the sedimentary floor classified as Silurian. It is deepest in the southern part of the analysed area, at a depth of over 200 m below the bottom surface, and shallowest in the northeastern part of the area, a few metres below the bottom surface. Above the Silurian sediments, in the southeastern part of the analysed area, sediments interpreted as Permian and Triassic were recognised. Their floor is uneven and erosional, lying at depths of approx. 20 to 90 m below the seabed. The thickness of these sediments is over 160 m. Above the Permian and Triassic sediments in the southeastern part of the area, and above the Silurian sediments in the remaining study area, Paleogene and Neogene sediments are recognised. Their floor is uneven with numerous denivelations. The Palaeogene and Neogene sediments lie at depths of a few metres to 35 metres below the bottom surface. Their thickness ranges from 30-40 m to over 100 m.

Quaternary cover

The quaternary cover forms a continuous layer that is from a few metres to more than 30 metres thick, composed of glacial, fluvioglacial, ice-marginal lake, and modern marine sediments. The top surface of the glacial and fluvioglacial sediments is varied, but without significant gradients. Sediments of this unit were recognised throughout the study area. They are glacial and fluvioglacial sediments with a predominance of clay.

On top of the glacial and fluvioglacial sediments, there are ice-marginal lake sediments, mainly clay, silts and fine sands of the Pleistocene and Holocene, in the southwestern part of the BC-Wind area. These form a discontinuous layer, in depressions within the floor of the glacial sediments.

Above the glacial and ice-marginal lake sediments lie mainly fine-grained and, in some places, medium-grained sands. The seabed is formed by modern marine sands (Holocene) and, in some places, gravel and silts (Pleistocene/Holocene). There are some clusters of boulders on the surface.

Detailed data on the bottom structure of the analysed area, obtained on the basis of the conducted surveys, are included in Appendix 1 to the EIA Report.

Bottom sediments and their quality

The bottom is covered by a discontinuous layer of fine- to medium-grained sands over almost the entire study area. In places, there are accumulations of variably grained sediments, clusters of boulders, and outcrops of cohesive sediments on the surface.

In the BC-Wind Area, two types of sediments building up the bottom surface were distinguished (fig. 7.3): fine- to medium-grained sands, and clay with abrasive cobbles of stone and gravel, and a sandy cover.

The fine- to medium-grained sands in the BC-Wind Area mainly form compact covers with flat surfaces (except in those parts of the seabed where sand waves occur). Clay with abrasive cobbles of stone and gravel and a sandy cover form areas of varied relief with fields of ripplemarks and megaripplemarks moving across the surface of the clay and abrasive cobbles. Locally, abrasive cobble on clay alone is present on the surface of the seabed.

The bottom surface within the area of the **kame terraces** is composed mainly of sand, and locally of sand and gravel as well as clay in the form of outcrops and hills, often with a stone cover in the slopes of the clay, with the character of an erosion cobble. Below the deposits of sand and sand and gravel, the bottom is composed of cohesive sediments, mainly clay. The ceiling of the clay is uneven, with denivelations of up to several metres. The depressions in the ceiling of the clay are in places filled with silt loam (ice-marginal) material, and locally with sand.

The bottom surface within the **abrasive-accumulative plain** is made up of a thin, discontinuous layer of sand up to about 0.5 m thick, on a clay substrate.

The bottom surface within the **accumulative plain** is made up of a layer of sand up to about 1-2 m thick (in places within the sand waves area – up to 7-8 m).



Fig. 7.3 Map of surface sediments of the BC-Wind Area

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 107

Seabed sediments are a very important component of the aquatic ecosystem of the Baltic Sea, which is a shallow sea with limited water exchange and an area approximately four times smaller than its catchment area. Such conditions mean that any interference with the marine environment, including seabed mining and development activities, has an impact on the ecological balance of the sea.

The transfer of pollutants from the sediments to the water (and thus the change in water quality) and the formation of long-lasting suspended solids is dependent on the type of sediment. Most pollutants and nutrients will pass into the water from sediments with an increased amount of organic matter (e.g. silty and muddy sediments with higher concentrations of metals and POPs). These sediments will also favour the formation of more suspended solids, which will persist in the water for a long time. Intense resuspension can result in the release of nutrients immobilised in the sediment and contribute to eutrophication. In the case of sandy sediments with a low organic matter content (e.g. coarse sandy sediments), the processes described will be less intense. These sediments are generally characterised by small amounts of fine fractions and low concentrations of metals and POPs.

The analysed bottom surface sediments from the BC-Wind OWF Area are inorganic sediments with an organic matter content expressed by loss on ignition (LOI) of less than 4%.

The bottom sediments collected during the environmental studies were analysed for, i.a., nutrients, metals and POPs (i.e. PAHs, PCBs, TBTs, mineral oils).

None of the sediment samples tested exceeded the permissible concentrations of metals, PAHs and PCBs set out in the Regulation of the Minister of the Environment of 11 May 2015 on the recovery of waste outside installations and equipment (Journal of Laws of 2015, item 796), which allows sediment to be classified as clean in the context of practical applications, and although it does not apply to sediment transported within water bodies, it can form the basis for assessing chemical contamination of bottom sediments.

Nutrients

The primary processes affecting the nutrient content of the sea are the geophysical and geochemical processes that control not only the inflow of these elements into seawater, but are also responsible for the dispersion and removal of these compounds.

Compounds present in bottom sediments are cycled through biogeochemical processes. The oxidation of ammonia and its compounds by nitrifying bacteria leads to the formation of nitrogen oxides, and then nitrates. Nitrification that is too intensive is not desirable, however, as nitrates are much more easily flushed out of the sediment than ammonium ions. Processes associated with the construction of foundations and/or substructures, ship anchoring or cable burial can result in better oxygenation of the sediment and thus increased intensity of nitrification processes and a multiplied release of nitrate into the water. This may also upset the overall pattern of the nitrogen cycle by reducing the intensity of denitrification processes under anaerobic conditions, involving the conversion of nitrate to molecular nitrogen.^{43, 44}

In the sediments of the Baltic Sea, nitrogen occurs mainly in organic form and its regional variability is analogous to that of carbon.⁴⁵ Inorganic forms of nitrogen typically account for no more than 10% of total nitrogen present in sediments.⁴⁶ An increase in the proportion of inorganic forms of nitrogen is possible in the erosion and transport zone of fine-dispersed sediments.⁴⁷

As the nitrogen cycle in the environment is a very complex process and its intensity depends on many factors (e.g. oxygenation, temperature, season, primary production, etc.), as well as on the amount of nutrient input from point and diffuse sources and atmospheric deposition^{48, 49}, an exact calculation of the nitrogen load that will enter the water column from the sediment during construction works is not possible. The performed studies were used to provide a very general estimate of the load of this element that may enter the water column during the works. The average nitrogen concentration in the studied sediments was below the LOQ of the method used (i.e. 200 mg·kg⁻¹ DM). The presence of total nitrogen was found only in 9 samples collected in winter (max. concentration 364 mg·kg⁻¹ DM) and in 14 samples collected in summer (max. concentration 537 mg·kg⁻¹ DM).

This is in agreement with literature data on nitrogen content in sediments of the southern Baltic Sea, which ranges from 98-2604 mg N·kg⁻¹ DM in sandy sediments, 1106-3094 mg N·kg⁻¹ DM in sandy and silty sediments, 1904-9506 mg N·kg⁻¹ DM in silty sediments and 1694-4606 mg N·kg⁻¹ DM in clay.⁵⁰ In our study, the content of total nitrogen in both summer and winter was below the LOQ of the method

⁴³ O'Neil P., *Chemistry of the environment*. PWN Scientific Publishers, Warsaw-Wrocław 1998

⁴⁴ Trzeciak A., *Wstęp do chemii nieorganicznej środowiska*. Wydawnictwo Uniwersytetu Wrocławskiego, Wrocław 1995

⁴⁵ Carman R., *Carbon and nutrients*, [in:] Perttälä M. (ed.), *Contaminants in the Baltic Sea sediments. Results of the ICES/HELCOM sediment baseline study. MERI – Report Series of Finnish Institute of Marine Research No. 50.*, Helsinki 2003

⁴⁶ Carman R., Rahm L., *Early diagenesis and chemical characteristics of interstitial water and sediments in the deep deposition bottoms of the Baltic Proper*. J. Sea Res. 1997, 37: 25-47

⁴⁷ Uścińowicz S. (ed.), *Geochemia osadów powierzchniowych Morza Bałtyckiego*. Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Warszawa 2011

⁴⁸ Boynton W.R., Garber J.H., Summers R., Kemp W.M., *Inputs, transformations and transport of nitrogen and phosphorus in Chesapeake Bay and selected tributaries*. Estuaries 1995, 18 (1B): 285-314

⁴⁹ European Commission, *Science for Environment Policy, Mitigation Measures*, Bristol 2015

⁵⁰ Kramarska R., *Osady powierzchni dna*, [in:] Mojski J.E. (ed.), *Atlas geologiczny południowego Bałtyku – 1:500 000, Tab. XXV*. Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995

used, i.e. 200 mg·kg⁻¹ DM in sandy sediments of the central coast. Taking this data into account, it was shown that the amount of nitrogen that could pass from the sediment to the water depths during the construction works would be negligible compared to the approx. 190000 tonnes of total nitrogen carried into the Baltic Sea annually with river waters.⁵¹

Phosphorus in bottom sediments is conventionally divided into labile (mobile, reactive) and refractive. Refractive forms are combinations of phosphorus with calcium, clay, clay minerals and degradation-resistant organic forms of this element. Refractive phosphorus is deposited in sediments and is therefore removed from circulation in the water table. Labile phosphorus is phosphorus contained in fresh organic matter, phosphates in interstitial waters, combinations of phosphorus with Fe³⁺ and phosphates loosely bound to various sediment elements by adsorption. These forms readily re-circulate in the water body, mainly as a result of mineralisation of organic matter and dissolution of phosphorus-Fe connections³⁺ as a result of a decrease in the redox potential.^{52,53} Phosphorus can be a limiting factor in the productivity of marine ecosystems.⁵⁴ In the aquatic environment, when primary production is limited by the amount of phosphorus, the introduction of 1 mg of phosphorus results in an increase of 100 mg of algal dry weight per biological cycle.⁵⁵

The content of nutrients in the study area did not exceed values typical of southern Baltic sediments. The amount of phosphorus that can migrate into the water (so-called available phosphorus) is estimated to be 10-20% of the total phosphorus pool contained in the sediments.⁵⁶ The average concentration of phosphorus in the surveyed sediments was 441 mg·kg⁻¹ DM in winter and 431 mg·kg⁻¹ DM in summer.

PAHs, PCBs

Concentrations of POPs (**PAHs, PCBs**) and harmful substances such as metals and mineral oils remained at low levels in the study area and did not exceed values typical of sandy sediments in the southern Baltic.

Currently, PAHs and PCBs in sediments can undergo a number of transformations, as well as significantly impact the environment. The extent of the impact depends on the transformations these compounds undergo. These can be abiotic processes such as sorption, leaching, oxidation, photodegradation and reactions with other compounds, and biological processes such as microbial transformations. They can have an inhibitory or stimulatory effect on microbial growth, a phytotoxic or stimulatory effect on plant growth and a toxic effect on fauna.⁵⁷ Accumulation of PAHs and PCBs in sediments is favoured by, i.e., a high proportion of the silty and clay fraction with a sediment particle size <0.063 mm, characterised by a large specific surface area and a high capacity to adsorb hydrophobic pollutants and organic phosphorus, sulphur, and nitrogen compounds.

Pyrogenic PAHs, as well as PCBs, show an extremely high persistence in bottom sediments, which is caused by the occlusion of these chemicals in very fine sediment particles.⁵⁸ Consequently, the

⁵¹ Uścińowicz S. (ed.), *Geochemia osadów powierzchniowych Morza Bałtyckiego*. Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Warszawa 2011

⁵² Alloway B.J., Ayres D.C., *Chemiczne podstawy zanieczyszczenia środowiska*. Wydawnictwo Naukowe PWN, Warszawa 1999

⁵³ Uścińowicz S. (ed.), *Geochemia osadów powierzchniowych Morza Bałtyckiego*. Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Warszawa 2011

⁵⁴ Vuorinen I., Antsulevich A., Maximovich N., *Spatial distribution and growth of the common *Mytilus trossulus* L. in the archipelago of SW-Finland, northern Baltic Sea*. Boreal Environment Research 2002, 7: 41-52

⁵⁵ Dojlido J.R., *Chemia wód powierzchniowych*. Wydawnictwo Ekonomia i Środowisko, Białystok 1995

⁵⁶ Wiśniewski S., Dembska G., Grynkiewicz M., Sapota G., Aftanas B., *Badania form fosforu w osadach powierzchniowych strefy brzegowej Zatoki Gdańskiej i osadach dennych kanałów portowych Gdańska i Gdyni*. Ekologia i Technika 2006, XIV (supl.): 113-116

⁵⁷ Galer K., Makuch B., Wolska L., Namieśnik J., *Toxic organic compounds in bottom sediments: problems of sample preparation and analysis*. Chem. Inż. Ekol. 1997, 4 (3): 285

⁵⁸ Bolałek J. (ed.), *Physical, biological and chemical studies of marine bottom sediments*. University of Gdańsk Publishing House, Gdańsk 2010

phenomenon of desorption of the substances in question from the sediment into the water occurs to a limited extent. Generally, it is a maximum of 0.5% for PCB congeners up to 5% for PAH analytes.^{59, 60} Assuming that these amounts will pass into the water from the sediments, it can be concluded that the risk of recontamination of water associated with the remobilisation of PAHs and PCBs in the study area is low.

The concentrations of PAHs and PCBs in the investigated sediments (dry matter) and their availability are presented in the table below (tab. 7.1).

Tab. 7.1 Concentrations of PAHs and PCBs in studied bottom sediments

Indicator	Average concentration in the studied sediments (converted to dry matter) [mg·kg ⁻¹ DM]	Available form [%]
Congeners from the PCB group	<0.0001	0.5
Analytes from the PAH group	0.031	5

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 109

Metal concentrations

The concentrations of metals in the studied sediments from the BC-Wind OWF Area were at low levels. In addition, their availability (i.e. possibility to pass into water) should be taken into account, which depends on the physico-chemical form in which they occur.⁶¹ Metals permanently embedded in the crystal lattice of minerals are immobilised and will not pass into water under natural conditions. However, the mobile (labile) part of the metals is susceptible to passage from the sediment to water.^{62, 63, 64, 65}

The labile form of metals can account (depending on the type of sediment for the individual metals) for between 30 and 80%.^{66, 67, 68, 69, 70, 71} The results of the analysis of the labile form of metals in the studied sediments showed that under unfavourable conditions approx. 62% of lead, approx. 37% of copper and approx. 38% of zinc can pass from the sediment into the water. In the case of nickel and chromium, which are more firmly bound to the sediment, about 24% and 17%, respectively, can pass through.

⁵⁹ Gdaniec-Pietryka M., Mechlińska A., Wolska L., Gałuszka A., Namieśnik J., Remobilisation of polychlorinated biphenyls from sediment and its consequences for their transport in river waters. *Environ. Monit. Assess.* 2013, 185: 4449-4459

⁶⁰ Gdaniec-Pietryka M., Physical speciation and mobility of analytes from the group of polycyclic aromatic hydrocarbons and polychlorinated biphenyls at the bottom sediment-water interface. Doctoral dissertation. Faculty of Chemistry, Department of Analytical Chemistry, Gdańsk University of Technology, Gdańsk, 2008

⁶¹ Scheidat M., Tougaard J., Brasseur S., Carstensen J., van Polanen Petel T., Teilmann J., Reijnders P., Harbour porpoises (*Phocoena phocoena*) and wind farms. A case study in the Dutch North Sea. *Environmental Research Letters* 2011, 6: 025102

⁶² Dembska G., Trace metals in the sediments of the Port of Gdańsk. Doctoral dissertation. Faculty of Biology, Geography and Oceanology, University of Gdańsk, Gdańsk 2003

⁶³ Scheidat M., Tougaard J., Brasseur S., Carstensen J., van Polanen Petel T., Teilmann J., Reijnders P., Harbour porpoises (*Phocoena phocoena*) and wind farms. A case study in the Dutch North Sea. *Environmental Research Letters* 2011, 6: 025102

⁶⁴ SMDI Advisory Group (ed.), Offshore wind farm Baltic Central II. Environmental impact report. Warsaw 2015

⁶⁵ SMDI Advisory Group (ed.), Offshore wind farm Baltic Central III. Environmental impact report. Warsaw 2015

⁶⁶ Dembska G., Trace metals in the sediments of the Port of Gdańsk. Doctoral dissertation. Faculty of Biology, Geography and Oceanology, University of Gdańsk, Gdańsk 2003

⁶⁷ Czech-Damal N.U., Dehnhardt G., Manger P., Hanke W., Passive electroreception in aquatic mammals. *Journal of Comparative Physiology A: Neuroethology, Sensory, Neural, and Behavioural Physiology* 2013, 199: 555-563

⁶⁸ Rydell J., Bach L., Dubourg-Savage M.-J., Green M., Rodrigues L., Hedenström A., Mortality of bats at wind turbines links to nocturnal insect migration? *Eur. J. Wildlife Res.* 2010, 56: 823-827

⁶⁹ Parkman R.H., Curtis C.D., Vaughan D.J., Metal fixation and mobilisation in sediments of the Afon Goch Estuary – Dulas Bay, Anglesey. *Appl. Geochem.* 1996, 11: 203-210

⁷⁰ Scheidat M., Tougaard J., Brasseur S., Carstensen J., van Polanen Petel T., Teilmann J., Reijnders P., Harbour porpoises (*Phocoena phocoena*) and wind farms. A case study in the Dutch North Sea. *Environmental Research Letters* 2011, 6: 025102

⁷¹ Usero J., Gamero M., Morillo J., Gracia I., Comparative study of three sequential extraction procedures for metals in marine sediments. *Environmental International* 1998, 24 (4): 487-496

The average metal concentrations in the investigated sediments (dry matter) and the concentrations of the labile form are shown in the table below (tab. 7.2).

Tab. 7.2 Mean metal concentrations in studied bottom sediments

Metal	Average concentration of total content in the studied sediments (converted to dry matter) [mg·kg⁻¹ DM]	Average concentration of the available (labile) form [mg·kg⁻¹ DM]
Lead (Pb)	3.92	2.42
Copper (Cu)	1.64	0.60
Zinc (Zn)	10.03	3.78
Nickel (Ni)	1.84	0.44
Chromium (Cr)	4.94	0.84
Arsenic (Ar)	1.93	<1.25

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 110

There were trace concentrations of cadmium (LOQ <0.05 mg·kg⁻¹ DM), mercury (LOQ <0.01 mg·kg⁻¹ DM) and TBT (LOQ <0.01 mg·kg⁻¹ DM) in the analysed sediment, generally below the lower LOQ. For this reason, the risk of water contamination associated with the resuspension of these chemicals from the bottom sediment during the construction of the OWF was considered negligible and was not further analysed.

The studied sediments were also characterised by a low activity of the radioactive isotope caesium¹³⁷ Cs, which is typical for sandy sediments.

Raw materials and deposits

The BC-Wind Area is located within the prospective crumbstone raw material area II – the Baltic seabed coastal zone (Fig. 7.4). This area constitutes one large field with an area of 3547.4 km² and extends from Kołobrzeg to Chałupy on the Hel Peninsula. It is dominated by medium-grained sand with admixture of fine-grained sand and, locally, coarse-grained sands, gravelly sand and sandy gravel.⁷²

Area II occupies more than 91% of the BC-Wind Area, i.e. 79.1 km², including 27.82 km² in the prospective sand area (the northeastern part of the area) and 51.28 km² in the prospective sand and sand and gravel area (the remaining part of the area).

⁷² Kramarska R. (ed.), 2019. Explanations to the geoenvironmental map of Polish maritime areas 1:200 000, PGI – PIB Warsaw

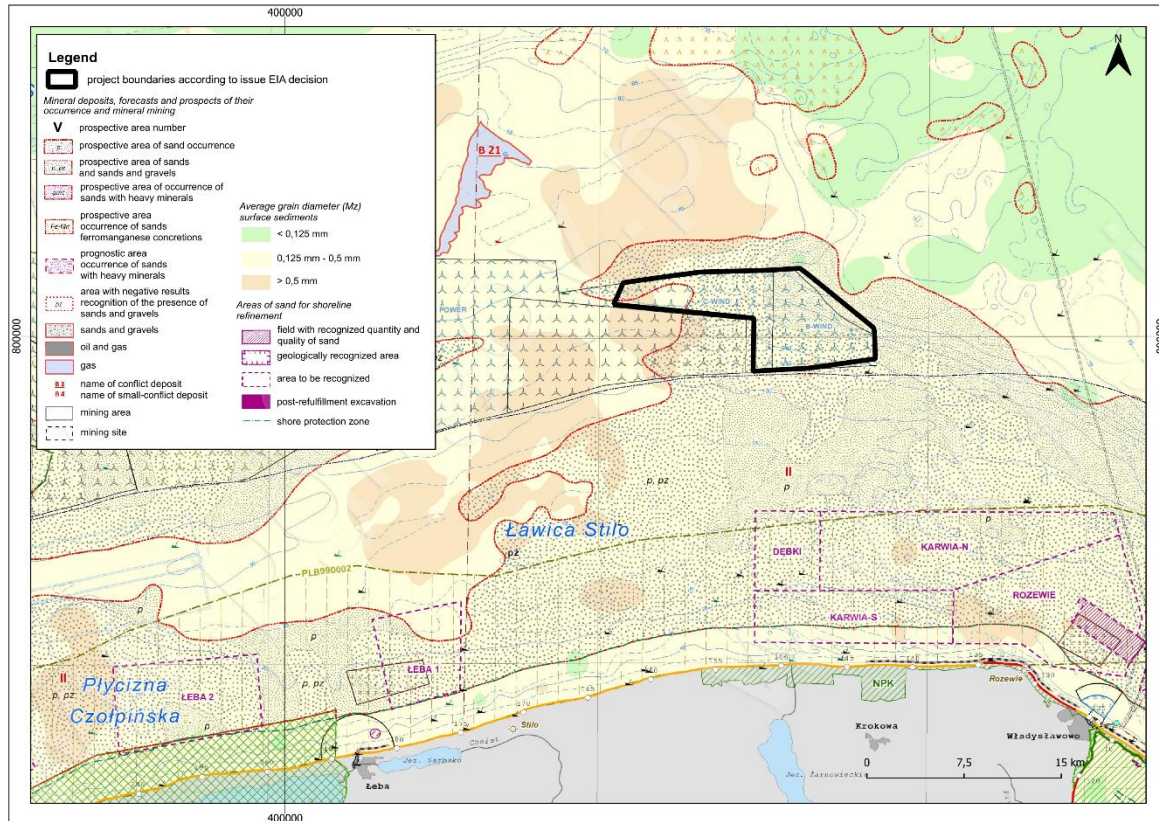


Fig. 7.4 Range of prospective sand areas in the area of the planned project

Source: own compilation based on data from the National Geological Survey (<https://www.pgi.gov.pl>)

Seismoacoustic and bathymetric data was accordingly analysed to identify potential areas of exploitable resources in the BC-Wind Area.

Based on the performed analyses of bathymetric and seismoacoustic data, it is not possible to obtain information on the parameters of the accumulations of fine- and medium-grained sands, which may constitute deposits of minerals [in accordance with the Act of 9 June 2011 – the Geological and Mining Law (Journal of Laws of 2023, item 633, consol., as amended) and the Regulation of the Minister of the Environment of 1 July 2015 on geological documentation of mineral deposits, excluding hydrocarbon deposits (Journal of Laws of 2015, item 987)]. On the predominant part of the bottom identified as a bottom with a sandy cover, sands form a layer with a thickness of 0.5 m to 2 m, and up to several metres only in some places (the northeastern part of the area and the area where sand waves occur) (fig. 7.5). The sands overlie a silty-muddy substrate, with a clayey substrate in some places.

According to the Regulation of the Minister of the Environment of 1 July 2015 on the geological documentation of mineral deposits, excluding hydrocarbon deposits (Journal of Laws of 2015, item 987), the deposit should be at least 2 m thick (the limits of the parameters defining the deposit and its boundaries for individual minerals – gravel, gravelly sand and sandy gravel deposits with a sand point of less than 75% – these parameters could not be determined on the basis of analyses of bathymetric and seismoacoustic data alone).

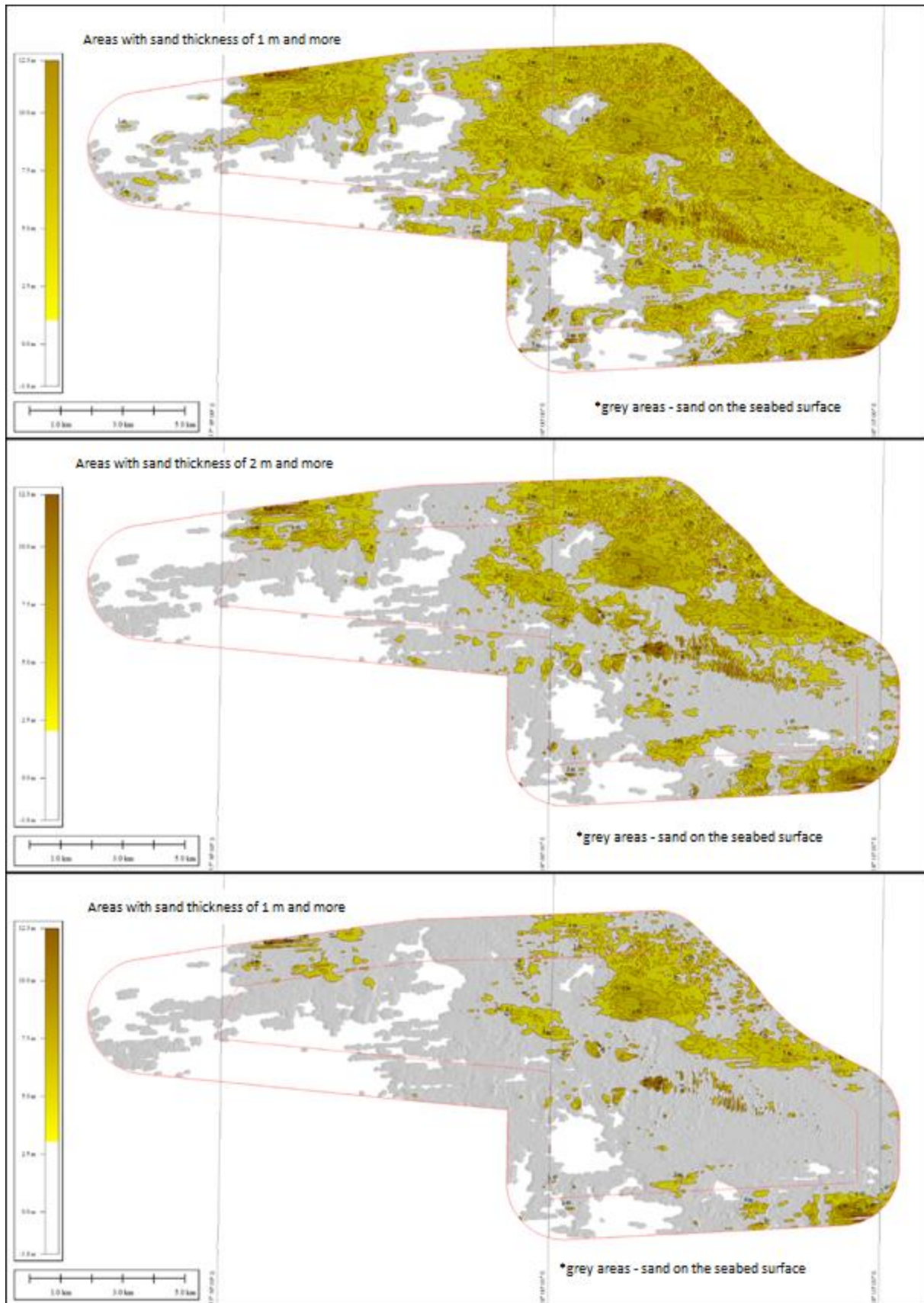


Fig. 7.5 Map of sand thickness in the BC-Wind Area

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 112

On the basis of the data obtained as part of the performed environmental surveys, it is not possible to exclude the presence of crumbstone raw materials suitable for exploitation. Such recognition

requires core sampling to determine the geotechnical parameters of the sediments building up the bottom of the analysed area.

Detailed data on potential resource areas will be collected as part of further work towards obtaining the building permit. Based on these results, the results of the analyses of the nature of the bottom sediments will be presented. The Investor will describe the issue of raw materials in detail when reassessing the environmental impact using the information obtained on the geotechnical parameters of the sediments.

No oil or gas has yet been documented in the BC-Wind Area.⁷³ The area planned for the construction of the offshore wind farm lies in an area of high hydrocarbon prospectivity (Area I and II). The zone of their migration and accumulation (Area I) covers the eastern part of the BC-Wind Area with an area of 18.44 km² (Fig. 7.6). In addition, the western end of the area of the planned project, comprising a 7.43 km² section of the seabed, lies within a zone of elevated hydrocarbon content in the seabed sediments.

As of today, no exploration work is expected to take place in the area (nor are any licences issued).

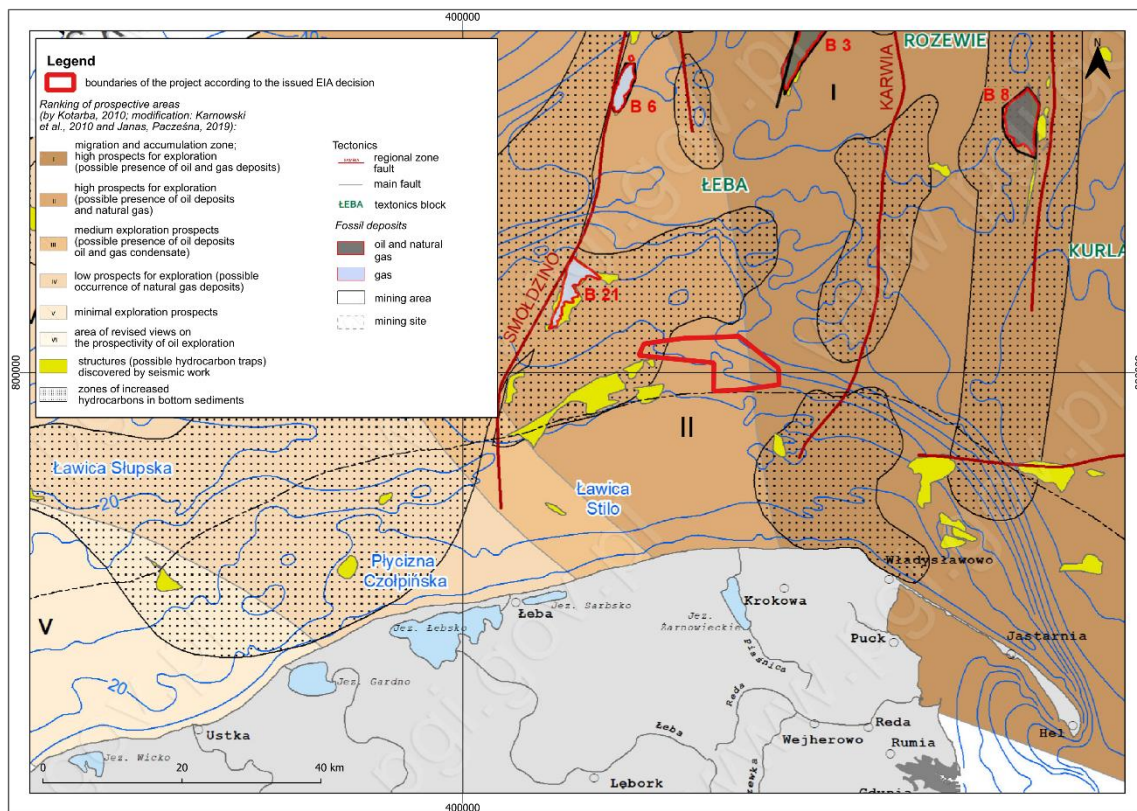


Fig. 7.6 Extent of oil and gas prospective areas in the area of the planned Project

Source: own compilation based on Kramarska (ed.) 2019

7.3. QUALITY OF MARINE WATERS

The results of tests on individual chemical parameters of waters in the BC-Wind OWF Area, such as pH, oxygenation, five-day biochemical oxygen demand (BOD₅), TOC, nutrients, PCBs, PAHs, mineral oil, cyanides, metals, phenols, caesium and strontium, did not generally differ from typical values for South Baltic waters.

⁷³ Kramarska R. (ed.), 2019. Explanations to the geoenvironmental map of Polish maritime areas 1:200 000, PGI – PIB Warsaw

The waters were characterised by an alkaline reaction (pH 7.28-8.26), an alkalinity of approx. 1.75 mval-dm⁻³ and relatively good oxygenation, with seasonal variation characteristic of southern Baltic waters. The assessment of the water quality index in the BC-Wind OWF Area based on oxygen contents in the bottom layer in summer (VII/IX) indicates a good condition (no oxygen deficit). Average dissolved oxygen contents during this period were above the limit value of 6.0 mg-dm⁻³.⁷⁴

During the entire measurement period (November 2019 to September 2020), the average biochemical oxygen demand (BOD₅) in the water samples collected from the BC-Wind OWF Area during the individual measurement periods was below 2.00 mg dm⁻³. Also, the content of suspended solids during the individual measurement periods was at a level typical for the waters of the southern Baltic Sea. The lowest average concentrations of suspended solids in the study area occurred in May and February, while the highest in March, which could be due to increased primary production and agitation and mixing of waters during the storm period.

The content of nutrients – total nitrogen, mineral nitrogen (sum of nitrates, nitrites and ammonia), phosphates and total phosphorus – in the studied waters was characterised by seasonal variability, typical for southern Baltic waters. The lowest concentrations of the analysed substances occurred in the period from May to July, while in autumn and winter months (November to February) their significant increase was observed in accordance with the seasonal tendency of reconstruction of the pool of biogenic substances.

The waters of the study area were characterised by low concentrations of particularly harmful substances. Concentrations of PCBs, mineral oils (mineral oil index), free and bound cyanides, metals Pb, Cd, Cr, Cr(VI), As, Ni, Hg] and phenols were found at trace levels.

The surveyed waters were also characterised by low activity values of ¹³⁷Cs and ⁹⁰Sr, typical of southern Baltic waters, confirming the slow downward trend of ⁹⁰Sr and ¹³⁷Cs concentrations in the Baltic Sea.⁷⁵

In the BC-Wind OWF Area, slightly higher concentrations of PAHs than noted in literature^{76, 77} were observed, which may be due to differences in the preparation of samples for analysis (PAHs were determined in waters without separating suspended matter).

When comparing the obtained results of the analysed water indicators with the limit values specified in the Regulation of the Minister of Maritime Economy and Inland Navigation of 25 June 2021 on the classification of ecological status, ecological potential and chemical status and the method of classification of the status of surface water bodies, as well as environmental quality standards for priority substances (Journal of Laws of 2021, item 1475), it is possible to assign the physicochemical elements analysed in the studied BC-Wind OWF Area the 1st class of water quality (very good condition) due to the value of the following indicators in winter: dissolved oxygen, nitrate nitrogen, inorganic DIN nitrogen compounds and total nitrogen, TOC (in summer), free and bound cyanides, mineral oil index, phenols and metals [As, Cr(VI), Cu]. Due to the value of the indicator of total phosphorus, which was assigned the 2nd class of water quality, and the value of the indicator of phosphate phosphorus, which does not meet the requirements of the 2nd class of water quality, the studied area did not achieve the good status.

Despite the slight difference in concentrations compared to the data presented in the 2002 literature, the limit values of water quality indicators indicated by the regulations listed above for PAHs

⁷⁴ Krzysiński W. (ed.), *Preliminary assessment of the status of marine waters of the Polish Baltic Sea area. Report to the European Commission. Chief Inspectorate for Environmental Protection, 2013*

⁷⁵ Zalewska T., *Radionuclides of anthropogenic origin*, [in:] Zalewska T., Jakusik E., Łysiak-Pastuszek E., Krzysiński W. (eds.), *Bałtyk Południowy w 2011 roku. Characteristics of selected elements of the environment. Institute of Meteorology and Water Management, National Research Institute, Warsaw 2012*

⁷⁶ Witt G., *Occurrence and transport of polycyclic aromatic hydrocarbons in the water of the Baltic Sea. Marine Chemistry 2002, 79: 49-66*

⁷⁷ HELCOM, *Environment of The Baltic Sea area 1994-1998. Baltic Sea Environ. Proceed. No. 82B. Helsinki 2002*

[anthracene, fluoranthene, naphthalene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene] were also not exceeded. The limit values for the indicators of cadmium, lead, mercury and nickel were also not exceeded.

7.3.1. Environmental assessment of marine waters

The planned project is located in *sub-area 27 Open Waters of the Eastern Baltic Proper* according to the National Sea Water Protection Programme, adopted by the Regulation of the Council of Ministers of 11 December 2017 on the adoption of the National Programme for the Protection of Marine Waters (Journal of Laws 2017, item 2469); according to the monitoring of HELCOM and the Chief Inspectorate for Environmental Protection, the basin is referred to as the Eastern Gotland Basin. The location of sub-basin 27 is shown in Fig. 2.1 in Chapter 2.2 of this Report.

The assessment of the environmental status of marine waters was carried out on the basis of the criteria recommended by the MSFD, for eleven features from D1 to D11, which are divided into features assessing environmental status and those describing pressures. Member states are developing a set of environmental targets and associated indicators to guide efforts towards achieving a Good Environmental Status (GES) of the marine environment. Baseline indicators and parameters for assessing whether environmental objectives have been achieved are established under the Marine Water Monitoring Programme. The current set of environmental objectives for marine waters was adopted by the Regulation of the Minister of Infrastructure of 25 February 2021 on the adoption of an update of the set of environmental objectives for marine waters (Journal of Laws of 2021, item 569).

The current set of environmental objectives and the deadline for achieving them are outlined in the table below (Tab. 7.3. The achievement of the updated environmental objectives for marine waters should be possible by 2022. This is because the next update of the preliminary assessment of the environmental status of marine waters will be carried out for the period of 2017-2022, which will make it possible to determine the effectiveness of the measures taken to achieve the identified environmental objectives for marine waters in practice.

Tab. 7.3 Set of environmental targets set for individual features of marine waters

No.	Feature	Target for the feature	Criterion	Environmental objective
I. STATUS FEATURES				
1.	Feature D1 – Biodiversity is maintained. The quality and occurrence of habitats and the distribution and diversity of species correspond to the prevailing physiographic, geographic and climatic conditions of the Baltic Sea region.	Reduce or maintain anthropogenic pressure at a level that ensures the maintenance of natural habitats in which the natural biodiversity of the biotic elements present is maintained, including in fisheries, and habitat protection within Natura 2000 sites is ensured.	Criterion D1C1 (baseline): Bycatch mortality is below levels that threaten the species, so its long-term viability is assured.	Comprehension of the extent of by-catch of species listed in Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Official Journal of the EU L 20 of 26 January 2010, p. 7, as amended), hereinafter referred to as the Birds Directive, and Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Official Journal of the EU L 206 of 22 July 1992, p. 7, as amended –Polish Special Edition, Chapter 15, Vol. 2, p. 102), hereinafter referred to as the Habitats Directive, in order to implement measures to minimise its effects and to restore and maintain natural, stable populations of species.
			Criterion D1C2 (core): The population size of the species has not suffered from anthropogenic impacts, so its long-term viability is ensured.	Maintenance of populations of the species listed in the Birds Directive and the Habitats Directive, corresponding to natural physical, geographical and climatic conditions, by aiming to reduce the main factors that reduce the abundance or welfare of the populations of these species, such as bycatch in fishing nets, direct elimination from the environment or the introduction of biogenic, synthetic, non-synthetic substances and energy sources, including underwater noise.
			Criterion D1C3 (secondary): Demographic characteristics of the population (e.g. body size or age class structure, sex ratio, fecundity rate and survival rate) of the species indicate a healthy population that has not suffered from anthropogenic impacts.	Maintenance of population status of the species listed in the Birds Directive and the Habitats Directive, corresponding to natural physical, geographical and climatic conditions, by reducing the main pressures such as disturbance of species, direct elimination from the environment, including bycatch in nets, and the introduction of biogenic, synthetic and non-synthetic substances into the environment.
			Criterion D1C4 (primary): The range of species and, where appropriate, their structure, are consistent with the prevailing physiographic, geographical and climatic conditions.	The geographical distribution and range of species listed under the Birds Directive and the Habitats Directive should be given a near-natural range and condition by aiming to reduce the main pressures, such as disturbance of species, direct elimination from the environment, including by-catch in nets, or the introduction of biogenic, synthetic and non-synthetic substances into the environment.

No.	Feature	Target for the feature	Criterion	Environmental objective
			Criterion D1C5 (core): The species' habitat has the necessary range and conditions to support the different stages in the species' life spans.	Reduction of pressure factors associated with permanent and temporary changes within habitats and the introduction of nutrients, synthetic, non-synthetic substances and energy, including underwater noise. Taking steps to revitalise degraded marine areas and protect threatened biotopes.
			Criterion D1C6 (core): The condition of the habitat type, including its biotic and abiotic structure and its functions (e.g. typical species composition, relative abundance, absence of particularly sensitive species or species performing a key function, size structure of species), has not been harmed by anthropogenic impacts.	Reduction of pressures from nutrient, synthetic, non-synthetic and organic matter inputs, to restore the natural structure and function of pelagic habitats.
			Criterion D6C4 (core): The extent of habitat type loss resulting from anthropogenic impacts does not exceed a certain percentage of the natural range of the habitat type in the area under assessment. The maximum acceptable extent of habitat loss in relation to the total natural range of the habitat type is established by the Member States of the European Union through cooperation at European Union level, taking into account regional or sub-regional specificities.	Same as objectives for feature D6.

No.	Feature	Target for the feature	Criterion	Environmental objective
			Criterion D6C5 (core): The extent of negative effects of anthropogenic impacts on the status of habitat types, including changes to their biotic and abiotic structure and function (e.g. typical species composition, relative abundance, absence of particularly sensitive species or species providing a key function, size structure of species), does not exceed a certain percentage of the natural range of the habitat in the assessed area.	Same as objectives for feature D6.
2.	Feature D4 – Occurrence of elements of the marine food chain in numbers and diversity at levels that ensure species diversity and maintain full reproductive capacity.	Reduce the impact of human activities to a level that allows the ecosystem to reach a state where all components of the marine trophic chain exhibit a natural and stable level of abundance and diversity, and where the productivity of the biotic components guarantees the proper functioning of the trophic network.	Criterion D4C1 (primary): Diversity (species composition, as well as their relative abundance) in the trophic group has not been affected due to anthropogenic impacts.	Limiting the introduction of nutrients and organic matter and the scale of exploitation of species listed in the Birds Directive and the Habitats Directive to a level that ensures the maintenance of natural diversity within trophic groups.
			Criterion D4C2 (primary): The balance of total abundance between trophic groups has not been compromised due to anthropogenic impacts.	Limiting the introduction of nutrients and organic matter and the scale of exploitation of species listed under the Birds Directive and the Habitats Directive to a level that ensures a balance in abundance between trophic groups.
			Criterion D4C3 (secondary): The size distribution of individuals in the trophic group has not been affected due to anthropogenic impacts.	Environmental objective: not to increase the pressure from nutrient and organic matter inputs and the scale of exploitation of species listed under the Birds Directive and the Habitats Directive to a level that ensures that the natural size distribution of individuals in the trophic group is maintained.
			Criterion D4C4 (secondary): The productivity of the trophic group has not been affected due to anthropogenic impacts.	Environmental objective: not to increase the pressure from nutrient and organic matter inputs and the scale of exploitation of species listed under the Birds Directive and the Habitats Directive to a level that ensures the natural productivity of trophic groups is maintained.

No.	Feature	Target for the feature	Criterion	Environmental objective
II. PRESSURE FEATURES				
3.	Feature D2 – Maintain alien species introduced into marine ecosystems as a result of human activities at levels that do not adversely alter those ecosystems.	Reduce the spread of alien species introduced into the environment as a result of human activities to ensure that alien species occur at levels that do not disturb the structure and functioning of the ecosystem, in particular for specific groups of species, areas particularly vulnerable to introduction and general habitat types, by taking appropriate action.	Criterion D2C1 (core): The number of alien species newly introduced into marine ecosystems as a result of human activities within a period of 6 years from the reference year, according to the initial assessment of the environmental status of marine waters referred to in Article 8(1) of the MSFD, shall be minimised and, where possible, reduced to zero.	Reduction of pressure from the introductions of alien species and limiting the potential for newly introduced alien species to spread from their original introduction sites.
			Criterion D2C2 (secondary): High abundance and spatial distribution of established alien species, especially invasive alien species, significantly contributing to adverse effects on particular species groups or general habitat types.	Minimisation of new introductions of alien species and the scale of dispersal of alien species to reduce their negative impacts on ecosystem structure and functioning.
			Criterion D2C3 (secondary): Percentage of species groups or spatial extent of general habitat types that are adversely altered due to alien species, especially invasive alien species.	Reduction of the impact of invasive species to a level that ensures only minimal or no noticeable negative impact on the environment.
4.	Feature D3 – Maintain populations of all commercially exploited fish and shellfish within safe biological limits and distribution of these fish and shellfish populations by age	The aim is to maintain commercially exploited fish and shellfish populations within safe biological limits consistent with natural conditions by ensuring that all commercially exploited fish stocks are exploited at or below the	Criterion D3C1 (core): The fishing mortality rate of commercially exploited species populations is at or below the level to achieve maximum sustainable yield (MSY).	Maintenance of exploitation of all commercially exploited fish stocks at or below the maximum sustainable yield level, ensuring that all commercially exploited fish species are within safe biological limits.

No.	Feature	Target for the feature	Criterion	Environmental objective
5.	and abundance indicative of good status.	maximum sustainable yield level, ensuring that all commercially exploited fish are within safe biological limits, and by limiting or maintaining the exploitation of fish stocks at a level that maintains their full reproductive capacity and full range of age and size individuals.	Criterion D3C2 (core): The spawning stock biomass of commercially exploited species populations is above levels to achieve maximum sustainable yield.	Maintenance of exploitation of all commercially exploited fish stocks at a level that ensures they remain at full reproductive capacity.
			Criterion D3C3 (primary): The age and size cross-section of individuals in a commercially exploited species population indicates good population health. This should be associated with a high proportion of old or large individuals and limited adverse effects of exploitation on genetic diversity.	Limiting the exploitation of all commercially exploited fish stocks to a level that ensures that the full natural range of ages and sizes of individuals in the population is achieved.
		Maintain the inflow of annual nitrogen and phosphorus loads into the Baltic Sea through rivers and atmospheric deposition below the maximum allowable inputs (MAI) established under the regional arrangement (HELCOM), which will allow a reduction of nutrient concentrations in the sea to levels not exceeding acceptable threshold values, which are in accordance with the recommendations of existing national and European Union legislation, and which guarantee the achievement or maintenance of a good environmental status and do not cause adverse effects in the form of excessive algal growth, elevated concentrations of chlorophyll 'a' in the water column, decreased transparency of seawater and	Criterion D5C1 (baseline): Nutrient concentrations are not at levels that indicate negative effects of eutrophication.	Maintenance of the current downward trend in the level of annual nitrogen and phosphorus loads deposited to the Baltic Sea by the waters of the Vistula River, the Oder River, the Pomeranian rivers and the Pomeranian Coastal Region, as well as the downward trend in the intensity of atmospheric deposition of nitrogen and phosphorus, in order to achieve a reduction in the concentrations of nutrients to levels not exceeding permissible threshold values, which are in accordance with the recommendations of the applicable national and international legal acts and which guarantee the achievement or maintenance of good environmental status.
			Criterion D5C2 (baseline): Concentrations of chlorophyll 'a' are not at levels that indicate negative effects of excess nutrients.	Environmental objective: to maintain the decreasing trend of nitrogen and phosphorus compound inflows to the sea influencing the reduction of excessive algal growth and, consequently, to reduce the concentrations of chlorophyll 'a' in the water column below acceptable threshold values, which are in line with the recommendations of the applicable national and international legislation.
			Criterion D5C3 (secondary): The number, spatial extent and duration of harmful plankton blooms	Environmental objective: to maintain a declining trend of nitrogen and phosphorus inputs to the sea to reduce excessive plankton growth, including toxic cyanobacteria blooms.

No.	Feature	Target for the feature	Criterion	Environmental objective
		oxygenation levels in the bottom waters, which consequently promote the proper development of pelagic and benthic habitats.	are not at levels that indicate negative effects of excess nutrients.	
			Criterion D5C4 (secondary): The limit of the euphotic zone (transparency) of the water column has not been lowered, due to an increase in the amount of suspended algae in the water column, to a level that indicates the negative effects of excess nutrients.	Maintenance of a decreasing trend in the inflow of nitrogen compounds, phosphorus compounds and organic matter into the sea, resulting in seawater clarity not reducing below acceptable threshold values, which are in line with the recommendations of existing national and international legislation, leading to the disturbance of submerged vegetation.
			Criterion D5C5 (baseline): Dissolved oxygen concentration has not been reduced to a level that indicates negative effects of excess nutrients on benthic habitats, including associated biota and mobile species, or other effects of eutrophication.	Achievement of a higher level of oxygenation in bottom waters, particularly in the deep sea, as a result of maintenance of the downward trend in the input of nitrogen and phosphorus compounds to the sea, which will translate into a reduction in the occurrence of conditions that increase oxygen consumption from bottom waters, mainly due to an excessive increase in the production of organic matter, resulting in the absence of negative impacts on seabed dwelling organisms and adjacent waters and reducing the occurrence of internal recurrent enrichment of the ecosystem in phosphorus released from sediments.
			Criterion D5C6 (secondary): The abundance of opportunistic macroscopic algae is not at levels that indicate negative effects of excess nutrients.	Reduction of the excessive proliferation of opportunistic macroalgae, leading to an imbalance in the benthic community, by maintaining the decreasing trend of nitrogen and phosphorus inputs to the sea.
			Criterion D5C7 (secondary): The species composition and relative prevalence or depth of distribution of macrophyte assemblages reach values that indicate no negative effects of excess nutrients, including by reducing water clarity.	Maintenance of the decreasing trend of nitrogen and phosphorus inputs to the sea in order to reduce adverse impacts resulting from decreased seawater transparency and reduced oxygenation of bottom waters, which will translate into an increase in the proportion of perennial species in the macrophyte community at the sites and an increase in the depth range of their occurrence.

No.	Feature	Target for the feature	Criterion	Environmental objective
			Criterion D5C8 (secondary): The species composition and relative prevalence of macrofaunal assemblages reach values that indicate no negative effects of excess nutrients and organic matter.	Maintenance of the decreasing trend of nitrogen and phosphorus inputs to the sea in order to achieve an improvement in the state of the macrozoobenthic community at sea.
6.	Feature D6 – Maintain the integrity of the seabed at a level that ensures that the structure and function of benthic ecosystems are protected and not adversely affected in particular.	Reduce cumulative pressure on the seabed to a level that allows benthic habitats to function at near-natural levels.	Criterion D6C1 (primary): Spatial extent and distribution of physical loss (permanent change) of the natural seabed.	Reduction of pressures associated with seabed loss.
			Criterion D6C2 (primary): Spatial extent and distribution of seabed physical disturbance pressures.	Reduction of physical pressures associated with seabed disturbance.
			Criterion D6C3 (core): The spatial extent of any habitat type that is adversely affected by altering its biotic and abiotic structure and function (e.g. typical species composition, relative abundance, absence of particularly sensitive species or species with a key function, size structure of species) by physical disturbance.	Reduction of cumulative pressures on habitats.
			Criterion D6C4 (core): The extent of habitat type loss resulting from anthropogenic impacts does not exceed a certain percentage of the natural range of the habitat type in the area under assessment. The maximum acceptable extent of habitat loss, in relation to the total natural range of the habitat	Reduction of habitat loss to maintain a near-natural range.

No.	Feature	Target for the feature	Criterion	Environmental objective
			type, shall be determined by the Member States of the European Union through cooperation at European Union level, taking into account regional or sub-regional specificities.	
			Criterion D6C5 (core): The extent of negative effects of anthropogenic impacts on the status of habitat types, including changes to their biotic and abiotic structure and function (e.g. typical species composition, relative abundance, absence of particularly sensitive species or species providing a key function, size structure of species), does not exceed a certain percentage of the natural range of the habitat in the assessed area.	Reduction of the negative impact of anthropogenic pressures associated with, i.a., the introduction of biogenic, synthetic, non-synthetic substances and organic matter into the environment in order to maintain habitats, especially benthic habitats, in a near-natural state.
7.	Feature D7 – A permanent change in hydrographic characteristics that does not adversely affect marine ecosystems.	The environmental objectives for feature D7 were set at a general level for each of the assessment criteria contained in Commission Decision 2017/848 and at a specific level for the indicators used for the assessment in the update of the preliminary assessment of the environmental status of marine waters.	Criterion D7C1 (secondary): The spatial extent and distribution of permanent changes in hydrographic conditions (e.g. changes in wave activity, currents, salinity or temperature) of the seabed and water column associated in particular with the physical loss of the natural seabed.	Reduction of pressures associated with permanent changes in hydrographic conditions.
			Criterion D7C2 (secondary): Spatial extent of any negatively affected benthic habitat (physical and hydrographic features and associated biological communities) due to	Reduction of cumulative pressures on habitats.

No.	Feature	Target for the feature	Criterion	Environmental objective
			permanent changes in hydrographic conditions.	
8.	Feature D8 – Maintain concentrations of pollutants at a level that does not cause marine pollution.	For each criterion of feature D8, an environmental objective has been defined taking into account all the elements included in that criterion.	Criterion D8C1 (primary): Within coastal and territorial waters and outside territorial waters, concentrations of pollutants do not exceed specified threshold values.	Reduction or maintenance at current levels of inputs of pollutants from marine sources, including the application of measures to minimise releases of pollutants resulting from acute events, and land-based inputs to the marine environment, with the aim of achieving or maintaining concentrations of pollutants in biotic and abiotic components of the marine ecosystem at levels not exceeding acceptable threshold values, below which the likelihood of adverse effects of hazardous substances on marine organisms is minimal and which comply with the recommendations of existing national and international legal instruments and which ensure the achievement or maintenance of good environmental status.
			Criterion D8C2 (secondary): Species health and habitat condition (such as species composition of these habitats and relative abundance in long-term contaminated locations) have not been adversely affected due to contaminants, including through cumulative and synergistic effects.	Areas selected for long-term exposure to pollutants: the impact of pollutants on marine biota organisms at different levels: molecular, cellular, tissue, organ, individual, population taking into account cumulative and synergistic effects is at a level that guarantees the proper functioning of the organisms taking into account the preservation of normal physiological functions and thus guarantees the preservation of normal species structure and habitat range.
			Criterion D8C3 (baseline): The spatial extent and duration of significant acute pollution involving polluting substances as defined in Article 2, point 2 of Directive 2005/35/EC of the European Parliament and of the Council of 7 September 2005 on ship-source pollution and on the introduction of penalties, including criminal penalties,	Polish sea areas defined by national borders: the occurrence of pollution emergencies involving pollutants as defined in Article 2, point 2 of Directive 2005/35/EC of the European Parliament and of the Council of 7 September 2005 on ship-source pollution and the introduction of penalties, including criminal penalties, for pollution offences, including oil and similar constituents, is reduced to a minimum through the implementation of appropriate measures at operational level and security systems.

No.	Feature	Target for the feature	Criterion	Environmental objective
			for pollution offences (Official Journal of the EU L 255 of 30 September 2005, p. 11, as amended), including oil and similar constituents, is minimised.	
			Criterion D8C4 (secondary): Negative effects of significant acute pollution on species health and habitat condition (such as species composition and relative abundance) are minimised and eliminated where possible.	Areas of occurrence of contaminants of an abrupt nature: the impact of pollutants from releases resulting from abrupt events on the structure of species (listed in Table 1 in Part II of the Annex to the Commission Decision 2017/848) and the extent of habitats (listed in Table 2 in Part II of the Annex to the Commission Decision 2017/848) is reduced to a minimum by implementing measures and safeguards to eliminate the occurrence of abrupt pollutants.
9.	Feature D9 – Maintain levels of contaminants in fish and shellfish intended for human consumption that do not exceed the levels specified in standards or regulations for levels of these substances.	To reduce or maintain at current levels the input of pollutants from various marine and terrestrial sources entering the marine environment in order to achieve or maintain concentrations of pollutants in fish and seafood intended for human consumption at levels not exceeding limit values that comply with the standards and recommendations of existing national and European Union legislation and that guarantee the safety of consumption and the achievement or maintenance of good environmental status.	Criterion D9C1 (primary): The level of contaminants in edible tissues (muscle, liver, eggs, flesh or other soft parts) of fish and seafood (including fish, crustaceans, molluscs, echinoderms, seaweeds and other marine plants) caught or collected in the wild (excluding mariculture fish) does not exceed specified thresholds.	For Polish marine areas: FAO 27.3d.25 (ICES 25*) (ICS: International Council for the Exploration of the Sea fishing grounds): concentrations of the contaminants or groups of contaminants listed in Commission Regulation (EC) No. 1881/2006 of 19 December 2006, setting maximum levels for certain contaminants in foodstuffs (Official Journal of the EU L 364 of 20 December 2006, p. 5, as amended) measured in the specified matrices do not exceed the permitted levels defining the thresholds laid down in that Regulation. Concentrations of substances or groups of substances other than those listed in the aforementioned Regulation which may have a regional pollution effect and which have been identified at regional level as being relevant for the assessment of the environmental status, do not exceed the thresholds defined regionally or nationally.
10.	Feature 10 – Maintain waste characteristics and quantities at a level that does not cause harm to the marine, transitional and coastal water environment.	Reduce the amount of newly emerging and deposited solid waste in the marine environment, from a variety of terrestrial and marine sources, to levels that guarantee the proper functioning of the ecosystem, taking into account the natural resilience of the ecosystem, or to eliminate newly emerging waste altogether.	Criterion D10C1 (primary): The composition, quantity and spatial distribution of waste on the shore, in the surface layer of the water column and on the seabed are maintained at levels that do not cause damage to the coastal and marine environment. The element of this criterion is waste,	Achievement of decreasing trends in solid waste, excluding micro-waste, falling into one of the categories: artificial polymeric materials, rubber, fabric and textiles, paper and cardboard, processed or treated wood, metal, glass and ceramics, chemicals, unidentified waste and food waste, occurring on the shoreline, floating on the surface of the water and deposited on the seabed, with a particular focus on waste characterised by extreme harmfulness or a very long degradation period, by taking appropriate action including appropriate legislation, waste disposal, but also by proper education and raising public awareness.

No.	Feature	Target for the feature	Criterion	Environmental objective
			excluding micro-waste, falling into one of the following categories: 1) artificial polymeric materials; 2) rubber; 3) fabric and textiles; 4) paper and cardboard; 5) processed or treated wood; 6) metal; 7) glass and ceramics; 8) chemicals; 9) unidentified waste; 10) food waste.	
			Criterion D10C2 (primary): The composition, quantity and spatial distribution of micro-waste on the shore, in the surface layer of the water column and in the sediment on the seabed are maintained at levels that do not cause damage to the coastal and marine environment. An element of this criterion is micro-waste, by which is meant particles less than 5 mm in size classified into two categories: 'artificial polymeric materials' and 'other'.	Achievement of decreasing trends in micro-waste, i.e. particles less than 5 mm in size classified in two categories: 'artificial polymeric materials' and 'other', found on the shoreline, in surface water and in marine sediments, by taking appropriate action including appropriate legislation on the use of microparticles in industry and their disposal at the waste water treatment stage, the disposal of marine wastes that are a source of secondary microparticles, but also by actions including appropriate education and raising public awareness.
			Criterion D10C3 (secondary): The amount of waste and micro-waste ingested by marine animals is maintained at a level that does not adversely affect the health of these species. An element of this criterion is waste and micro-waste classified into two categories: 'artificial polymeric materials' and 'other', which have been	Achieving trends of decreasing numbers of waste and micro-waste classified in two categories: 'artificial polymeric materials' and 'other', ingested by marine animals representing resident species belonging to the groups: birds, mammals, reptiles, fish or invertebrates, by meeting the targets indicated for criteria D10C1 and D10C2.

No.	Feature	Target for the feature	Criterion	Environmental objective
			quantified in any species from the following groups: birds, mammals, reptiles, fish or invertebrates.	
			Criterion D10C4 (secondary): The number of individual individuals of each species adversely affected by waste, e.g. through entanglement in nets, other types of injury, health impacts or death, for which the criterion element is the number of individuals belonging to selected bird, mammal, reptile, fish or invertebrate species.	Minimisation of the number of individuals belonging to selected species of birds, mammals, reptiles, fish or invertebrates that have suffered adverse effects in the form of health changes or death, resulting from the presence of waste, including micro-waste, in the marine environment (e.g. as a result of ingestion of waste or entanglement in nets) by meeting the objectives indicated for criteria D10C1 and D10C2.
11.	Feature 11 – Maintain energy inputs, including undersea noise, at levels that do not adversely affect the marine environment.	It is proposed to set general environmental objectives for anthropogenic underwater noise in the marine environment, as it represents a potential significant threat to marine animal organisms, despite the lack of established threshold values at European level. Environmental objectives have been identified at an overall level for each of the criteria and their related indicators used for assessment in the update of the preliminary assessment of the environmental status of marine waters.	Criterion D11C1 (baseline): The spatial distribution, temporal range and levels of impulse sound in water associated with human activities do not reach levels that cause adverse effects on marine animal populations. Criterion D11C2 (baseline): The spatial distribution, temporal range and levels of continuous low-frequency sounds in the water associated with human activities do not reach levels that cause adverse effects on marine animal populations.	Reduce the pressures associated with the temporal and spatial occurrence of impulse sounds in the sea associated with human activities, above levels that adversely affect marine animal populations. Reduce the pressures associated with the temporal and spatial occurrence of continuous low-frequency sounds in the sea associated with human activities, above levels that adversely affect marine animal populations.

Source: own compilation based on the Regulation of the Minister of Infrastructure of 25 February 2021 on the adoption of an updated set of environmental objectives for marine waters (Journal of Laws of 2021, item 569)

The assessment of the state of the marine water environment for sub-area 27, within which the BC-Wind OWF is located, was carried out on the basis of the criteria recommended by the MSFD on the basis of the baseline indicators set for the individual features. The data obtained from the Marine Water Monitoring Programme enabled an assessment to be made in 2022 for two status features: D1 – biodiversity and D6 – seabed integrity, and six pressure features: D2 – alien species, D3 – commercially exploited fish and invertebrate populations, D5 – eutrophication, D8 – pollutants with pollution-related effects, D9 – pollutants in fish and other seafood, and D10 – waste in the marine environment.

An assessment of the condition of the marine environment of sub-area 27 is presented in the table below (Tab. 7.4), which is based on the results presented in the 'Assessment of the environmental status of the Polish marine areas of the Baltic Sea on the basis of monitoring data from the year 2022 against the background of the decade of 2012-2021'.

Tab. 7.4 Assessment of the state of the marine environment in 2022 (good environmental status – GES, inadequate environmental status – subGES, n.d. – no data, n.a. – indicator not applicable)

Sub-area	Sub-area name	D1/D4							D6	D3	D5	D8				D9		D10
		Fish – PMFI	Fish – LFI	Fish – key species and trophic	Phytoplankton	Zooplankton	Macrozoobenthos	Chlorophyll a				Radionuclides	Heavy metals	POPs	Micronucleus test	Heavy metals	POPs	
27	Open waters of the eastern Baltic Proper	—	subGES	—	GES	GES	subGES	GES	subGES	subGES	subGES	GES	subGES	subGES	GES	GES	subGES	n.d.

D1 – Biodiversity, D3 – Commercially exploited fish and invertebrate species, D4 – Food chains, D5 – Eutrophication, D6 – Seabed integrity, D8 – Contaminants and pollution effects, D9 – Harmful substances in fish and seafood, D10 – Marine litter

Source: Zalewska and Kraśniewski (eds.), 2023

The assessment of the status of the marine environment of sub-area 27 shows that good status has been achieved in the attributes: D1/D4 biodiversity/food chains – phytoplankton, zooplankton and chlorophyll a, D8 pollutants and pollution effects – radionuclides and micronucleus test and D9 harmful substances in fish and seafood – heavy metals. In the remaining attributes, good environmental status was not achieved or not assessed.

7.4. ANIMATE NATURE

The characterisation of animate nature was prepared based on annual surveys conducted in 2019-2020 within the BC-Wind OWF and in its immediate vicinity (within 1 NM of the boundary of the farm). The results were cross-referenced with surveys conducted as part of the State Environmental Monitoring and to surveys conducted in neighbouring offshore wind farm areas.

7.4.1. Phytobenthos

Surveys carried out in the area of the planned BC-Wind OWF and in the zone 1 NM from the boundary of the area have shown the absence of submerged vegetation attached to boulders and stones lying on the seabed. Previous surveys carried out in the PMA showed that phytobenthos is present up

to a depth of approx. 22 m, i.e. to the extent of the euphotic zone.^{78, 79, 80, 81, 82, 83} According to the general classification of benthic habitats based on the EUNIS (European Union Nature Information System) classification, the dominant habitat type in the area of the planned project are the circalittoral sands⁸⁴ located in the aphotic zone, which is reached by less than 1% of photosynthetically active radiation (PAR).⁸⁵ The minimum depth of the seabed in the study area is 28 m, which is below the limit of the phytobenthic range. It should therefore be assumed that phytobenthos is not present in the entire BC-Wind OWF Area.

7.4.2. Macrozoobenthos

Macrozoobenthos (benthic macrofauna) is a group of invertebrate organisms living within the sediment (infauna) or inhabiting the superficial layer of bottom sediments (epifauna), including hard substrate (boulders, stones), remaining when the sediment is washed over a 1 mm mesh sieve. They are mostly sedentary organisms with at least an annual life cycle. The Baltic macrozoobenthos comprises marine, brackish and even freshwater species, mainly bivalves (*Bivalvia*), crustaceans (*Crustacea*), polychaetes (*Polychaeta*), oligochaetes (*Oligochaeta*) and gastropods (*Gastropoda*). In addition, bryozoans (*Bryozoa*) and helminths (*Hydrozoa*) are often found on hard substrates. Macrozoobenthos plays an important role in the trophic network of marine ecosystems as food for many fish and seabird species. Bivalve eggs and larvae are food for zooplankton and fish larvae. Benthic fauna shape the living conditions of other organisms (habitat-forming role of bivalves, provision of shelter for associated fauna) and influence the state of the environment (e.g. bioturbation by riffle organisms transforms the physical and geochemical structure of the sediment and has a positive effect on its oxygenation; biofiltration of suspended matter from the water by bivalves cleans the bottom water and reduces the effects of eutrophication). Benthic invertebrates can be a sensitive bioindicator of the environment, as the taxonomic diversity, abundance, biomass and sensitivity of the individual taxa that make up the assemblage of benthic organisms are indicative of the ecological quality of the seabed.^{86,}

^{87, 88, 89, 90, 91, 92}

For the purpose of this report, separate macrozoobenthos surveys were carried out on a soft bottom (sand and gravel sediments) and a hard bottom (stones). In the area of the BC-Wind OWF (1

⁷⁸ Feistel R., Nausch G., Wasmund N. (ed.), *State and evolution of the Baltic Sea, 1952-2005. A detailed 50-year survey of meteorology and climate, physics, chemistry, biology, and marine environment*. A John Wiley & Sons, Inc., 2008

⁷⁹ SMDI Advisory Group (ed.), *Offshore wind farm Baltic Central II. Environmental impact report*. Warsaw 2015

⁸⁰ SMDI Advisory Group (ed.), *Offshore wind farm Baltic Central III. Environmental impact report*. Warsaw 2015

⁸¹ Kruk-Dowgiałło L., Kramarska R., Gajewski J. (eds.), *Siedliska przyrodnicze polskiej strefy Bałtyku. Głazowisko Ławicy Słupskiej*. Instytut Morski w Gdańsku, Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Gdańsk-Warszawa 2011

⁸² 328. *State Environmental Monitoring. State Environmental Monitoring data on phytobenthos in Polish marine areas, 2000-2018*

⁸³ *Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters, CIEP, Warsaw 2024*

⁸⁴ *Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters, CIEP, Warsaw 2024*

⁸⁵ Sokołowski A., Jankowska E., Bazy P., Jędruch A., *Distribution and extent of benthic habitats in Puck Bay (Gulf of Gdańsk, southern Baltic Sea)*, *Oceanologia* 63, 301-320, 2019

⁸⁶ Andruliewicz E., Szymelfening M., Urbański J., Węslawski J.M., Węslawski S., *Morze Bałtyckie – o tym warto wiedzieć*. Polski Klub Ekologiczny, Okręg Wschodnio-Pomorski, Gdańsk 1998

⁸⁷ Michaud E., Desrosiers G., Mermillod-Blondin F., Sundby B., Stora G., *The functional group approach to bioturbation. II. The effects of the *Macoma balthica* community on fluxes of nutrients and dissolved organic carbon across the sediment-water interface*. *Journal of Experimental Marine Biology and Ecology* 2006, 337: 178-189

⁸⁸ Oppel S., Powell A.N., Dickson D.L., *Timing and distance of king eider migration and winter movements*. *The Condor* 2008, 110: 296-305

⁸⁹ Szaniawska A., *Baltic Crustaceans*. Springer International Publishing, 2018

⁹⁰ Warzocha J., Rzemkowska H., Gromisz S., Szymanek L., *Fauna denna*, [in:] Gic-Grusza G., Kryla-Straszewska L., Urbański J., Warzocha J., Węslawski J. (eds.), *Atlas siedlisk dna polskich obszarów morskich. Waloryzacja przyrodnicza siedlisk morskich*. Broker-Innowacja Gabriela Gic-Grusza, Gdynia 2009: 60-85

⁹¹ Węslawski J.M., *Waloryzacja dna morskiego*, [in:] Gabriela G., Kryla-Straszewska L., Urbański J., Warzocha J., Węslawski J., *Atlas siedlisk dna polskich obszarów morskich. Waloryzacja przyrodnicza siedlisk morskich*. Broker-Innowacja Gabriela Gic-Grusza, Gdynia 2009: 14-15, 86-87, 92-93

⁹² Żmudziński L., *Świat zwierzęcy Bałtyku. Atlas makrofauny*. Wydawnictwa Szkolne i Pedagogiczne, Warszawa 1990

NM), 21 taxa representing two types and 6 clusters were found in the macrozoobenthos samples collected on the soft bottom. The most common taxa were three polychaete species: *Pygospio elegans*, *Marenzelleria* sp. and *Bylgides sarsi*, one species of bivalve *Macoma balthica* and a representative of the malacostraca *Diastylis rathkei*. On the hard bottom, among the epiphytic and phytophilous fauna, 17 taxa belonging to 7 clusters were found. The most common taxa were the polychaete *Bylgides sarsi*, the bivalve *Mytilus trossulus*, the marine bryozoan species *Einhornia crustulenta*, the centipede *Gonothyraea loveni*, and the crustacean *Jaera* (*Jaera*) *albifrons*.

The area of the BC-Wind OWF is located within the Eastern Gotland Basin. The area where the project is intended to be implemented had not been identified with regard to macrozoobenthos until the inventory survey in 2020. The nearest two macrozoobenthos research stations, on the basis of which an assessment of the state of the environment is performed in Polish maritime areas (PMA) based on the requirements of the Water Law (Journal of Laws of 2023, item 1478, consol.) and in accordance with the requirements of Article 11 of Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 within the framework of the State Environmental Monitoring, updated in 2021 (M.P.2021.414)⁹³, are located between 19.5 km and 53 km from the boundaries (1 NM) of the area. In this case, it is historically impossible to determine the nature and direction of changes in the taxonomic and quantitative structure that have occurred in the macrozoobenthos communities in the area of the planned OWF.

The results of macrozoobenthos research from the areas of other planned OWFs: the Baltica 3 OWF⁹⁴, located the closest from the BC-Wind OWF (approx. 12 km away); the Baltic III OWF⁹⁵, located approx. 18 km away from the BC-Wind OWF, and, at larger distances, the Baltica 2 OWF (approx. 30 km⁹⁶ away) and the Baltic II OWF (approx. 50 km⁹⁷ away), can serve as a small comparative material for the assessment of taxonomic composition and constancy of macrozoobenthos occurrence on the soft bottom in the area of the BC-Wind OWF in 2020. A summary of the results of the macrozoobenthos surveys carried out within the framework of the listed projects, in 2013-2016, at a slightly smaller depth range (21-54 m) in the area of the open waters of the southern Baltic for the soft bottom, is presented in the table below (tab. 7.5).

Tab. 7.5 Characteristics of the soft-bottom macrozoobenthos surveys for the BC-Wind OWF Area in 2020 against the results of the Baltic III and Baltic II OWF area macrozoobenthos surveys of 2013 and 2014, and Baltica 2 and Baltica 3 results in 2016

Parameter	Baltic III OWF Area (2013)	Baltic II OWF Area (2013, 2014)	Baltica 2, Baltica 3 OWF Area (2016)	BC-Wind OWF Area (2020)
Number of stations	175	117	402	146
Depth [m]: range	26-42	23-44	21-54	30-63
Number of taxa: max., range	27; 4-16	32; 3-12	33; 4-18	21; 4-13
Most frequently recorded taxa	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp., <i>Macoma balthica</i> , <i>Hediste diversicolor</i>	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp.	<i>Marenzelleria</i> sp., <i>Pygospio elegans</i> , <i>Macoma balthica</i> , <i>Bylgides sarsi</i> , <i>Diastylis rathkei</i>	<i>Pygospio elegans</i> , <i>Marenzelleria</i> sp., <i>Macoma balthica</i> , <i>Diastylis rathkei</i> , <i>Bylgides sarsi</i>

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 121-122

⁹³ Resolution No. 38 of the Council of Ministers of 22 March 2021 on agreeing to submit an update of the marine water monitoring programme to the European Commission. Warsaw 2021

⁹⁴ Bednarska M., Brzeska-Roszczyk P., Dawidowicz D., et al. Report on the environmental impact of the Baltica Offshore Wind Farm. Maritime Institute in Gdańsk (Leader) in consortium with MEWO S.A., Gdańsk 2017

⁹⁵ SMDI Advisory Group (ed.), Offshore wind farm Baltic Central III. Environmental impact report. Warsaw 2015

⁹⁶ Bednarska M., Brzeska-Roszczyk P., Dawidowicz D., et al. Report on the environmental impact of the Baltica Offshore Wind Farm. Maritime Institute in Gdańsk (Leader) in consortium with MEWO S.A., Gdańsk 2017

⁹⁷ SMDI Advisory Group (ed.), Offshore wind farm Baltic Central II. Environmental impact report. Warsaw 2015

A total of 175 macrozoobenthos samples were taken in the area of the Baltic III OWF and its one-mile buffer zone from the sandy bottom, using a Van Veen grab sampler. As a result of the surveys, 27 macrozoobenthos taxa were found. In June 2013 and May 2014, a total of 117 macrozoobenthos samples were also collected from the sandy bottom in the Baltic Sea II OWF Area and its one-mile buffer zone. As a result of the surveys, 32 macrozoobenthos taxa were found. The results of the macrozoobenthos surveys carried out in May, June and July 2016 in the Baltica2 and Baltica3 areas, based on a total of 402 macrozoobenthos samples taken from the sandy bottom, indicate the presence of 33 macrozoobenthos taxa in the area. On the other hand, the taxonomic composition of macrozoobenthos found as a result of the present study in the BC-Wind OWF Area in 2020 is slightly poorer (21 taxa) than that recorded in the Baltic III and Baltic II OWF areas as well as in Baltica2 and Baltica3, but similar in terms of the most frequently recorded taxa (absolutely constant). This is probably due to the close proximity of the planned investments, similar type of bottom sediment, and similar depth range.

The multimetric B index was used to assess the quality status of the macrozoobenthos community on soft bottoms, while the OGT index was used on hard bottoms.

The largest area of the planned area of the BC-Wind OWF (1 NM) is occupied by sandy bottoms (sand, gravel). According to the general classification of benthic habitats based on the EUNIS classification, the dominant habitat type in the area of the planned project are circalittoral sands, however the information on dominant macrozoobenthos communities was not included in this classification.⁹⁸ The performed valuation showed that the macrozoobenthos of the soft bottom is not characterised by high values and the quality status of the macrozoobenthos communities was assessed as 'moderate'. Furthermore, the soft bottom in the northern and southern part of the planned project was found to contain small fragments of the bottom with macrozoobenthos in a 'good' or even 'very good' ecological status. On the other hand, the condition of the macrozoobenthos community within the fragments of the bottom covered with stones (less than 5% of the bottom area of the study area), found mainly in the western and southern part of the BC-Wind OWF Area (1 NM), was defined as 'moderate' or 'good'. Rock covered with epiphytic fauna is overwhelmingly found only in the buffer zone (1 NM) and not in the development area proper. The development area will also not include the western part of the planned project area, where a stony bottom was found. The quality status of the macrozoobenthos communities in the BC-Wind OWF Area is shown on the map below (fig. 7.7).

⁹⁸ *Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters, CIEP, Warsaw 2024*

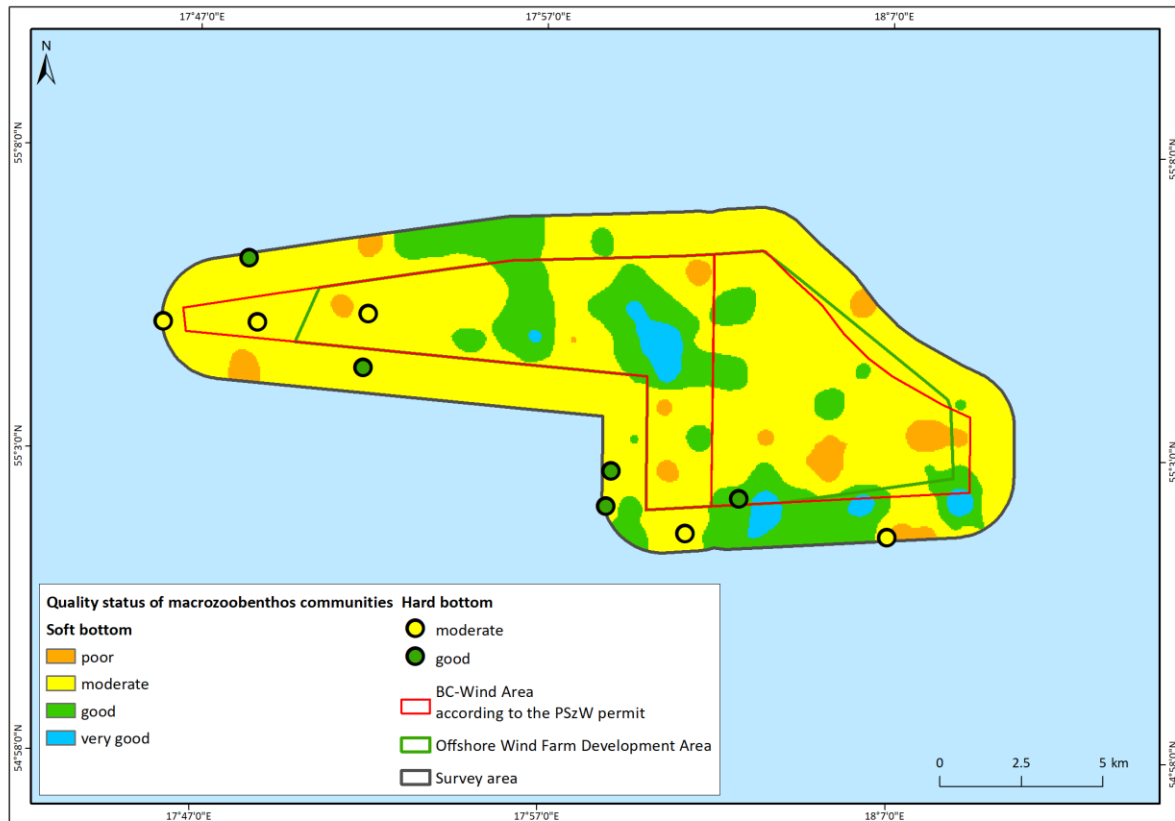


Fig. 7.7 Spatial distribution of the quality status of macrozoobenthos communities in the BC-Wind OWF Area (1 NM)

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 123

7.4.3. Ichthyofauna

According to the data contained in the Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters⁹⁹, more than 64 fish species and 2 lamprey species are consistently found in the PMA. In addition, about 20 fish species are found occasionally in the waters of the PMA. The planned project is located in the Eastern Gotland Basin of the Baltic Sea. According to current data provided by HELCOM, 34 species of ichthyofauna occur and breed continuously in the Eastern Gotland Basin, while a further 12 species also occur continuously, but do not breed in the basin. Periodically, 36 fish species are encountered in the Eastern Gotland Basin. The area of the planned BC-Wind OWF is located in the ICES marine area 25, east of the Słupsk Bank, at a distance of approx. 40 km. The depth of the sea water in the area of the planned OWF ranges from approx. 32 m in the southern part to more than 60 m in the northeastern part. The salinity in the seabed ranges from 6.93 PSU to 11.08 PSU, the bottom waters are slightly more saline and exhibit greater salinity variability as more saline water masses from distant parts of the Baltic Sea periodically reach them.

Inventory of ichthyofauna carried out for the purpose of this Report

The characterisation of the ichthyofauna in the BC-Wind OWF was based on the results of an ichthyofauna inventory carried out by the Marine Fisheries Institute between October 2019 and July 2020. It included a four-fold ichthyoplankton fishery during the autumn, winter, spring and summer seasons, as well as repeated hydroacoustic surveys and fish catches with trawl and multi-panel pound nets during the same periods. Details of the fishing methodology and results of the inventory carried out are detailed in Appendix 1 of this EIA Report (Volume III. Appendices to the EIA Report).

⁹⁹ Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters, CIEP, Warsaw 2024

The ichthyofauna survey in the BC-Wind OWF Area was intended to determine the species composition, abundance and distribution of the ichthyofauna, as well as the structure and biological characteristics of the fish species present, including the species composition and abundance of ichthyoplankton.

The research was conducted on an annual basis with four research cycles covering all seasons.

During the surveys carried out in winter, spring and summer, eggs of only one species – sprat – were found. In autumn, however, no eggs of any species were recorded.

The highest abundances of larvae of species other than sprat were observed in spring and summer. The spring was dominated by flounder larvae (7.81 ind.-10 m⁻²). Seasnail was also observed during this season, but was represented very sparsely (0.85 ind.-10 m⁻²). In summer, however, gobiid larvae dominated (12.66 ind.-10 m⁻²), followed by sand eel (1.81 ind.-10 m⁻²) and spring spawning herring (1.11 ind.-10 m⁻²). The mean abundance of the other taxa present in the summer season samples – rockling, flounder and cod – was less than 1.0 ind.-10 m⁻². The autumn and winter seasons were characterised by low abundance of larvae. In autumn, the samples were dominated by gobies (1.82 ind.-10 m⁻²), while in winter they were dominated by rock gunnel (0.55 ind.-10 m⁻²). Both in autumn and winter, few autumn spawning herring larvae were present in the samples (0.16 and 0.25 ind.-10 m⁻², respectively).

The spatial distribution of eggs and larvae of the different fish species in the inventory area varied. Sprat eggs and larvae were most abundant in the northern and central parts of the area, and their highest density was recorded in summer. It can be assumed that the sprat larvae caught in July in the BC-Wind OWF Area originated from shallow water spawning, which took place directly in the study area. Flounder and seasnail larvae were evenly distributed throughout the area and occurred almost exclusively in spring. In the BC-Wind OWF Area, flounder spawning is unlikely and the larvae caught mainly in spring originated from spawning in the Gdańsk Deep or the Słupsk Furrow, from where they were transported with the currents to shallower areas, including the study area, where they were evenly distributed. Similarly, seasnail larvae originate from shallower areas with vegetated bottoms (in the Słupsk Bank), where they find convenient spawning grounds. Herring larvae were recorded in the southern and western part of the area in summer, and in the northern part in winter. The obtained results allow to conclude that both spring and autumn herring do not spawn in the study area and their larvae may have originated from spawning grounds in the nearest rocky substrate located in the southwestern direction, or in coastal areas or around the Słupsk Bank. In contrast, few cod larvae were found, only in the deepest, northeastern part of the area in summer and autumn. They migrate from spawning grounds located in the Gdańsk Deep or the Słupsk Furrow. The distribution of sand eel larvae was highest in summer and fairly even, slightly higher in the northern and eastern parts of the area. Sand eel spawns in summer and autumn, on the bottom of the shallower areas adjacent to the BC-Wind OWF Area. Similarly, gobiid larvae were mainly abundant in summer, in different areas, with a slightly lower distribution in the northern part of the surveyed area. It can be assumed that gobiid larvae drift to the OWF area from spawning sites located in coastal areas or around the Słupsk Bank, where these fish find suitable substrate to lay their eggs.¹⁰⁰

During pelagic control fisheries to test the proportion of each species for the purpose of estimating the pelagic fish biomass, in addition to herring and sprat, a few individuals of garfish, stickleback, sand eel, cod, anchovy, flounder, lumpfish and sand lance were caught.

The result of the bottom fishing with fixed nets carried out in the BC-Wind OWF Area was 1645.51 kg of fish belonging to 13 taxa. The dominant species were flounder and cod, with the remaining species being small bycatches (sand eel, plaice, shorthorn sculpin, hooknose, mackerel, rockling, turbot, herring, sprat, lumpfish, eelpout).

¹⁰⁰ Gic-Grusza G et al, 2009. Atlas of bottom habitats of Polish marine areas....

In the autumn, seven species of fish with a total weight of 261.8 kg were recorded. Cod dominated, accounting for 56% of the total catch by weight. Among the other species, flounder accounted for 32% and shorthorn sculpins for 9%. Plaice, mackerel, rockling and herring were also sparsely represented.

In the winter, nine species of fish with a total weight of 579.8 kg were recorded. Flounder dominated, accounting for 61% of the total catch by weight, as well as cod, which made up 30% of the catch by weight. Other species were represented in lesser numbers and accounted for 9% of the catch by weight. These included plaice, shorthorn sculpin, hooknose, rockling, herring and eelpout.

In the spring, nine species of fish with a total weight of 316.2 kg were recorded, of which cod accounted for 64%, flounder for 33%, and the remaining 3% of the catch by weight was made up of species such as plaice, shorthorn sculpin, hooknose, rockling, sprat, herring and lumpfish.

In the summer, ten species of fish with a total weight of 487.5 kg were recorded. Flounder dominated, accounting for 62% of the total catch by weight, as well as cod, which accounted for 32% of the catch by weight. The remaining species were less represented and accounted for 6% of the catch by weight. These included sand eel, plaice, shorthorn sculpin, mackerel, rockling, turbot, sprat and herring.

In all survey gear in the BC-Wind OWF Area, fish belonging to 21 taxa were caught (tab. 7.6). The persistent fish assemblages of the area included cod, flatfish, herring, sprat and, sparsely, shorthorn sculpin, lumpfish, sand eel and eelpout. The observed occurrence of larvae of species such as gobies, rockling, rock gunnel, long-spined bullhead and seasnail does not indicate that the area is permanently inhabited by adult individuals.

Tab. 7.6 Specification of taxa recorded during exploratory fishing in the BC-Wind OWF Area

No.	Species	Pelagic fishing	Bottom fishing	Catches of ichthyoplankton
1.	Garfish <i>Belone belone</i>	X		
2.	Stickleback <i>Gasterosteus aculeatus</i>	X		
3.	Sand eel <i>Hyperoplus lanceolatus</i>	X	X	X
4.	Cod <i>Gadus morhua</i>	X	X	X
5.	Plaice <i>Pleuronectes platessa</i>		X	
6.	Shorthorn sculpin <i>Myoxocephalus scorpius</i>		X	
7.	Hooknose <i>Agonus cataphractus</i>		X	
8.	Mackerel <i>Scomber scombrus</i>		X	
9.	Rockling <i>Enchelyopus cimbrius</i>		X	X
10.	Anchovy <i>Engraulis encrasicolus</i>	X		
11.	Turbot <i>Scophthalmus maximus</i>		X	
12.	Flounder <i>Platichthys flesus</i>	X	X	X
13.	Sprat <i>Sprattus sprattus</i>	X	X	X
14.	Herring <i>Clupea harengus</i>	X	X	X
15.	Lumpfish <i>Cyclopterus lumpus</i>		X	
16.	Sand lance <i>Ammodytes tobianus</i>	X		

No.	Species	Pelagic fishing	Bottom fishing	Catches of ichthyoplankton
17.	Eelpout <i>Zoarces viviparus</i>		X	
18.	Gobies <i>Gobiidae</i>			X
19.	Long-spined bullhead <i>Taurulus bubalis</i>			X
20.	Rock gunnel <i>Pholis gunnellus</i>			X
21.	Seasnail <i>Liparis liparis</i>			X
Number of species		9	13	10

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 124

The BC-Wind OWF Area is typical of southern Baltic waters, with a clear predominance of cod and flounder in demersal fisheries and herring and sprat in pelagic fisheries.

The obtained results indicate that the area of the planned project was a habitat for **herring** during the study period, as well as an area through which migration routes to wintering grounds, reproductive migration (likely) and foraging migration pass.

The area of the planned project formed part of a body of water in which both spawning and feeding migrations of **sprat** took place temporarily, with the latter increasing during the autumn season.

Taking into account the literature on the subject and the results of the performed research, it can be assumed that sprat spawning may take place in the BC-Wind OWF Area, the intensity of which – compared to other shallow water areas – is relatively low.

The area of the planned project was characterised by a predominance of young, small specimens of **cod** (<35 cm) in all survey seasons in 2019. The study area is located on the reproductive and foraging migration route of cod.

The area of the planned project is a seasonal habitat for adult **flounder**. Flounder do not spawn directly in the study area as the prevailing salinity is too low to allow successful fertilisation.

In summary, of the 21 taxa observed during the ichthyofauna surveys carried out for the planned project, 4 are of particular economic importance, being subject to commercial fishing. These are: sprat, herring, cod and flounder. No salmon or sea trout were observed during the survey fisheries (no standardised survey methods, low density); however, these two species do occur in commercial fisheries.

Sprat, herring, cod and flounder were most abundant in the survey catches conducted in the BC-Wind OWF Area.

Two of the recorded taxa of fish larvae – gobies and seasnail – belong to partially protected species according to the Regulation of the Minister of Environment of 16 December 2016 (*Journal of Laws of 2022, item 2380, consol.*). The frequency of occurrence was as follows: gobies – two survey seasons (autumn and summer), seasnail – one survey season (spring). Gobiid larvae were not identified down to a species; nevertheless, based on literature on the subject and random observations, it can be assumed that the dominant species in the collected samples was the protected sand goby.

In order to assess the importance of the BC-Wind OWF Area in relation to ichthyofauna, the following values were considered: taxonomic diversity, presence of protected and endangered species and commercial species, feeding or spawning grounds, migration routes. On the basis of these functions, the natural values of the area were assessed as medium. The assessment was based on expert judgement.

Key findings from the inventory:

- The project area is characterised by a typical southern Baltic ichthyofauna composition, with a clear predominance of cod and flounder in demersal fisheries and herring and sprat in pelagic fisheries;
- The study area is not a significant breeding area for any fish species;
- The study area is a breeding area for **sprat** of minor importance from winter to summer;
- Two species partially protected in Poland were found in the study area: **goby** (sand goby) and **seasnail**; these larvae do not originate from spawning in the study area – they come from breeding areas located in shallow coastal areas or around the Stupsk Bank;
- The area of the planned project was characterised, in all survey seasons, by the predominance of young, small specimens of **cod** (<35 cm) (from 56.1 to 77.2% of the share);
- The study area is located on the breeding and feeding migration route of **cod**;
- The diversity of nutritional components found in the stomachs of **cod** indicates that the area of the planned project is favourable in terms of food composition for cod of different sizes;
- The area of the planned project is a habitat for adult **flounder**;
- Migration routes of **flounder** from deep-water spawning grounds to coastal feeding grounds may pass through the area of the planned project;
- The study area serves as a **flounder** feeding ground;
- The area of the planned project in the four 2019-2020 seasons was part of an area of periodic residence and migration of **sprat** populations, but temporally varied in terms of the weight of fish caught there; significant and fairly even sprat catches were obtained in spring, summer and autumn, with marginal catches in winter;
- During the four seasons, the distribution of sample sizes was dominated by fairly large individuals of **sprat**, with the same modal length of 12 cm; the bycatch of small fish, i.e. smaller than the minimum commercial size (10 cm in length) was small;
- The spawning and migration process of spawning **sprat** relative to previous years was prolonged in calendar time, as it lasted from January to July, and spawning fish were most abundant in the spring samples;
- The area of the planned project formed part of a basin in which temporary migrations of both spawning and feeding **sprat** took place, with the latter increasing in the autumn season;
- In the area of the planned project, **herring** was present in all seasons of the annual cycle, most abundant in the winter season; in the autumn season, there were mainly juvenile fish recruiting to the stock, from age group 0 of the local spring spawning population; in the other seasons, herring of the adult fraction of the stock predominated;
- The absence of fish rubbing and half-rubbed fish and the relatively low intensity of foraging (except during the winter season) suggests that the study area is located on the reproductive migration route, wintering grounds and foraging routes of **herring**;
- The predominant **herring** population in the study area was spring herring from the northern Baltic coast;
- Based on the conclusions listed above, the area can be rated as medium value and not distinguished in terms of habitat quality from the adjacent areas where an OWF inventory was also carried out.

Inventory of ichthyofauna for the neighbouring Baltic Power OWF 2019-2020

To provide a broader context for the characterisation of the ichthyofauna, the results of the inventory carried out for the neighbouring Baltic Power OWF (located 4 km away from the BC-Wind OWF) at the same time as the BC-Wind OWF inventory, were cross-referenced. 22 fish species and representatives of the goby family (*Gobiidae*) were recorded in the ichthyoplankton in 2019-2020 for that inventory. Among the commercially important species, sprat, herring, cod and flounder were recorded; salmon (*Salmo salar*) and sea trout (*Salmo trutta trutta*) were not observed, but both species were indicated to be present in the fishery. Of the fish under partial species protection, seasnail (*Liparis liparis*)

was found in the ichthyoplankton, while sand goby (*Pomatoschistus minutus*) was present among the goby fish.

Tab. 7.7 Inventory results for the Baltic Power OWF Area (type of catch: P – pelagic, D – demersal, IP – ichthyoplankton)

English name	Latin name	Type of fishing
Cod	<i>Gadus morhua</i>	D
Flounder	<i>Platichthys flesus</i>	P, D, IP
Plaice	<i>Pleuronectes platessa</i>	D, IP
Turbot	<i>Scophthalmus maximus</i>	D
Herring	<i>Clupea harengus</i>	P, D, IP
Sprat	<i>Sprattus sprattus</i>	P, IP
Sand eel	<i>Hyperoplus lanceolatus</i>	P, D, IP
Sand lance	<i>Ammodytes tobianus</i>	P, IP
Shorthorn sculpin	<i>Myoxocephalus scorpius</i>	D, IP
Lumpfish	<i>Cyclopterus lumpus</i>	P, D
Eelpout	<i>Zoarces viviparus</i>	D
Rockling	<i>Enchelyopus cimbrius</i>	D, IP
Whiting	<i>Merlangius merlangus</i>	D
Common dab	<i>Limanda limanda</i>	D
Hooknose	<i>Agonus cataphractus</i>	D
Garfish	<i>Belone belone</i>	P
Stickleback	<i>Gasterosteus aculeatus</i>	P
Anchovy	<i>Engraulis encrasicolus</i>	P
Long-spined bullhead	<i>Taurulus bubalis</i>	IP
Rock gunnel	<i>Pholis gunnellus</i>	IP
Seasnail*	<i>Liparis liparis</i>	IP
Gobies**	Gobiidae	IP
A total of 22 species and representatives of the goby family		

* partial species protection

** including representatives of the sand goby (*Pomatoschistus minutus*) – partial species protection

Source: Baltic Power Offshore Wind Farm Environmental Impact Report, MEWO 2020

The species composition was very similar to that found in the inventory conducted for the BC-Wind OWF. No mackerel were found in the surveys for the Baltic Power OWF, but two species (whiting and dab) were recorded that were not caught in the inventory presented above.

Data on the state of the marine environment

In 2024, the Chief Inspectorate for Environmental Protection developed the 'Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters'¹⁰¹ resulting from Article 17 para. 1 of the Marine Strategy Framework Directive (MSFD)¹⁰² and Article 151 para. 1 of the Water Act¹⁰³. The second update of the preliminary assessment of the environmental status of marine waters is based on a set of indicators allowing to obtain quantitative and qualitative information on the environmental status of Polish marine waters for all eleven features, and covers the period of 2016-2021.

¹⁰¹ Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters, GIOŚ, Warsaw 2024

¹⁰² Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (the Marine Strategy Framework Directive) (Journal of the EU L164/19)

¹⁰³ Water Act (Journal of Laws of 2023, item 1478, as amended)

The BC-Wind OWF Area lies close to the coastal water body of Jastrzębia Góra – Rowy. The assessment of the environmental status of the Baltic Sea coastal zone on the basis of ichthyofauna is performed using two indicators recommended by HELCOM: abundance of key trophic groups and abundance of key species (expressed in CPUE units). However, the available time series in the Polish coastal zone for the period 2011-2016 were insufficient to determine reference periods and threshold values for ichthyofauna indicators, and therefore it was not possible to make an assessment based on them.¹⁰⁴ Following the amendment to the division of surface water bodies introduced in Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters¹⁰⁵, the coastal waters adjacent to the planned Project were included in JCWP CW20001WB2 Polish Coastal Waters of the Gotland Basin. The most recent available CIEP studies carried out in 2022 in this water body did not include an assessment of ichthyofauna, and the status of the biological elements in the water body was determined as moderate based on the results of phytoplankton surveys (Class III), with an appreciation for macroalgae and angiosperms and Class II for benthic macroinvertebrates.

In the period of 2016-2021, a second update of the assessment of the environmental status of open waters in the Polish Baltic Sea area was carried out on the basis of an index reflecting the overall fish size structure at a community level.¹⁰⁶ This indicator is assessed on the basis of the *Large Fish Index* (LFI1) biomass. The environmental status of marine waters in relation to the LFI1 indicator was assessed for the period in question for the marine waters of ICES areas 25 and 26 as sub-GES according to the MSFD.¹⁰⁷ This means that the environmental objective set for LFI1 was not met in both ICES Subdivisions 25 and ICES 26, where the planned Project is located. The LFI1 values were significantly lower than the GES thresholds, which were set at 0.80 for the open sea area – western part (ICES 25) and 0.70 for the open sea area – eastern part (ICES 26). The LFI index value for ICES area 25 in 2016 was 0.45, lower than the threshold value set for this area (0.80). In the following years, it fluctuated between 0.38 and 0.42 and increased significantly to 0.56 in 2020, before falling back to 0.48 in 2021. The LFI index value for ICES area 26 in 2016 was 0.60, below the designated threshold value (0.70). It later declined sharply to 0.28 in 2018. There was a slight increase over the next 3 years to a value of 0.32 in 2021.¹⁰⁸

7.4.4 Marine mammals

Taking into account the specific occurrence of marine mammals in the southern Baltic Sea, three species of marine mammals may occur in the BC-Wind OWF Area: the harbour porpoise (*Phocoena phocoena*), the grey seal (*Halichoerus grypus*), and the common seal (*Phoca vitulina*). There is a very low probability of the presence of a ringed seal (*Pusa hispida*), so the analysis focuses on the three species mentioned above.

The harbour porpoise (*Phocoena phocoena*) is the only cetacean representative found in the Baltic Sea. The species is protected as per the IUCN Red List of Threatened Species as 'Critically Endangered', while in Poland it is under strict species protection. Based on the 2013 SAMBAH project, its abundance in the Baltic Proper was estimated at 80-1091 individuals.¹⁰⁹ A repeat annual porpoise count is currently underway as part of the SAMBAH II project, the results of which will be available in late 2025/2026. The exact status of the harbour porpoise population in the Polish part of the Baltic Sea

¹⁰⁴ HELCOM, HELCOM coastal fish core indicator database

¹⁰⁵ Regulation of the Minister of Infrastructure of 4 November 2022 on the Vistula River Basin Management Plan. Journal of Laws of 2023, item 300

¹⁰⁶ Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters, CIEP, Warsaw 2024

¹⁰⁷ CIEP, Warsaw 2024

¹⁰⁸ CIEP, Warsaw 2024. Appendix 25. Fish size index LFI

¹⁰⁹ SAMBAH, Final report for LIFE+ project SAMBAH LIFE08 NAT/S/000261 covering the project activities from 01/01/2010 to 30/09/2015, 2016

is unknown, although it is generally reported that its abundance is very low.^{110, 111} According to data from the SAMBAH project, Polish marine areas belong to waters with low densities of this species, with a higher probability of detection in November to April than in May to October (fig. 7.8).¹¹² In the environmental study for the BC-Wind OWF, there were few detections of harbour porpoise, but with more occurring between May and October than between November and April (fig. 7.9).

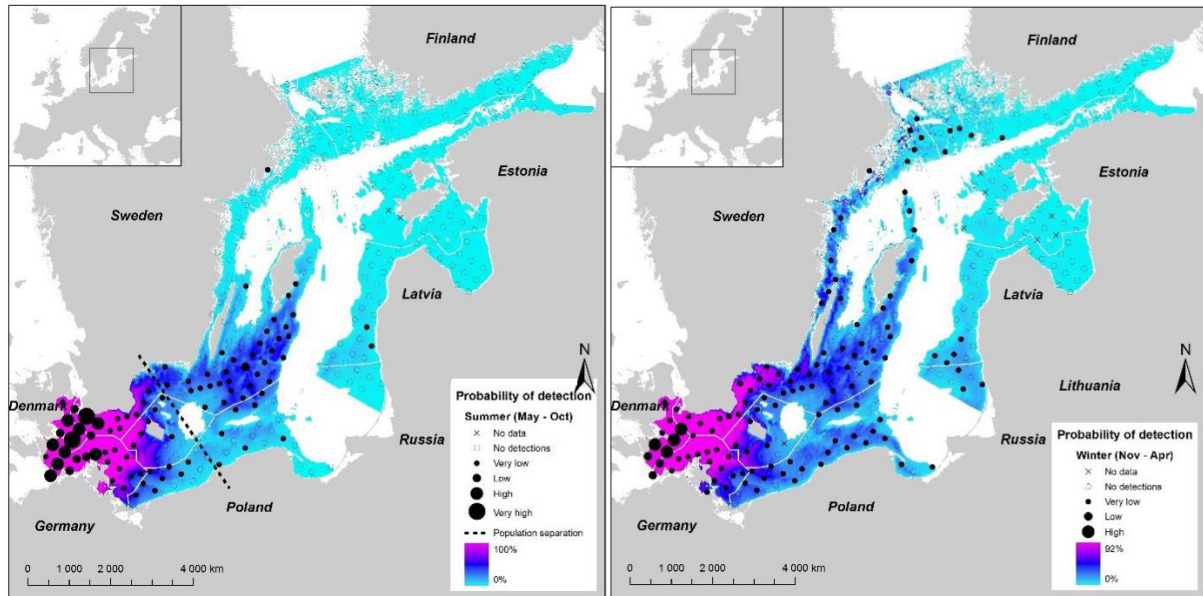


Fig. 7.8 Probability of detecting harbour porpoises from May to October (left panel) and November to April (right panel), obtained from the SAMBAH project (2011-2013)

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 126

¹¹⁰ Gillespie D., et al. Relative abundance of harbour porpoises (*Phocoena phocoena*) from acoustic and visual surveys of the Baltic Sea and adjacent waters during 2001 and 2002. *J. Cetacean Res. Manag.* 2005, 7: 51-57

¹¹¹ Koschinski S., Current knowledge on harbour porpoises (*Phocoena phocoena*) in the Baltic Sea. *Ophelia* 2011, 55: 167-197

¹¹² SAMBAH, Final report for LIFE+ project SAMBAH LIFE08 NAT/S/000261 covering the project activities from 01/01/2010 to 30/09/2015, 2016

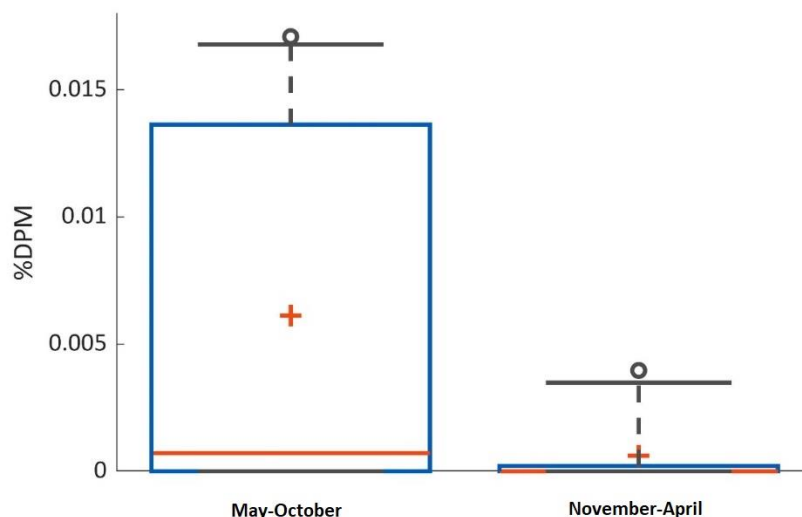


Fig. 7.9 Box plot showing harbour porpoise activity (%DPM) in the area of the BC-Wind project, for the months of May to October and November to April (annual distribution used in the SAMBAH project), throughout the monitoring period. The red cross represents the mean; the red horizontal line represents the median (50th percentile); the bottom edge of the box represents the lower quartile (25th percentile); the top edge of the box represents the upper quartile (75th percentile). The whiskers represent the maximum and minimum values

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 126

The most recent surveys commissioned by the Chief Inspectorate for Environmental Protection (CIEP) as part of the project 'Pilot implementation of marine species and habitat monitoring 2015-2018' showed detections of harbour porpoises in the area of the Pomeranian Bay and Stilo Bank in 2016-2018. Within the Pomeranian Bay, average values of DPD expressed in percentage (%DPD) were recorded at 4.56%DPD, and for Stilo Bank at 0.32%DPD. Furthermore, analyses of the collected data showed differences in the seasonality of harbour porpoise occurrence. The highest values of DPD in the Pomeranian Bay area were recorded in the summer season, while in the Stilo Bank area they occurred in the spring season.¹¹³ In the BC-Wind Area (2 NM), the mean%DPD from all stations was 0.61 (=17 DPD out of 2790 total monitoring days) (fig. 7.10), with the most frequent detection of this species during the summer season (average%DPD) (fig. 7.11).

¹¹³ Malinga M., Opiola R., Barańska A., Świstun K., Aninowska M., Methodological guides – 1351 Porpoise, Work commissioned by the Chief Inspectorate of Environmental Protection, 2018; available at: http://morskiesiedliska.gios.gov.pl/images/1351_Morswin_OST.pdf

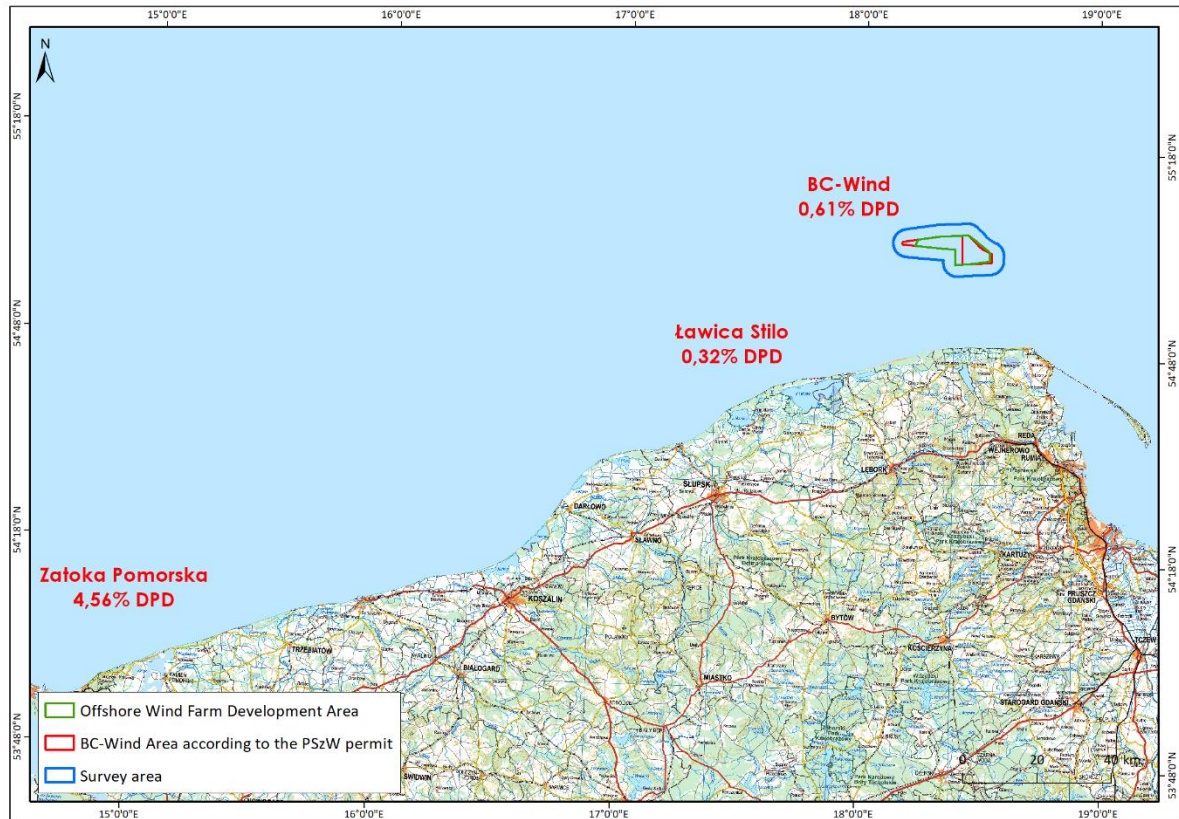


Fig. 7.10 Acoustic activity of harbour porpoises, expressed in mean %DPD, obtained from the 'Pilot implementation of marine species and habitat monitoring conducted in 2015-2018' projects (porpoise monitoring was carried out in 2016-2018) in the Pomeranian Bay and Stilo Bank and environmental studies for the BC-Wind OWF conducted in 2019-2021

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 127

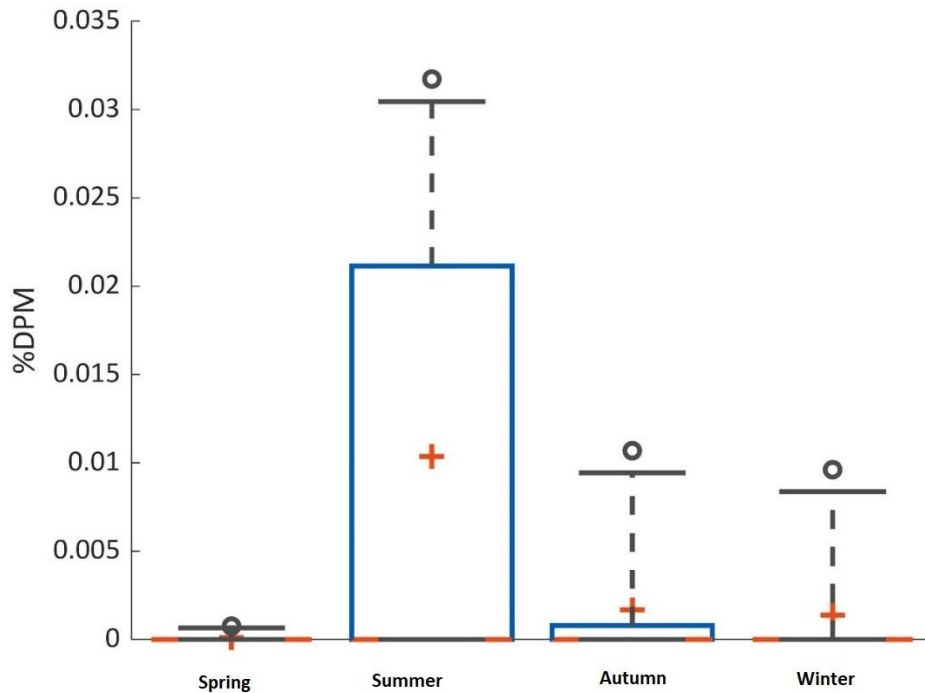


Fig. 7.11 Box plot showing porpoise activity (%DPM) for each season across the entire BC-Wind OWF Area. The red cross represents the mean; the red horizontal line represents the median (50th percentile); the bottom edge of the box represents the bottom quartile (25th percentile); the top edge of the box represents the top quartile (75th percentile). The whiskers represent the maximum and minimum values

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 128

The monitoring carried out in cooperation between WWF Poland and the Marine Station of the Institute of Oceanography of the University of Gdańsk (IO UG) during the project 'Support for the restitution and conservation of Baltic mammals in Poland' and the project 'Protection of marine mammal and bird habitats' showed that in the years 2011-2021, 60 dead individuals of harbour porpoise were found on the Polish coast, with one observed within 30 km of the BC-Wind OWF Area (fig. 7.12).¹¹⁴

¹¹⁴ WWF Poland. Database 2013; available at: http://link.wwf.pl/baza_ssaki/public/mapa/mapa (accessed 01.2021)

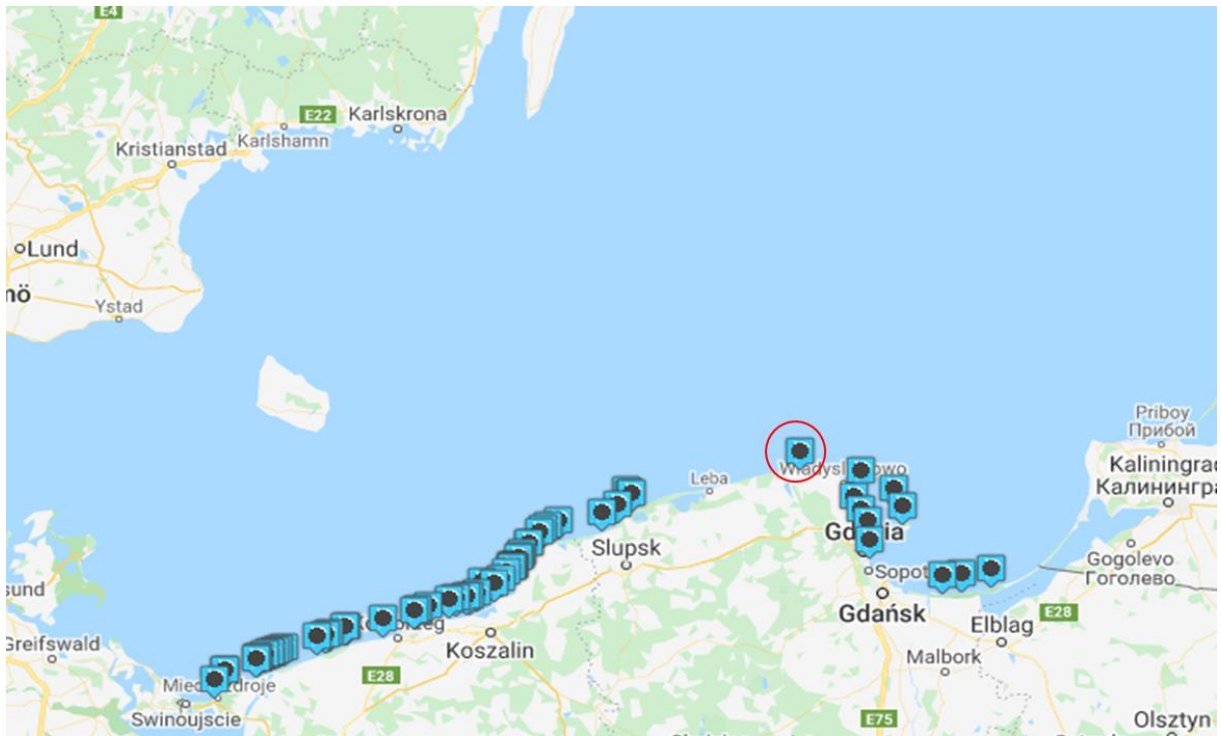


Fig. 7.12 Observations of harbour porpoises on the Polish coast between January 2011 and January 2021. The red circle represents 1 sighting of harbour porpoise within 30 km of the BC-Wind OWF Area
Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 129

During the research for the EIA Report for the BC-Wind OWF from October 2019 to January 2021, passive acoustic monitoring of harbour porpoise was carried out in the BC-Wind OWF Area (2 NM) using C-POD equipment and aerial observations. Five primary and two secondary acoustic devices were deployed in the study area to continuously detect sounds made by harbour porpoise. The layout of the equipment is shown in figure in Appendix 1 (Volume III) on page 289.

The highest DPM values were recorded at station CPOD_03 during the summer season (42 DPM), located in the middle part of the BC-Wind OWF Area. Porpoises were recorded at most stations except CPOD_01 (located on the western edge of the area) and CPOD_04 (located on the southern edge of the area). The highest daily porpoise activity was recorded on 17 August 2020, 18 DPM at station CPOD_06, reaching 1.52%DPM (fig. 7.13). The number of recorded harbour porpoise clicks was low. No harbour porpoises were observed during observation flights or observations from ships during the seabird surveys.

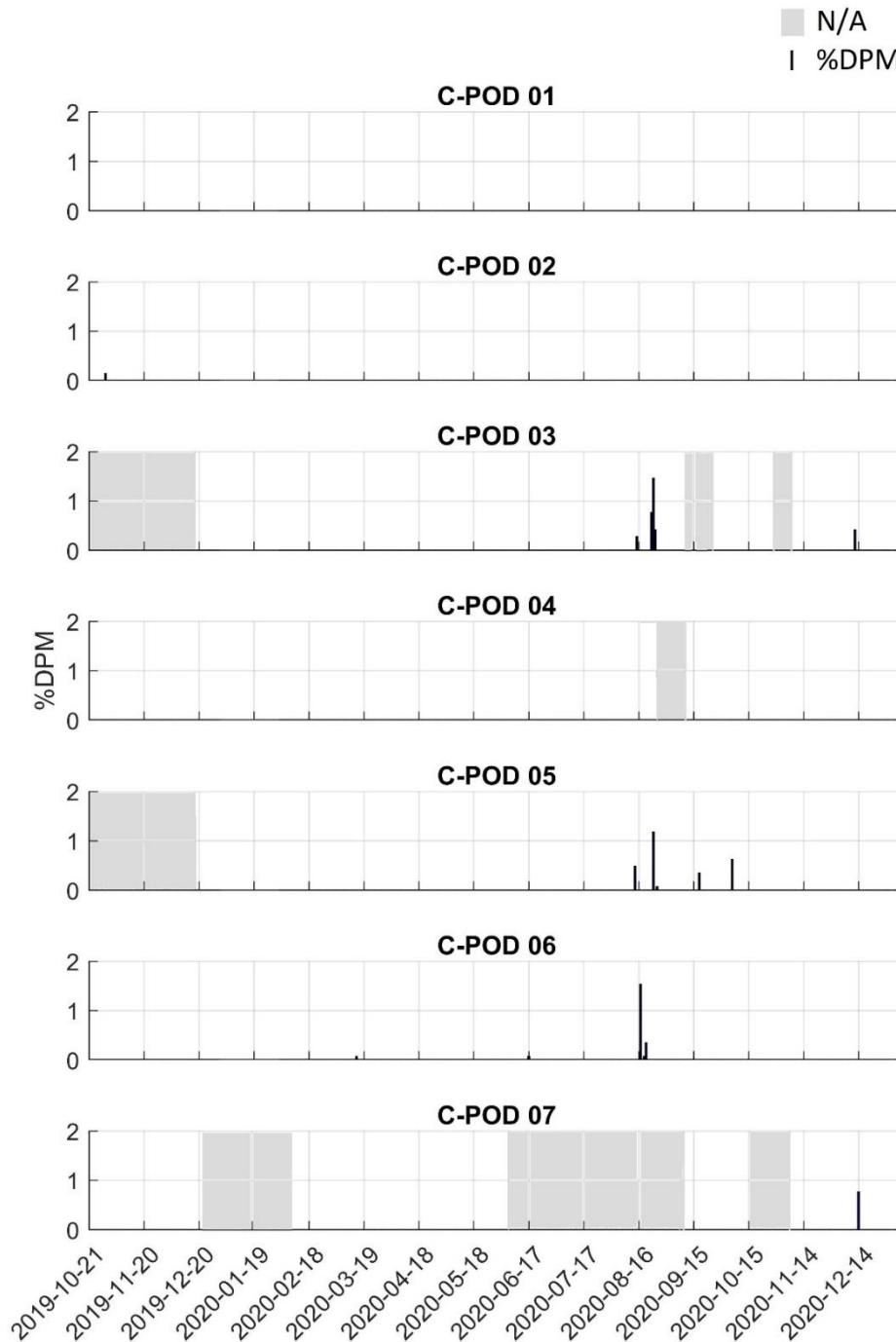


Fig. 7.13 Daily activity of harbour porpoise at seven survey stations in the BC-Wind OWF Area (2 NM). Activity is expressed as percentage of positive detection minutes (%DPM). Grey colour indicates a period with missing data

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 130

There are three species of seals in the Baltic Sea. The number of Baltic grey seals exceeds 32000 individuals. In contrast, the subpopulation of the southern Baltic common seal is estimated at 1563 individuals (NOVANA census, Jonas Teilmann personal communication). Ringed seals are estimated at 10000 individuals. According to HELCOM, grey seals regularly occur in the Polish part of

the Baltic Sea, common seals occur on the western side of the Baltic Sea, while ringed seals may be observed in the northern part of Polish waters.¹¹⁵

According to the results of seal observations in the Polish part of the Baltic Sea from the last 10 years, derived from the WWF database and the IO UG Marine Station, out of the marked species, the grey seal was the most frequently observed seal in the study area (66% of observations), followed by the common seal (5% of observations) and the ringed seal (2% of observations) (fig. 7.14).¹¹⁶

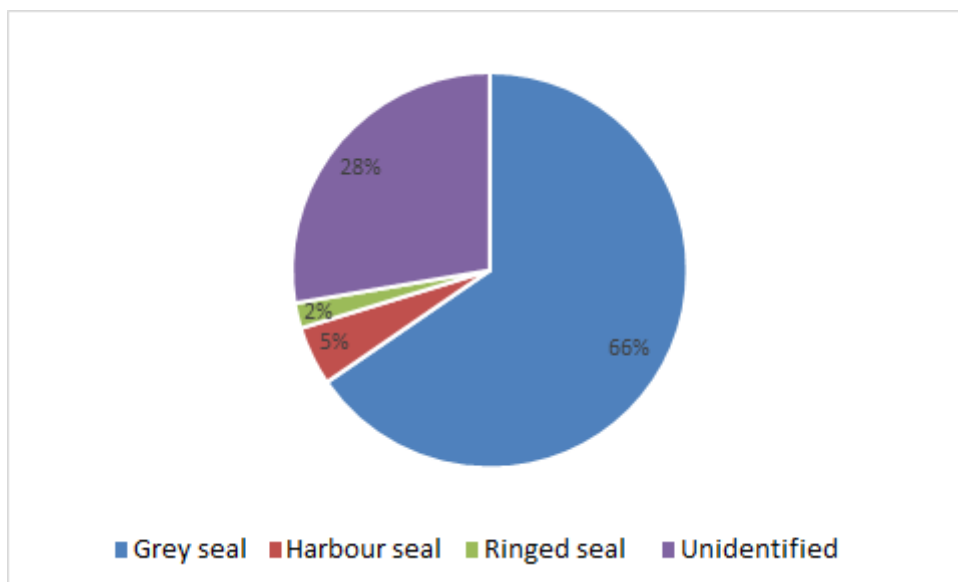


Fig. 7.14 Breakdown of seal sightings on the Polish coast obtained from 1 January 2011 to 1 January 2021 based on the database maintained by WWF Poland and the K. Skóra IO Marine Station in Hel within the project 'Support for the restitution and conservation of Baltic mammals in Poland' and 'Protection of marine mammal and bird habitats'

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 131

The highest number of grey seals is recorded in the area of the mouth of the Vistula Crossing, where the species finds good resting conditions. Data collected in 2016-2018 as part of the project 'Pilot implementation of marine species and habitat monitoring 2015-2018' confirmed the occurrence of haul-out grey seals in the area of the mouth of Przekop Wisły. During the stated period, the abundance of grey seals averaged around 200 individuals during the molting period. During the course of the observations, one individual of a common seal was recorded hauled-out, and no individual of a ringed seal was observed.¹¹⁷

During the monitoring period for the BC-Wind OWF (between October 2019 and January 2021), WWF's Blue Patrol recorded along the coast, approx. 30 km from the BC-Wind OWF Area, 11 sightings of live grey seals and 4 sightings of dead individuals of this species. The remaining seal species were not observed (tab. 7.8).

¹¹⁵ HELCOM, Population trends and abundance of seals. HELCOM core indicator report. Online, 2018; available at: <http://www.helcom.fi/baltic-sea-trends/indicators/population-trends-and-abundance-of-seals/> (accessed 12.2019)

¹¹⁶ WWF Poland. Database 2013; available at: http://link.wwf.pl/baza_ssaki/public/mapa/mapa (accessed 01.2021)

¹¹⁷ Malinga M., Opiola R., Barańska A., Świstun K., Aninowska M., Methodological guides – 1351 Porpoise, Work commissioned by the Chief Inspectorate of Environmental Protection, 2018; available at: http://morskiesiedliska.gios.gov.pl/images/1351_Morswin_OST.pdf

Tab. 7.8 Results of seal sightings on the Polish coast in an area approx. 30 km from the BC-Wind OWF from 21 October 2019 to 7 January 2021 based on a database maintained by WWF Poland and the K. Skóra UG Marine Station in Hel within the framework of the project 'Support for the restitution and conservation of Baltic mammals in Poland' and 'Protection of marine mammal and bird habitats'

Species	Number of live individuals	Number of dead individuals	Total
Grey seal	11	4	15
Common seal	0	0	0
Ringed seal	0	0	0
Unidentified	0	0	0

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 131

During seabird monitoring surveys from vessels for the BC-Wind OWF project, 28 seal sightings were made, of which 21 sightings were of grey seals. Directly within the BC-Wind OWF Area (2 NM), 9 seal sightings were made (7 were identified as grey seals) (fig. 7.15). It is possible that the same animal was spotted multiple times. Furthermore, it is likely that the 7 grey seal sightings in the BC-Wind OWF Area were of hauled-out seals from the mouth of Przekop Wisły. This is confirmed by the results of seal sightings conducted during seabird surveys from vessels within the BC-Wind project. Considering the total survey effort (>2000 km), it can be concluded that grey seals can be encountered in the BC-Wind OWF Area throughout the year, but their numbers are relatively small.

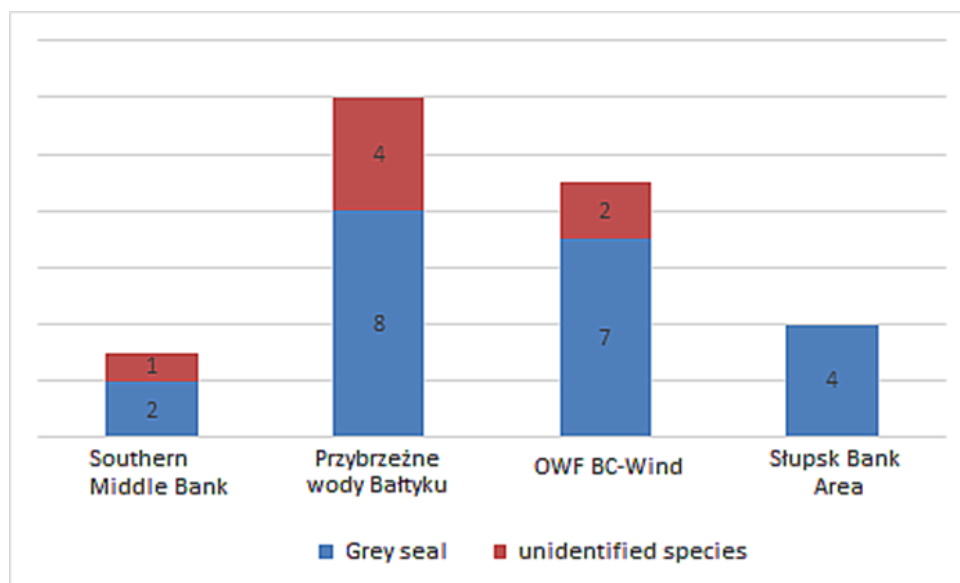


Fig. 7.15 Summary of marine mammal sightings during seabird surveys

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 132

Between October 2019 and January 2021, 6 observatory flights took place as part of the environmental monitoring in the BC-Wind OWF Area (2 NM), during which no seal sightings were made in the study area.

The results of acoustic monitoring of harbour porpoise, visual observations of marine mammals from the air and from vessels indicate a sparse occurrence of harbour porpoises and seals in the study area, which is in line with the general conclusions reached in the SAMBAH and 'Pilot Implementation of Marine Species and Habitats Monitoring 2015-2018' projects.

7.4.5. Seabirds

Observations of seabirds were conducted in the BC-Wind OWF Area with a buffer zone of 2 NM in width, as well as three additional areas of importance for birds: the Słupsk Bank, a fragment of the Baltic Coastal Waters area, and the Polish part of the Southern Middle Bank area. Observations were conducted between September 2019 and August 2020. Detailed results of the surveys for these areas are provided in the seabird inventory results report attached as part of Appendix 1 to the EIA Report (Volume III).

The Baltic Sea is used by seabirds as a wintering area or as a stopover during migration. Most of the surveyed birds reach their highest numbers in the high seas, more than 1 km from the shore. The exceptions are gulls, which accompany fishing boats on fishing grounds; their occurrence on the open sea is strongly influenced by human activity.

Wintering birds

Species composition of birds perched on water in the BC-Wind OWF Area

A total of 16 water-dwelling bird species were recorded during the observations at the BC-Wind OWF Area (2 NM), including 12 species associated with the marine environment and 4 species of waterbirds rarely seen at sea away from the coast (tab. 7.9, fig. 7.16).

Tab. 7.9 Abundance and percentages of the grouping of individual water-sitting bird species found in the BC-Wind OWF Area (2 NM) along the cruise route, throughout the period of September 2019 to August 2020

Species	Number of individuals observed [ind.]	Grouping share [%]
Seabirds		
European herring gull <i>Larus argentatus</i>	1331	57.3
Razorbill <i>Alca torda</i>	280	12.1
Common guillemot <i>Uria aalge</i>	237	10.2
Long-tailed duck <i>Clangula hyemalis</i>	210	9.0
Great black-backed gull <i>Larus marinus</i>	33	1.4
Little gull <i>Hydrocoloeus minutus</i>	30	1.3
Lesser black-backed gull <i>Larus fuscus</i>	25	1.1
Common scoter <i>Melanitta nigra</i>	9	0.4
Black-throated loon <i>Gavia arctica</i>	3	0.1
Velvet scoter <i>Melanitta fusca</i>	2	0.1
Black guillemot <i>Cephus grylle</i>	2	0.1
Red-throated loon <i>Gavia stellata</i>	1	+
Waterbirds rarely seen at sea far from the coast		
Common gull <i>Larus canus</i>	10	0.4
Greylag goose <i>Anser anser</i>	6	0.3
Great cormorant <i>Phalacrocorax carbo</i>	3	0.1
Eurasian wigeon <i>Anas penelope</i>	2	0.1
Birds not marked as specific species		

Species	Number of individuals observed [ind.]	Grouping share [%]
Razorbill/guillemot <i>Alca torda/Uria aalge</i>	133	5.7
Unmarked loon <i>Gavia sp.</i>	6	0.3
Total	2323	100

+ - percentage share of less than 0.1%

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 145-146

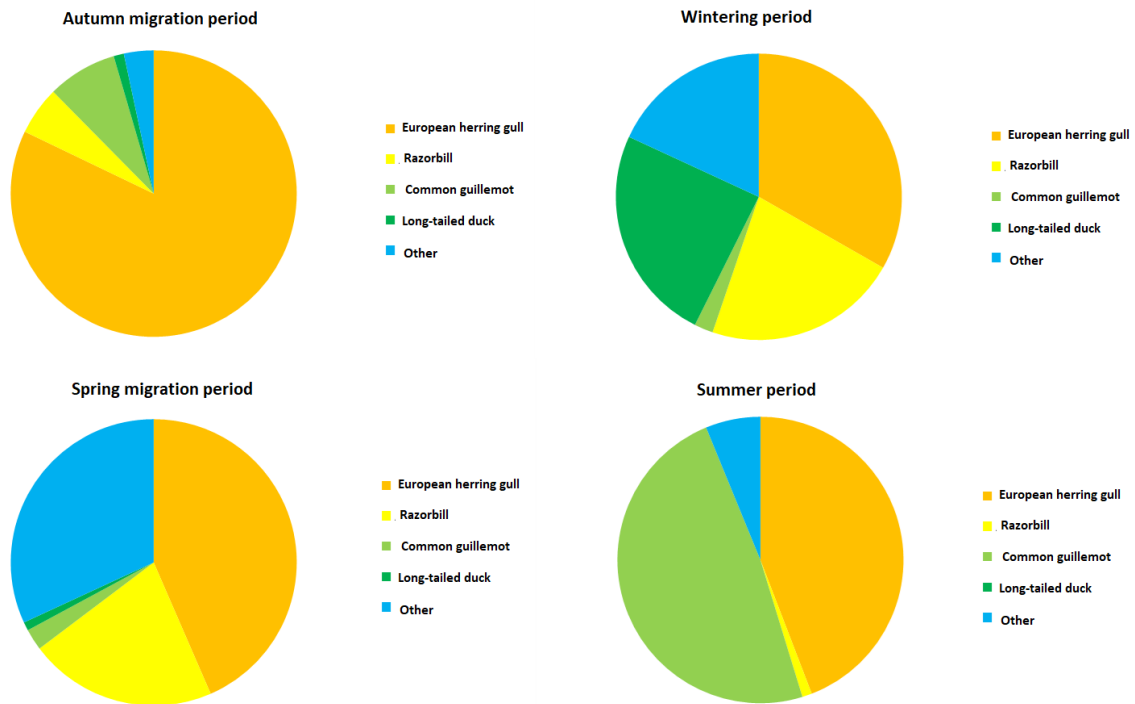


Fig. 7.16 Proportion of dominant water-sitting bird species in the total bird grouping in the BC-Wind OWF Area (2 NM) throughout the period from September 2019 to August 2020

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 146

A total of 2323 seabird individuals were observed along transects in the BC-Wind OWF Area (2 NM). The category 'waterbirds rarely seen at sea away from the coast' includes 4 species (common gull, great cormorant, greylag goose, Eurasian wigeon). The largest number of cases of undetermined specific species concerned the razorbill and the guillemot, species that are very similar and difficult to distinguish from a distance. They feed mainly on pelagic fish and have similar habitat requirements¹¹⁸, and react in a similar way to wind farms located in offshore areas¹¹⁹.

In the area designated for the construction of the BC-Wind OWF, the average density of seabirds was very low, and only during the wintering period exceeded the value of 10 ind.·km⁻² in most of the area (density maps are included in Appendix 1 to the EIA Report, Volume III). The most abundant species was the European herring gull, whose occurrence in areas far from the coast is associated with the presence of fishing boats. The low abundance of birds in the BC-Wind OWF Area is due to the great water depth, which makes it difficult for birds from the most numerous wintering group of diving

¹¹⁸ Cramp S., Simmons K.E.L., *The Birds of the Western Palearctic, Vol. III. Waders to gulls*. Oxford University Press, Oxford 1983

¹¹⁹ Cook A.S.C.P., Johnston A., Wright L.J., Burton N.H.K., *A review of flight heights and avoidance rates of birds in relation to offshore wind farms*. Strategic Ornithological Support Services. Project SOSS-02. BTO Research Report Number 618. the British Trust for Ornithology, The Nunnery, Thetford 2012

benthophages in the Baltic, which include the long-tailed duck and the velvet scoter, to reach food. Compared to the additional areas belonging to Natura 2000, razorbills and guillemots were abundant in the BC-Wind OWF Area. These are fish-eating species and their occurrence is not greatly affected by the depth of the water body. It can be assumed that they found an abundant food base here.

In the BC-Wind OWF Area, 13 bird species that are under strict species protection in Poland were found (razorbill, common guillemot, long-tailed duck, great black-backed gull, little gull, lesser black-backed gull, common scoter, black-throated loon, velvet scoter, black guillemot, red-throated loon, common gull, Eurasian wigeon), as well as two species under partial protection (European herring gull and great cormorant). Three species of water-dwelling birds are listed in Annex I of the Birds Directive (little gull, red-throated loon and black-throated loon). One bird species (black guillemot) has a SPEC rank of 2, and four species (velvet scoter, little gull, red-throated loon and black-throated loon) have a SPEC rank of 3. Two of the observed species (long-tailed duck and velvet scoter) have an elevated category of VU (Vulnerable), and the razorbill has an elevated category of NT (Near Threatened), according to the IUCN International Union for Conservation of Nature classification for the world, also used by HELCOM.

Detailed information on seabird sighting results is provided in Appendix 1 of the EIA Report (Volume III).

Species composition of birds perched on water in additional areas of importance for birds

As part of the observations in the additional areas of importance for birds: the Słupsk Bank, a fragment of the Baltic Coastal Waters area, and the Polish part of the Southern Middle Bank area, a total of 24 species of waterbirds were recorded, including 15 species associated with marine environment and 9 species of waterbirds rarely found at sea away from the coast, i.e.: the common gull, the great cormorant, the mute swan, the great crested grebe, the black-headed gull, the greater white-fronted goose, the red-breasted merganser, the Eurasian teal and the goosander (tab. 7.10).

Tab. 7.10 Abundance and grouping percentages of individual waterbird species found in additional areas of importance to birds between September 2019 and August 2020

Species	Number of individuals observed [ind.]	Grouping share [%]
Seabirds		
Long-tailed duck <i>Clangula hyemalis</i>	63218	69.6
Velvet scoter <i>Melanitta fusca</i>	23334	25.7
European herring gull <i>Larus argentatus</i>	1865	2.1
Razorbill <i>Alca torda</i>	1079	1.2
Common scoter <i>Melanitta nigra</i>	345	0.4
Common guillemot <i>Uria aalge</i>	264	0.3
Black-throated loon <i>Gavia arctica</i>	66	0.1
Black guillemot <i>Cepphus grylle</i>	65	0.1
Little gull <i>Hydrocoloeus minutus</i>	46	0.1
Great black-backed gull <i>Larus marinus</i>	33	+
Lesser black-backed gull <i>Larus fuscus</i>	30	+
Red-throated loon <i>Gavia stellata</i>	18	+
Common eider <i>Somateria mollissima</i>	3	+

Species	Number of individuals observed [ind.]	Grouping share [%]
Horned grebe <i>Podiceps auritus</i>	1	+
Great skua <i>Catharacta skua</i>	1	+
Waterbirds rarely seen at sea far from the coast	197	0.2
Birds not marked as specific species	259	0.3
Total	90824	100

+ - percentage share of less than 0.1%

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 147-148

Detailed results of seabird inventories carried out at the BC-Wind OWF Area and additional areas of significant importance to birds, together with analysis, are included in Appendix 1 of the EIA Report (Volume III).

Seabird species included in the impact assessment

The assessment of the environmental impact of the BC-Wind OWF includes birds, which stayed (sat on the water and flew over the water) along the transects during the performed research campaigns. The assessment does not take into account the results obtained from radar surveys, dealing in detail with the issue of avifauna migration. In the case of the European herring gull, which was present in the surveys performed with both methods, the scope of the assessment of potential impacts of the OWF is presented in the seabird section. The European herring gull is a species that accompanies fishing boats on fishing grounds and its occurrence on the open sea is strongly influenced by human activity. The assessment took into account the most abundant seabird species, whose share in the total number of birds observed at the OWF reached 1% in at least one phenological period, or are subject to protection in the closest Natura 2000 sites.

Therefore, a total of 7 bird species were considered. The condition of a share of at least 1% in the total abundance of the group was met by: the long-tailed duck, the velvet scoter, the razorbill, the common scoter and the European herring gull. A species that does not meet the above condition but is protected in the closest Natura 2000 sites is the black guillemot. It is protected within the Natura 2000 sites of Słupsk Bank (PLC990001) and Baltic Coastal Waters (PLB990002), but its abundance in the OWF area was very low. In total, only 1 individual was recorded during the winter survey campaigns. Therefore, the guillemot was only included in the assessment in the context of the impact of the OWF on Natura 2000 sites.

The assessment did not take into account birds of conservation interest from nearby Natura 2000 sites for which the parameter 'population' in the SDF reached category 'D' (insignificant), i.e. the black-throated and red-throated loon and the common gull.

7.4.6. Migratory birds

The most abundant migratory birds observed during the survey included sea ducks [common scoter (*Melanitta nigra*), velvet scoter (*Melanitta fusca*), long-tailed duck (*Clangula hyemalis*)], geese (identified down to the family), and passerines (identified down to the order). The observed migratory birds were assigned to 93 categories, of which 75 are birds identified down to the species. tab. 7.11 shows the species of migratory birds observed during performed surveys (categories marked down to the order or the family can only be found in Appendix 1 of the EIA Report) together with their conservation status and the total number of individuals observed during the surveys.

Tab. 7.11. Number of bird individuals designated down to the species (other categories in Appendix 1 of the EIA Report) recorded during the surveys and their national and international conservation status

No.	Species	Number of individuals	Species protection in Poland ¹	Annex I of the Birds Directive	IUCN ²	HELCOM ³
1.	Common scoter <i>Melanitta nigra</i>	828	P	Not	LC	EN
2.	Velvet scoter <i>Melanitta fusca</i>	531	P	Not	VU	VU
3.	Long-tailed duck <i>Clangula hyemalis</i>	477	P	Not	VU	EN
4.	Eurasian skylark <i>Alauda arvensis</i>	419	P	Not	LC	-
5.	Wood pigeon <i>Columba palumbus</i>	403	G	Not	LC	-
6.	Razorbill <i>Alca torda</i>	328	P	Not	NT	-
7.	Bean goose <i>Anser fabalis</i>	290	G	Not	LC	EN
8.	Great cormorant <i>Phalacrocorax carbo</i>	244	PP	Not	LC	-
9.	Common starling <i>Sturnus vulgaris</i>	184	P	Not	LC	-
10.	Eurasian siskin <i>Carduelis spinus</i>	159	P	Not	LC	-
11.	Eurasian wigeon <i>Mareca penelope</i>	147	P	Not	LC	-
12.	White wagtail <i>Motacilla alba</i>	129	P	Not	LC	-
13.	Eurasian chaffinch <i>Fringilla coelebs</i>	124	P	Not	LC	-
14.	Black-headed gull <i>Larus ridibundus</i>	114	P	Not	LC	-
15.	Lesser black-backed gull <i>Larus fuscus</i>	113	P	Not	LC	VU
16.	Common gull <i>Larus canus</i>	112	P	Not	LC	-
17.	Little gull <i>Hydrocoloeus minutus</i>	106	P	Yes	NT	NT
18.	Greylag goose <i>Anser anser</i>	103	G	Not	LC	-
19.	Common guillemot <i>Uria aalge</i>	96	P	Not	NT	-
20.	Black-throated loon <i>Gavia arctica</i>	48	P	Yes	LC	CR
21.	Eurasian teal <i>Anas crecca</i>	45	G	Not	LC	-
22.	Barn swallow <i>Hirundo rustica</i>	41	P	Not	LC	-
23.	Common crane <i>Grus grus</i>	34	P	Yes	LC	-
24.	Greater scaup <i>Aythya marila</i>	24	P	Not	VU	VU
25.	Mute swan <i>Cygnus olor</i>	23	P	Not	LC	-
26.	Eurasian curlew <i>Numenius arquata</i>	20	P	Not	VU	-
27.	Northern shoveler <i>Spatula clypeata</i>	20	P	Not	LC	-
28.	Common swift <i>Apus apus</i>	18	P	Not	LC	-
29.	Common goldeneye <i>Bucephala clangula</i>	16	P	Not	LC	-
30.	Tufted duck <i>Aythya fuligula</i>	14	G	Not	LC	NT
31.	Great black-backed gull <i>Larus marinus</i>	14	P	Not	LC	-

No.	Species	Number of individuals	Species protection in Poland ¹	Annex I of the Birds Directive	IUCN ²	HELCOM ³
32.	Northern pintail <i>Anas acuta</i>	13	P	Not	LC	-
33.	Red-breasted merganser <i>Mergus serrator</i>	13	P	Not	NT	-
34.	Mallard <i>Anas platyrhynchos</i>	9	G	Not	LC	-
35.	Red-throated loon <i>Gavia stellata</i>	8	P	Yes	LC	CR
36.	Dunlin <i>Calidris alpina</i>	8	P	Yes	LC	EN
37.	Arctic skua <i>Stercorarius parasiticus</i>	8	P	Not	LC	-
38.	Greater white-fronted goose <i>Anser albifrons</i>	7	G	Not	LC	-
39.	Goosander <i>Mergus merganser</i>	7	P	Not	LC	-
40.	Black tern <i>Chlidonias niger</i>	6	P	Yes	LC	-
41.	Common kestrel <i>Falco tinnunculus</i>	6	P	Not	LC	-
42.	Western yellow wagtail <i>Motacilla flava</i>	6	P	Not	LC	-
43.	Goldcrest <i>Regulus regulus</i>	6	P	Not	LC	-
44.	Grey heron <i>Ardea cinerea</i>	5	PP	Not	LC	-
45.	Common swan <i>Cygnus cygnus</i>	5	P	Yes	LC	-
46.	House martin <i>Delichon urbicum</i>	4	P	Not	LC	-
47.	Common tern <i>Sterna hirundo</i>	4	P	Yes	LC	-
48.	Eurasian sparrowhawk <i>Accipiter nisus</i>	3	P	Not	LC	-
49.	Great tit <i>Parus major</i>	3	P	Not	LC	-
50.	Rook <i>Corvus frugilegus</i>	2	P	Not	LC	-
51.	European robin <i>Erithacus rubecula</i>	2	P	Not	LC	-
52.	Brambling <i>Fringilla montifringilla</i>	2	P	Not	LC	-
53.	Woodlark <i>Lullula arborea</i>	2	P	Yes	LC	-
54.	Smew <i>Mergellus albellus</i>	2	P	Yes	LC	-
55.	European honey buzzard <i>Pernis apivorus</i>	2	P	Yes	LC	-
56.	Great crested grebe <i>Podiceps cristatus</i>	2	P	Not	LC	-
57.	Common eider <i>Somateria mollissima</i>	2	P	Not	VU	-
58.	Little grebe <i>Tachybaptus ruficollis</i>	2	P	Not	LC	-
59.	Mediterranean gull <i>Larus melanocephalus</i>	1	P	Yes	LC	EN
60.	Great egret <i>Ardea alba</i>	1	P	Yes	LC	-
61.	Short-eared owl <i>Asio flammeus</i>	1	P	Yes	LC	-
62.	Long-eared owl <i>Asio otus</i>	1	P	Not	LC	-

No.	Species	Number of individuals	Species protection in Poland ¹	Annex I of the Birds Directive	IUCN ²	HELCOM ³
63.	Common linnet <i>Carduelis cannabina</i>	1	P	Not	LC	-
64.	Twite <i>Carduelis flavirostris</i>	1	P	Not	LC	-
65.	Western jackdaw <i>Corvus monedula</i>	1	P	Not	LC	-
66.	Merlin <i>Falco columbarius</i>	1	P	Yes	LC	-
67.	Peregrine falcon <i>Falco peregrinus</i>	1	P	Yes	LC	-
68.	Red-footed falcon <i>Falco tinnunculus</i>	1	P	Yes	NT	-
69.	Great grey shrike <i>Lanius excubitor</i>	1	P	Not	VU	-
70.	Northern wheatear <i>Oenanthe oenanthe</i>	1	P	Not	LC	-
71.	Pomarine skua <i>Stercorarius pomarinus</i>	1	P	Not	LC	-
72.	Eurasian wren <i>Troglodytes troglodytes</i>	1	P	Not	LC	-
73.	Redwing <i>Turdus iliacus</i>	1	P	Not	NT	-
74.	Common blackbird <i>Turdus merula</i>	1	P	Not	LC	-
75.	Song thrush <i>Turdus philomelos</i>	1	P	Not	LC	-

¹ Species protection in Poland: P – protected species, G – game species, PP – partially protected species

² IUCN species status in Europe: LC – Least Concern, VU – Vulnerable, NT – Near Threatened

³ HELCOM species status: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 133-136

For the purpose of the analysis of the assessment of the impact of the project on migratory birds, some species and categories were summed up at the level of family (e.g. geese, gulls, terns) or at the level of order (e.g. auks). Pigeons and swifts were grouped with all the passerine birds due to similar migration phenology. Species from the Anatini tribe were included in the category of ducks proper. For further analyses of migration streams, 21 species and/or categories of the most abundantly observed migratory birds were included (tab. 7.12).

Tab. 7.12. Number of individuals observed of each bird group and species migrating in autumn and spring during all observation cruises

No.	Species/category	Autumn	Spring	Total	All observations [%]
1.	Geese <i>Anserinae</i>	4804	259	5063	42.94
2.	Passerines/pigeons <i>Passeriformes/Columbinae</i>	1643	715	2358	20.00
3.	Auks <i>Alcidae</i>	495	436	931	7.90
4.	Common scoter <i>Melanitta nigra</i>	53	775	828	7.02
5.	Velvet scoter <i>Melanitta fusca</i>	268	263	531	4.50
6.	Long-tailed duck <i>Clangula hyemalis</i>	203	274	477	4.05
7.	Great cormorant <i>Phalacrocorax carbo</i>	117	127	244	2.07
8.	Ducks proper <i>Anatini</i>	49	185	234	1.98
9.	Divers <i>Gaviidae</i>	23	108	131	1.11
10.	Black-headed gull	19	95	114	0.97

No.	Species/category	Autumn	Spring	Total	All observations [%]
	<i>Chroicocephalus ridibundus</i>				
11.	Lesser black-backed gull <i>Larus fuscus</i>	56	57	113	0.96
12.	Common gull <i>Larus canus</i>	59	53	112	0.95
13.	Little gull <i>Hydrocoloeus minutus</i>	17	89	106	0.90
14.	Plovers <i>Charadriidae</i>	14	31	45	0.38
15.	Swans <i>Cygnidae</i>	16	26	42	0.36
16.	Common crane <i>Grus grus</i>	0	34	34	0.29
17.	Greater scaup <i>Aythya marila</i>	14	10	24	0.20
18.	Mergansers <i>Merganser</i> sp.	5	15	20	0.17
19.	Hawks/owls <i>Accipitriformes/Strigiformes</i>	8	11	19	0.16
20.	Great black-backed gull <i>Larus marinus</i>	13	1	14	0.12
21.	Terns <i>Sternidae</i>	2	11	13	0.11
22.	Other observations	229	108	337	2.86
Total		8107	3683	11790	

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 136-137

The most abundant migration streams were determined for passerines including pigeons, auks, sea ducks (long-tailed ducks, common scoters and velvet scoters), ducks proper and geese (tab. 7.13). The beginning of the autumn season (August) and the end of the spring season (May) indicated low migration fluxes for most birds. The diurnal migration of landbirds, on the basis of which migration fluxes are determined, was particularly intensive in October (due to passerines flying in great numbers). The highest migration fluxes for geese (mainly the bean goose and the greylag goose) calculated from the collected data were recorded for September and October. In spring, the daily migration of seabirds had its peak in April. At that time, the highest migration fluxes were obtained for the scoter. Among the gull species, the highest migration fluxes were obtained in April for the black-headed gull, the little gull and the lesser black-backed gull. Relatively high fluxes were also estimated in March for the little gull and the common gull, and for the lesser black-backed gull in August and September. In the category of ducks proper (mainly the wigeon, the teal and the shoveler), the flight volume remained more or less the same throughout the study, fitting into the general pattern of migration: with low numbers at the beginning of the autumn migration and at the end of the spring migration.

Tab. 7.13. Migration flows for the most frequently observed migratory birds by month and season

Species/categories	Population size	Estimation of flight size [number of individuals]	
		Autumn total	Spring total
Passerines/pigeons <i>Passeriformes/Columbinae</i>	100000000	129699	19228
Common scoter <i>Melanitta nigra</i>	550000	1551	18687
Auks <i>Alcidae</i>	>5000000	14235	12221
Velvet scoter <i>Melanitta fusca</i>	450000	7190	7543
Long-tailed duck <i>Clangula hyemalis</i>	1600000	5958	7085
Ducks proper <i>Anatini</i>	>6500000	6977	6718

Species/categories	Population size	Estimation of flight size [number of individuals]	
		Autumn total	Spring total
Geese <i>Anseridae</i>	>3500000	35197	4509
Great cormorant <i>Phalacrocorax carbo</i>	515000	3228	3073
Divers <i>Gaviidae</i>	>400000	609	3050
Black-headed gull <i>Larus ridibundus</i>	>4770000	578	2420
Little gull <i>Hydrocoloeus minutus</i>	>72000	517	2274
Common gull <i>Larus canus</i>	1200000	1727	1478
Lesser black-backed gull <i>Larus fuscus</i>	>1200000	1684	1418
Common crane <i>Grus grus</i>	240000	0	937
Plovers <i>Charadriidae</i>	>1600000	534	833
Swans <i>Cygnus sp.</i>	300000	304	503
Mergansers <i>Merganser sp.</i>	80000	213	432
Terns <i>Sternidae</i>	>1800000	3240	312
Hawks/owls <i>Accipitriformes/Strigiformes</i>	>4600000	166	289
Greater scaup <i>Aythya marila</i>	310000	417	234
Great black-backed gull <i>Larus marinus</i>	120000	378	23
European herring gull <i>Larus argentatus</i>	700000	0	0
Total		214402	93266

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 138

Analyses of flight heights using a vertical radar carried out in autumn 2019 indicate that migration intensity during the night was higher than during the day for virtually the entire period covered by the observations, with the exception of altitudes up to 250 metres above sea level. At these altitudes, birds were often recorded during daylight hours, particularly in October and November. Night migration (particularly intense in September and October) was most likely dominated by Oscines passerines moving long distances. In contrast to the other months, a moderately intense but distinct migration more than 1200 metres above sea level was recorded in November. Visual observations for this period indicated an intense flight of passerines, auks and sea ducks, particularly the long-tailed duck. In spring 2020, the vertical distribution of bird flight heights obtained from the recorded echoes on the vertical radar reflects intensive night migration, especially in April. In March and April, migration during daylight hours (based on visual observations) was dominated by sea ducks (long-tailed duck and common scoter) and by passerine birds such as finches, while night migration was most likely dominated by passerines, mainly from the thrush family – the common blackbird and the redwing.

The visual observations made during the surveys indicate that the vast majority of the analysed groups of birds and species flew at heights of up to 20 m above sea level (tab. 7.14). At the same time, it should be noted that flight heights obtained from visual observations represent only a part of all flying birds, and these values should be treated as auxiliary information. Visual observations aim to identify as many birds as possible, but due to the nature of this type of monitoring, birds flying low are much more frequently recorded than birds flying at heights above 100 m above sea level. The ancillary nature of these flight height observations should be emphasised as they are subject to error due to the limited

possibilities of detecting birds at high altitudes, in favour of birds flying lower and closer to the observers at the survey station.

Tab. 7.14. Flight heights of species and species groups observed at distances up to 20 m and more than 20 m from the water surface

No.	Species/groups	Below 20 m a. s. l. [%]	Above 20 m a. s. l. [%]
1.	Auks <i>Alcidae</i>	100.0	0.0
2.	Long-tailed duck <i>Clangula hyemalis</i>	97.9	2.1
3.	Little gull <i>Hydrocoloeus minutus</i>	87.7	12.3
4.	Common scoter <i>Melanitta nigra</i>	87.0	13.0
5.	Greater white-fronted goose <i>Anser albifrons</i>	85.7	14.3
6.	Velvet scoter <i>Melanitta fusca</i>	83.8	16.2
7.	Mallard <i>Anas platyrhynchos</i>	77.8	22.2
8.	Swans <i>Cygnidae</i>	76.2	23.8
9.	Black-headed gull <i>Chroicocephalus ridibundus</i>	75.4	24.6
10.	Great cormorant <i>Phalacrocorax carbo</i>	74.6	25.4
11.	Greater scaup <i>Aythya marila</i>	66.7	33.3
12.	Eurasian wigeon <i>Mareca penelope</i>	23.8	76.2
13.	Common crane <i>Grus grus</i>	2.9	97.1
14.	Share of all observations	83.6	16.4

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 139-140

The collected acoustic recordings identified 5406 bird calls belonging to 18 bird species and categories in autumn and 8890 bird calls belonging to 23 bird species and categories in spring. Among passerines, the common blackbird (*Turdus merula*), the redwing (*Turdus iliacus*), the common starling (*Sturnus vulgaris*) and the song thrush (*Turdus philomelos*) were most frequently identified during nighttime hours, and the Eurasian chaffinch (*Fringilla coelebs*), the great tit (*Parus major*) and the white wagtail (*Motacilla alba*) during daylight hours (tab. 7.15). Among nocturnal migrants, two shorebird species – the common snipe and the common sandpiper – as well as the Eurasian teal, were also identified, but in decidedly smaller, insignificant numbers (a few to a dozen individuals). During the surveys conducted in August, the most frequently recorded calls were those of gulls, most likely mostly of individuals nesting locally, staying in the study area due to short foraging migrations. At the beginning of September, practically only gulls were recorded. It was only in the second half of September that passerines were recorded more frequently, with the highest number of recordings in November. In spring, as in autumn, gull calls dominated. The vast majority of spring recordings were made during daylight hours (94%).

Tab. 7.15. Bird calls identified from acoustic recordings during the autumn migration in August-November 2019 and the spring migration in March-May 2020

No.	Species/category	Day/night (voice recording time)	Autumn	Spring	Total
1.	Unidentified gull <i>Laridae indet.</i>	D/N	2993	5677	8670
2.	Eurasian chaffinch <i>Fringilla coelebs</i>	D	2	2276	2278
3.	Great tit <i>Parus major</i>	D	666	-	666

No.	Species/category	Day/night (voice recording time)	Autumn	Spring	Total
4.	European herring gull <i>Larus argentatus</i>	D	87	487	574
5.	Common blackbird <i>Turdus merula</i>	N	383	166	549
6.	White wagtail <i>Motacilla alba</i>	D	496	38	534
7.	Redwing <i>Turdus iliacus</i>	N	239	67	306
8.	Common starling <i>Sturnus vulgaris</i>	N	159	-	159
9.	Song thrush <i>Turdus philomelos</i>	N	138	9	147
10.	European robin <i>Erithacus rubecula</i>	N	114	9	123
11.	Goldcrest <i>Regulus regulus</i>	D	90	14	104
12.	Common gull <i>Larus canus</i>	D	2	41	43
13.	Unidentified passerine <i>Passeriformes indet.</i>	D	17	11	28
14.	Eurasian blue tit <i>Parus caeruleus</i>	D	10	11	21
15.	Meadow pipit <i>Anthus pratensis</i>	D/N	-	17	17
16.	Common snipe <i>Gallinago gallinago</i>	N	-	17	17
17.	Black-headed gull <i>Chroicocephalus ridibundus</i>	D/N	-	12	12
18.	Unidentified bird <i>Aves spec.</i>	D/N	-	12	12
19.	Eurasian teal <i>Anas crecca</i>	N	-	9	9
20.	Tree pipit <i>Anthus trivialis</i>	D/N	1	6	7
21.	Western yellow wagtail <i>Motacilla flava</i>	D	3	2	5
22.	Mistle thrush <i>Turdus viscivorus</i>	N	5	-	5
23.	Spotted flycatcher <i>Muscicapa striata</i>	N	-	4	4
24.	Lesser black-backed gull <i>Larus fuscus</i>	D/N	-	3	3
25.	Common sandpiper <i>Actitis hypoleucos</i>	N	-	1	1
26.	Common reed bunting <i>Emberiza schoeniclus</i>	N	-	1	1
27.	Great black-backed gull <i>Larus marinus</i>	N	1	-	1
Total			5406	8890	14296

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 140-141

Tracking individual birds in flight and recording their flight paths made it possible to determine the direction of flight during migration for individual species or groups of species. In autumn, a total of 522 flight paths were recorded for 30 species and 10 categories of birds not identified down to the species, and in spring, 1609 flight paths were recorded for 51 species and 15 categories of birds not identified down to the species. Analyses using a horizontal radar indicate fairly homogeneous directions for migratory birds in both spring (N-E direction) and autumn (W-S direction). Some of the tracked groups and species of birds flew in the direction opposite to the main direction of migration. This situation was observed for gulls, auks and divers, which may be related to the fact that not all radar-tracked birds from these groups were migrating at that moment. In the case of auks and divers, it is possible that some birds had already completed their migration and the tracks related to birds moving locally within the

wintering area. In the case of gulls, it is likely that tracks were recorded for local gulls residing in the Baltic coastal waters throughout the year.

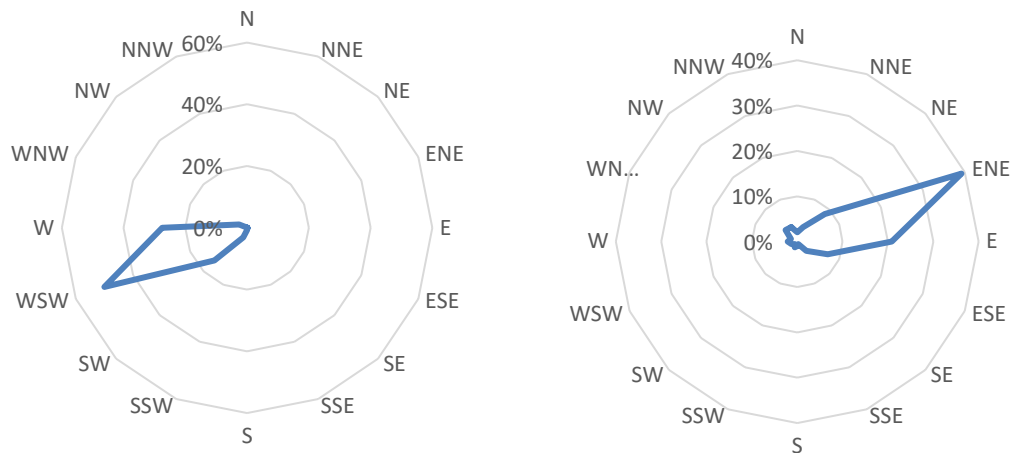


Fig. 7.17. Flight directions of all bird species recorded during the autumn migration in August-November 2019 (left) and spring migration in the months of March-May 2020 (right)

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 142

For further analyses performed for the purpose of modelling of collision risk and the barrier effect of the EIA, species were selected according to the criterion of abundance – the number of observations (the most frequently observed species and species groups were taken into account) – as well as according to the criterion of expert knowledge regarding species that usually migrate through the Baltic area, but were found during the studies in small numbers (e.g. cranes). In addition, information on the species' conservation status and the importance of the species as a receptor was taken into account based on the methodology adopted in the EIA Report. This information, alongside the abundance of biogeographic populations and an assessment of the importance of the resource, is presented in the table below (tab. 7.16). The information above formed the basis for assessing the significance of the impact of the BC-Wind OWF on migratory birds.

Tab. 7.16. Species and species groups included in the analyses for this Report, together with an assessment of the importance of the population at risk

Taxon/category	Biogeographical bird population influenced by potential OWF impacts	Migration season	Estimation of passage size [no. of individuals]	Share of population of migrating birds [%]	Importance of the vulnerable population	Size of population exposed	Receptor value/significance
Long-tailed duck <i>Clangula hyemalis</i>	1600000	Spring	7085	0.44	Moderate	Local	Large
		Autumn	5958	0.37	Irrelevant	Irrelevant	
Common scoter <i>Melanitta nigra</i>	550000	Spring	18687	3.40	Significant	Regional	Moderate
		Autumn	1551	0.28	Irrelevant	Irrelevant	
Velvet scoter <i>Melanitta fusca</i>	450000	Spring	7543	1.68	Irrelevant	Irrelevant	Large
		Autumn	7190	1.60	Moderate	Local	
Ducks proper <i>Anatini</i>	6500000	Spring	6718	0.10	Irrelevant	Irrelevant	Small
		Autumn	6977	0.11	Irrelevant	Irrelevant	
Greater scaup <i>Aythya marila</i>	310000	Spring	234	0.08	Moderate	Local	Small
		Autumn	417	0.13	Irrelevant	Irrelevant	
Geese <i>Anseridae</i>	3500000	Spring	4509	0.13	Irrelevant	Irrelevant	Small
		Autumn	35197	1.01	Moderate	Local	
Swans <i>Cygnus sp.</i>	300000	Spring	503	0.17	Irrelevant	Irrelevant	Small
		Autumn	304	0.10	Irrelevant	Irrelevant	
Divers <i>Gaviidae</i>	400000	Spring	3050	0.76	Irrelevant	Irrelevant	Small
		Autumn	609	0.15	Irrelevant	Irrelevant	
Auks <i>Alcidae</i>	5000000	Spring	12221	0.24	Irrelevant	Irrelevant	Small
		Autumn	14235	0.28	Irrelevant	Irrelevant	
Great cormorant <i>Phalacrocorax carbo</i>	515000	Spring	3073	0.60	Irrelevant	Irrelevant	Small
		Autumn	3228	0.63	Irrelevant	Irrelevant	
Little gull <i>Hydrocoloeus minutus</i>	72000	Spring	2274	3.16	Very significant	Global	Moderate
		Autumn	517	0.72	Irrelevant	Irrelevant	
Lesser black-backed gull <i>Larus fuscus</i>	1200000	Spring	1418	0.12	Irrelevant	Irrelevant	Small
		Autumn	1684	0.14	Irrelevant	Irrelevant	
Common gull <i>Larus canus</i>	1200000	Spring	1478	0.12	Irrelevant	Irrelevant	Small
		Autumn	1727	0.14	Irrelevant	Irrelevant	

Taxon/category	Biogeographical bird population influenced by potential OWF impacts	Migration season	Estimation of passage size [no. of individuals]	Share of population of migrating birds [%]	Importance of the vulnerable population	Size of population exposed	Receptor value/significance
Terns <i>Sternidae</i>	1800000	Spring	312	0.02	Irrelevant	Irrelevant	Small
		Autumn	3240	0.18	Irrelevant	Irrelevant	
Plovers <i>Charadriidae</i>	1600000	Spring	833	0.05	Irrelevant	Irrelevant	Small
		Autumn	534	0.03	Irrelevant	Irrelevant	
Common crane <i>Grus grus</i>	490000	Spring	937	0.39	Irrelevant	Irrelevant	Large
		Autumn	0	0.00	No	No	
Passerines <i>Passeriformes</i>	100000000	Spring	19228	0.02	Irrelevant	Irrelevant	Small
		Autumn	129699	0.13	Irrelevant	Irrelevant	

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 143-144

7.4.7. Bats

Ringling studies and direct observations have shown that many bat species from Scandinavia and northeastern Europe make seasonal migrations to central Europe. For some bat species, such as the common noctule (*Nyctalus noctula*), the Nathusius' pipistrelle (*Pipistrellus nathusii*), the parti-coloured bat (*Vespertilio murinus*) and the lesser noctule (*Nyctalus leisleri*), have been observed travelling long distances of 1500 to 2000 km per season.¹²⁰ Long-distance migratory flights have also been recently detected by measuring stable isotopes of the common noctule, particularly in northern Europe.¹²¹ The listed long-distance migratory species also migrate through the Baltic Sea in spring and autumn.¹²²

Many bat migration surveys have been carried out in Scandinavia and show that migrating bats congregate at particular departure points along the southern coast of Sweden and then set off individually or in small groups to their winter habitats in central and western Europe.¹²³ Large concentrations of Nathusius' pipistrelle during the migration period have, for example, been recorded on the west coast of Finland.¹²⁴ It is assumed that migrating bats take off from assembly points and fly along corridors that widen strongly as the distance from the point of departure increases in a southern – south-western direction.¹²⁵ Furthermore, it is assumed that bats migrate along characteristic landscape features, such as coastlines. Therefore, the entire coastline of the Baltic Sea as well as the Baltic Sea islands are of great importance for bat migration.¹²⁶

Each year, more than 250000 bats are killed by ground-based wind turbines in Germany, of which more than 70% are migratory species.¹²⁷ Comparable mortality rates for offshore wind farms are unavailable as offshore mortality cannot be estimated using conventional monitoring methods. However, it is assumed that the risk of collision with offshore wind turbines may be increased for migrating bats, especially during migration periods (spring and autumn).¹²⁸ The current amount of data on bat activity on coasts and at sea is scarce; however, habitats associated with the sea may be of particular importance for bats migrating over long distances.¹²⁹

Statistics for both the common noctule and the Nathusius' pipistrelle show a very high risk of mortality associated with wind turbines. This very high mortality risk is related to the specific flight behaviour of these two species. They use open spaces as feeding grounds; they fly fast and high, with little agility. According to available sources, the mortality of the common noctule to collisions with wind farm components is the highest, compared to other bat species. This data refers to European onshore

¹²⁰ Hutterer R., Ivanova T., Meyer-Cords C., Rodrigues L., *Bat migrations in Europe. A review of banding data and literature. Naturschutz und biologische Vielfalt. Bundesamt für Naturschutz (BfN), Bonn 2005*

¹²¹ Lehnert L.S., Kramer-Schadt S., Teige T., Hoffmeister U., Popa-Lisseanu A., Bontadina F., Ciechanowski M., Dechmann D.K.N., Kravchenko K., Presetnik P., Starrach M., Straube M., Zoephel U., Voigt C., *Variability and repeatability of noctule bat migration in Central Europe: evidence for partial and differential migration. Proc. R. Soc. B. 2018, 285: 20182174*

¹²² Skiba R., *Europäische Fledermäuse. Kennzeichen, Echoortung und Detektoranwendung. VerlagsKG Wolf, 2009*

¹²³ Ahlén I., Baggøe H.J., Bach L., *Behavior of Scandinavian bats during migration and foraging at sea. Journal of Mammalogy 2009, 90 (6): 1318-1323*

¹²⁴ ICES, *Effects of extraction of Marine Sediments on the Marine Ecosystem. Report of the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem. ICES Coop. Res. Rep. No. 247, 2001*

¹²⁵ Seebens A., Fuß A., Allgeyer P., Pommeranz H., Mähler M., Matthes H., Götsche M., Götsche M., Bach L., Paatsch C., *Fledermauszug im Bereich der deutschen Ostseeküste. Unveröff. Gutachten im Auftrag des Bundesamt für Seeschifffahrt und Hydrographie, Hamburg 2013*

¹²⁶ Rydell J., Engström H., Hedenström A., Larsen J.K., Pettersson J., Green M., *The effect of wind power on birds and bats. A synthesis. Report No. 6511. The Swedish Environmental Protection Agency, Stockholm 2012*

¹²⁷ Voigt C.C., Lehnert L.S., Petersons G., Adorf F., Bach L., *Wildlife and renewable energy. German politics cross migratory bats. European Journal of Wildlife Research 2015, 61: 213-219*

¹²⁸ Rodrigues L., Bach L., Doubourg-Savage M.-J., Karapandža B., Kovač D., Kervyn T., Dekker J., Kepel A., Bach P., Colling J., Harbusch C., Park K., Micevski B., Minderman J., *Guidelines for consideration of bats in wind farms projects – Revision 2014. EUROBATS Publication Series no. 6 (English version). UNEP/EUROBATS Secretariat, Bonn 2015*

¹²⁹ Ciechanowski M., Jakusz-Gostomska A., Żmihorski M., *Empty in summer, crowded during migration? Structure of assemblage, distribution pattern and habitat use by bats (Chiroptera: Vespertilionidae) in a narrow, marine peninsula. Mamm. Res. 2015, 61: 45-55*

wind farms. To date, no similar studies have been carried out for OWFs. The Nathusius' pipistrelle is the second most vulnerable species in this context.^{130,131}

In contrast to the common noctule and the Nathusius' pipistrelle, the soprano pipistrelle hunts at lower altitudes, flying not very fast, but quite agilely. Therefore, the mortality risk of the soprano pipistrelle due to wind turbines is relatively lower, although according to Kepel et al.^{132,133}, it is still high.

The table below (tab. 7.17) shows the expected risk of wind farm mortality for species recorded during surveys conducted in accordance with guidelines^{134, 135} in the BC-Wind OWF Area. Species collected under the Nyctaloid group name are also listed in the table (tab. 7.17). It should be noted that the data in the fourth and fifth columns of the table refer to onshore wind farms.

Tab. 7.17. Recorded bat species and their mortality risk at wind farms according to Kepel et al. (2013)

Species		Conservation status (IUCN Red List)	Mortality rates recorded in Europe	Risk of death at wind farms
English name	Latin name			
Common noctule	<i>Nyctalus noctula</i>	LC	+++	Very high
Lesser noctule	<i>Nyctalus leiseri</i>	LC	+++	Very high
Greater noctule bat	<i>Nyctalus lasiopterus</i>	VU	++	Very high
Northern bat	<i>Eptesicus nilssonii</i>	LC	++	Moderate
Serotine bat	<i>Eptesicus serotinus</i>	LC	+++	Moderate
Parti-coloured bat	<i>Vespertilio murinus</i>	LC	++	Moderate
Nathusius' pipistrelle	<i>Pipistrellus nathusii</i>	LC	+++	Very high
Soprano pipistrelle	<i>Pipistrellus pygmaeus</i>	LC	+++	High

Mortality recorded at onshore wind farms in Europe: + - single, ++ - regular, +++ - numerous

IUCN Red List categories (DIETZ et al. 2016): EN – Endangered, VU – Vulnerable, NT – Near Threatened, DD – Data Deficient, LC – Least Concern

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 150

In Poland, there are no legal regulations regarding bat survey methodology in the context of wind energy. Therefore, for the bat surveys conducted in the BC-Wind OWF study area, a methodology based on the guidelines of Kepel et al.^{136, 137}, as well as the EUROBATs specifications¹³⁸, was adopted. The methodology used is in line with these specifications, although adaptations were made as the guidelines were developed for onshore wind farms. As the bat surveys carried out are for OWFs, the survey periods were limited to the spring and autumn migration seasons.

¹³⁰ Kepel A., Ciechanowski M., Jaros R., Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011

¹³¹ Kepel A., Ciechanowski M., Jaros R., Guidelines for assessing the impact of wind turbines on bats. Draft – version of XI 2013. General Directorate for Environmental Protection, Poznań 2013

¹³² Kepel A., Ciechanowski M., Jaros R., Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011

¹³³ Kepel A., Ciechanowski M., Jaros R., Guidelines for assessing the impact of wind turbines on bats. Draft – version of XI 2013. General Directorate for Environmental Protection, Poznań 2013

¹³⁴ Kepel A., Ciechanowski M., Jaros R., Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011

¹³⁵ Kepel A., Ciechanowski M., Jaros R., Guidelines for assessing the impact of wind turbines on bats. Draft – version of XI 2013. General Directorate for Environmental Protection, Poznań 2013

¹³⁶ Kepel A., Ciechanowski M., Jaros R., Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011

¹³⁷ Kepel A., Ciechanowski M., Jaros R., Guidelines for assessing the impact of wind turbines on bats. Draft – version of XI 2013. General Directorate for Environmental Protection, Poznań 2013

¹³⁸ Rodrigues L, I inn., Guidelines for the consideration of bats in wind farms projects – Revision 2014. EUROBATs Publication Series no. 6 (English version). UNEP/EUROBATs Secretariat, Bonn 2015

Bat activity surveys in the BC-Wind OWF Area were conducted from August to October 2019 (autumn migration) and from April to May 2020 (spring migration). Recording of acoustic signals was carried out during surveys from a vessel along a designated transect route with a total length of approx. 55 km, and at two listening stations. Recordings at the listening stations were made from the deck of the anchored vessel.

During autumn migration surveys in the BC-Wind OWF Area, bat activity was recorded at one listening station and along the transect route. Bat sound sequences were attributed to the species of common noctule, *Nathusius' pipistrelle* and the soprano pipistrelle, as well as to the Nyctaloid species group (*Nyctalus* sp., *Vespertilio* spp. and *Eptesicus*, species with similar sonograms, which cannot be clearly identified down to the species level).

During the surveys conducted during the autumn migration, the dominant bat species in the BC-Wind OWF area was the common noctule. Most of the recorded bat activity units attributed to the common noctule were recorded during the August campaign. The second most frequently detected species during the autumn campaign was the *Nathusius' pipistrelle* (twelve activity units), while only one activity unit was recorded for soprano pipistrelle.

The average activity rates for the *Pipistrellus* spp., *Nyctalus* spp. and Nyctaloid groups of species and for all bats, calculated for the autumn migration period according to the methodology used^{139,140}, were in category A (low bat activity). No preventive nor mitigation measures are required for category A activity rates. At one listening station, the calculated average activity index for one species group (*Nyctalus* spp.) and for all bats was placed in category B (moderate bat activity). According to the guidelines^{141,142}, also in the case of moderate activity, no preventive nor mitigation measures are required if category B activity rates occur in one period, at particular sections or at particular points. This applies to the results of the performed monitoring studies.

During the spring migration survey – between April and May 2019 – bat activity was recorded at one of the two listening stations and along one transect. No bat activity was recorded at the other survey stations. Recorded bat activity was attributed to the *Nathusius' pipistrelle* and the common noctule, as well as the Nyctaloid group. The calculated bat activity indices, as well as the average bat activity indices^{143,144}, belonged to category A (low activity).

Three species of bats were recorded throughout the autumn and spring migration periods (the common noctule, the *Nathusius' pipistrelle* and the soprano pipistrelle). Two of these species, the *Nathusius' pipistrelle* and the common noctule, are long-distance migratory species. They are largely distributed across the European continent and use summer habitats in the northeastern part of Europe and hibernate in the southwestern parts of the continent. The *Nathusius' pipistrelle* is known to migrate long distances of up to 1900 km between summer and winter habitats, also crossing the Baltic Sea on the way¹⁴⁵. The same is true for the common noctule, which migrates approx. 1600 km and which has

¹³⁹ Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011*

¹⁴⁰ Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft – Version of XI 2013. General Directorate for Environmental Protection, Poznań 2013*

¹⁴¹ Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011*

¹⁴² Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft – Version of XI 2013. General Directorate for Environmental Protection, Poznań 2013*

¹⁴³ Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011*

¹⁴⁴ Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft – Version of XI 2013. General Directorate for Environmental Protection, Poznań 2013*

¹⁴⁵ Ahlén I., Baggøe H.J., Bach L., *Behavior of Scandinavian bats during migration and foraging at sea. Journal of Mammalogy 2009, 90 (6): 1318-1323*

also been observed flying over the Baltic Sea.^{146, 147} Unlike the two species mentioned above, the soprano pipistrelle is not counted as a migratory species. However, it has been recorded in OWF areas.¹⁴⁸

The activity indices for the different bat species calculated for the entire autumn migration period and the spring migration period, respectively, indicate **low bat activity in the surveyed part of the BC-Wind OWF Area**. According to *Guidelines...*^{149,150}, no preventive nor mitigation measures are required during the implementation of the planned OWF.

At the same time, it cannot be excluded that migrating bats will fly through the BC-Wind OWF Area. Nevertheless, the recorded levels of bat activity throughout the study period do not indicate intense bat migration in the area.

As recommended in the *Guidelines...*, an integral part of an assessment of the impact of a wind farm on bats is post-execution monitoring, which allows for the examination of bat activity and mortality during the exploitation phase of the project. This makes it possible for the initial assumptions made during the pre-implementation studies to be verified and mitigation measures to be adjusted accordingly. A proposal for post-execution monitoring is presented in Chapter 16.

7.4.7. Biodiversity and nature conservation of the basin

Phytobenthos

No phytobenthos has been identified in the BC-Wind OWF Area.

Macrozoobenthos

In the BC-Wind OWF Area (1 NM), 21 taxa (species and higher in rank – not designated to specific species) of taxonomic units belonging to the phyla *Nemertea* and *Priapulida* and 6 classes: the hydrozoans *Hydrozoa*, polychaetes *Polychaeta*, clitellates *Clitellata*, malacostracans *Malacostraca*, bivalves *Bivalvia* and gymnolaemates *Gymnolaemata*, were found on the soft bottom (sandy and gravelly sediments). Three species of polychaetes: *Pygospio elegans*, *Marenzelleria* sp. and *Bylgides sarsi*, one bivalve species *Macoma balthica*, and a representative of the malacostracans, *Diastylis rathkei*, were absolutely constant. In terms of abundance, this seabed type was dominated by the *Pygospio elegans*, common in the PMA, and the biomass was dominated by the *Limecola balthica*, characterised by a wide range of tolerance to environmental factors (Appendix 1 of the EIA Report – Volume III).

On the hard bottom (stone surfaces), among the epiphytic and phytophilous fauna, 17 taxa belonging to seven classes were found: hydrozoans *Hydrozoa*, clitellates *Clitellata*, polychaetes *Polychaeta*, *Hexanauplia*, malacostracans *Malacostraca*, bivalves *Bivalvia* and gymnolaemates *Gymnolaemata*. The most abundant taxa were the polychaete *Bylgides sarsi*, the bivalve *Mytilus trossulus*, the gymnolaemate *Einhornia crustulenta*, the hydrozoan *Gonothyraea loveni*, and the malacostracan *Jaera (Jaera) albifrons*. However, the bivalve *Mytilus trossulus* was by far the dominant species in terms of abundance and biomass, forming aggregations of several individuals, being an important food component for fish and birds and fulfilling an important habitat-forming role in the environment (Appendix 1 to the EIA Report – Volume III).

¹⁴⁶ Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011*

¹⁴⁷ Ahlén I., Baggøe H.J., Bach L., *Behavior of Scandinavian bats during migration and foraging at sea. Journal of Mammalogy 2009, 90 (6): 1318-1323*

¹⁴⁸ Ahlén I., Baggøe H.J., Bach L., *Behavior of Scandinavian bats during migration and foraging at sea. Journal of Mammalogy 2009, 90 (6): 1318-1323*

¹⁴⁹ Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft. General Directorate for Environmental Protection, Warsaw 2011*

¹⁵⁰ Kepel A., Ciechanowski M., Jaros R., *Guidelines for assessing the impact of wind turbines on bats. Draft – Version of XI 2013. General Directorate for Environmental Protection, Poznań 2013*

The taxa found are typical and common representatives of invertebrate macrofauna in the open waters of the southern Baltic Sea. The taxonomic composition, abundance and biomass of macrozoobenthos in both habitats (soft- and hard-bottom) in the area of the BC-Wind OWF were typical of the medium-depth bottom of the Eastern Gotland Basin (up to 60 m a. s. l.), but not outstanding in terms of taxonomic diversity. Compared to the results of macrozoobenthos surveys in the areas of the neighbouring planned projects: OWF Bałtyk III, OWF Bałtyk II and OWF Baltica 2 and OWF Baltica 3, the results of the qualitative structure of the macrozoobenthos assemblage of the BC-Wind OWF Area are somewhat poorer.

Ichthyofauna

The analysis of the catch and productivity of the fish living within the BC-Wind OWF Area showed that the area is typical of the southern Baltic in terms of species diversity, with a clear predominance of cod and flounder in the demersal fishery and herring and sprat in the pelagic fishery.

A total of 144 fish species were recorded in the Baltic Sea, including 97 marine species, 7 migratory species and 40 freshwater species. The dominant fish species in the deeper waters of the western Baltic are cod and flounder for the demersal lifestyle and herring and sprat for the pelagic lifestyle.

According to the data included in the Second Update of the Preliminary Assessment of the Environmental Status of Marine Waters (2024), more than 64 fish species and 2 lamprey species are consistently found in the PMA. In addition, approx. 20 fish species are found in the PMA sporadically.

A total of 21 fish species were observed in the BC-Wind OWF Area during the surveys.

For ichthyoplankton, eggs of one fish species and larvae belonging to 10 taxa were caught. Sprat was by far the most abundant larvae throughout the study period with 82.9% of the total larvae of all species, followed by gobies (8.7%) and flounder (4.8%). The larvae of the remaining 7 species, such as seasnail, herring, sand eel, rockling, long-spined bullhead, rock gunnel and cod, were significantly less abundant (0.12%-1.2%)

During pelagic fishing, 9 species of fish were caught, however 99% of the catch consisted of sprat and herring. Individual garfish, stickleback, sand eel, anchovy, flounder, sand lance and cod specimens were also found.

In the demersal fishery, fish belonging to 13 taxa were recorded. Flounder and cod were the dominant species, with other species constituting a small bycatch (sand eel, plaice, long-spined bullhead, hooknose, mackerel, rockling, turbot, herring, sprat, lumpfish, eelpout).

Seabirds

The species diversity of the seabirds recorded in the area of the BC-Wind OWF varied according to the seasons in which the observations were made (Tab. 7.18).

During the autumn migration period, 9 species of seabirds were found in the BC-Wind OWF Area, of which the European herring gull was by far the most numerous, accounting for 82.1% of all birds found. The share of 1% in the grouping was exceeded by 3 more species: the common guillemot (7.9%), the razorbill (5.5%) and the long-tailed duck (1.2%). The remaining species were not very numerous and their total abundance recorded during all surveys did not exceed 1% (0.8% for the lesser black-backed gull, 0.3% for the little gull, 0.3% for the great black-backed gull, 0.2% for the velvet scoter and 0.1% for the black guillemot).

Fewer species were recorded during the winter period compared to the autumn migration period, i.e. 7. The most abundant species found on this basin was the European herring gull (33.3% of the total grouping of birds), the long-tailed duck (24.5%) and the razorbill (22.0%). A share of more than 1% was also reached by the great black-backed gull (3.6%) and the common guillemot (2.1%). Other species the total abundance of which did not exceed 1% were the little gull (0.3%) and the black guillemot (0.1%).

During the spring migration period, 9 species were found in the BC-Wind OWF area, of which the most numerous were the European herring gull, representing 43.5% of all spotted birds, and the razorbill – representing 21.3%. A share of at least 1% in the whole grouping of birds was reached by 6 more species: the little gull (11.6%), the lesser black-backed gull (4.3%), the common scoter (4.3%), the common guillemot (2.4%), the black-throated loon (1.4%) and the long-tailed duck (1.0%). The least abundant species during this period was red-throated loon (0.5%). During the summer period, 6 seabird species were recorded in the BC-Wind OWF area. The most abundant were the common guillemot (48.5%) and European herring gull (44.2%). A share above 1% was also reached by the lesser black-backed gull (2.2%) and the razorbill (1.1%). Less numerous were the little gull and the great black-backed gull (0.4% each).

Tab. 7.18. Number of species and the most abundant seabird species found in the BC-Wind OWF Area by phenological period

Parameter	Autumn migration period	Winter period	Spring migration period	Summer period
Number of species	9	7	9	6
Most abundant species	European herring gull, common guillemot, razorbill, long-tailed duck	European herring gull, long-tailed duck, razorbill, great black-backed gull, common guillemot	European herring gull, little gull, lesser black-backed gull, common scoter, common guillemot, black-throated loon, long-tailed duck	Common guillemot, European herring gull, lesser black-backed gull, razorbill

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 132

Marine mammals

Three species of marine mammals may occasionally occur in the BC-Wind OWF Area: the harbour porpoise (*Phocoena phocoena*), the grey seal (*Halichoerus grypus*) and the common seal (*Phoca vitulina*). Additionally, there is a very low probability of sighting a ringed seal (*Pusa hispida*). For marine mammals, the BC-Wind OWF area may only provide a temporary residence site while they are foraging for food.

Natural valuation of the BC-Wind OWF Area

The natural valuation of a given marine area can be based on the significant differences that exist within that area, both in terms of generally habitat-forming abiotic conditions and biotic conditions, which are the result of the former. Suitable habitat conditions (type of seabed, quality of bottom sediments, depth, photic conditions) directly affect the inhabiting organisms that permanently reside in such conditions, or temporarily use the area.

The results of the comprehensive environmental research conducted for the purposes of the EIA Report indicate that the BC-Wind OWF Area is mostly homogenous in terms of abiotic conditions. Therefore, fragments of areas with different natural values cannot be indicated.

The only environmental element that differentiates the BC-Wind OWF Area is the depth of the water body. It varies from a depth of 27.6 m in the south of the area to 65.2 m in the northeast. This causes the shallowest, southern part of the BC-Wind OWF Area to be characterised by higher densities of seabirds (the long-tailed duck and the velvet scoter) during the wintering period. This is due to the fact that in water bodies with less depth, benthophagous seabirds can acquire food with a lower energy input, which is more favourable for them. Hence, it can be indicated that the southern part of the BC-Wind OWF Area is characterised by higher natural values through more favourable conditions for this group of birds in relation to the other parts of the area.

7.5. PROTECTED AREAS AND ECOLOGICAL CORRIDORS

7.5.1. Protected areas

The BC-Wind OWF Area is located outside the boundaries of the protected areas indicated in the Nature Conservation Act of 16 April 2004, including the European ecological network Natura 2000.

In relation to the BC-Wind OWF, the closest two Natura 2000 marine sites are (Fig. 7.18):

- Baltic Coastal Waters (PLB990002) – at a distance of approx. 12 km;
- Słupsk Bank (PLC990001) – at a distance of approx. 42 km;

as well as maritime and land areas:

- Ostoja Słowińska (PLH220023) – at a distance of approx. 37 km;
- Pobrzeże Słowińskie (PLB220003) – at a distance of approx. 40.1 km.

The Słowiński National Park is approx. 37 km southwest to the BC-Wind OWF, while over 63 km to the northwest there is the Swedish Natura 2000 area Hoburgs bank och Midsjöbankarna (SE0330308).

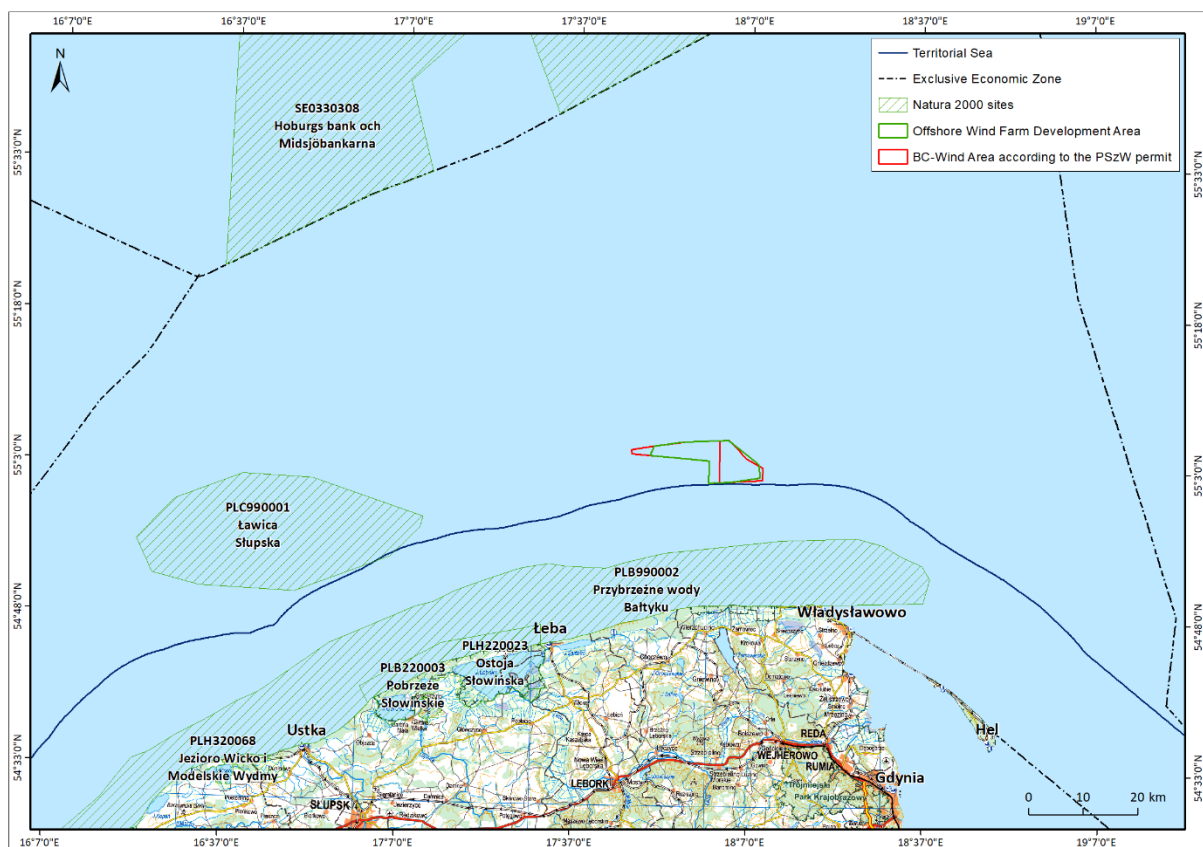


Fig. 7.18. Location of the BC-Wind OWF with the background of the European ecological network Natura 2000 sites

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 147

Baltic Coastal Waters (PLB990002)

The closest protected area to the BC-Wind OWF is the Baltic Coastal Waters site (PLB990002), pol. *Przybrzeżne wody Bałtyku*. The distance between these areas is approx. 12 km (taking into account the closest points of both areas). The Baltic Coastal Waters (PLB990002) site encompasses a belt of coastal waters of the southern Baltic Sea with depths ranging from 0 m to 20 m and a length of approx. 200 km, starting from the tip of the Hel Peninsula and ending in the Pomeranian Bay. The seabed here is uneven, with denivelations of up to 3 m. The benthic fauna is dominated by small crustaceans. Two bird species from Annex I of the Birds Directive winter in the area: the black-throated loon and the red-

throated loon. During winter, more than 1% of the migratory flyway population of the long-tailed duck and at least 1% of the migratory flyway population of the black guillemot and the velvet scoter occur in the area. Of the species included in the impact assessment of the BC-Wind OWF on seabirds in the Baltic Coastal Waters site (PLB990002), the wintering populations of the long-tailed duck, the velvet scoter, the razorbill and the European herring gull are protected. It is estimated that 90-120000 long-tailed ducks, 14-20000 velvet scoters and 8-15000 European herring gulls winter in this area.¹⁵¹ In contrast, the wintering population of razorbills in this area is estimated at 500 to 1000 individuals.¹⁵² In the Baltic Coastal Waters (PLB990002) site, the wintering and flyway population of the common scoter and the wintering population of the black guillemot are also protected (Tab. 7.19). No conservation plan is available for this area.

Tab. 7.19. Basic information on subjects of protection in the area of Baltic Coastal Waters (PLB990002)

Species	Type of population	Assessment of the area for the population*	Population size in the area [number of individuals]	
			Minimum	Maximum
European herring gull <i>Larus argentatus</i>	Overwintering	C	1250	7300
Black guillemot <i>Cepphus grylle</i>	Overwintering	B	1	7
Razorbill <i>Alca torda</i>	Overwintering	C	5	50
Long-tailed duck <i>Clangula hyemalis</i>	Overwintering	B	2750	7150
Velvet scoter <i>Melanitta fusca</i>	Overwintering	C	1600	11700
Common scoter <i>Melanitta nigra</i>	Overwintering	C	359	3000
	Transient	C	3000	3000

* Assessment of the population size of the species and its density in relation to the national population; class intervals: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; site assessment for population D (the species is not subject to site protection)

Source: own elaboration based on SDF Baltic Coastal Waters (March 2024)

Słupsk Bank (PLC990001)

The boundary of the BC-Wind OWF Development Area is located approx. 43 km from the Słupsk Bank area (PLC990001), pol. Ławica Słupska, designated under the Birds Directive and the Habitats Directive.

The Słupsk Bank site (PLC990001) comprises a submarine bank with a significantly shallower bottom in relation to its surrounding areas. Its boundary largely follows the course of the 20 m isobath. It is an area with a highly varied bottom, with many denivelations. The shallows are inhabited by numerous invertebrates and also provide a food base for resident seabirds, particularly during their wintering season.

The predominant plants are macroalgae, including red algae: *Furcellaria lumbricalis*, *Ceramium diaphanum* and *Polysiphonia fucoides*. Two bird species listed in Annex I of the Birds Directive winter in the area: the black-throated loon and the red-throated loon. During the winter, at least 1% of the migratory flyway population of the long-tailed duck and the black guillemot occurs here. Seabirds occur in numbers exceeding 20000 individuals.

There are two bird species within the boundaries of the Słupsk Bank Natura 2000 site (PLC990001) that are the subjects of protection in this area (Tab. 7.20):

¹⁵¹ Meissner W., Przybrzeżne wody Bałtyku, [in:] Wilk T., Jujka M., Krogulec J., Chylarecki P. (ed.), *Ostoje ptaków o znaczeniu międzynarodowym w Polsce*. Ogólnopolskie Towarzystwo Ochrony Ptaków, Marki 2010: 531-532

¹⁵² General Directorate for Environmental Protection (GDOŚ), *Standard Data Form (SDF) for the Natura 2000 area (PLB990002) Baltic Coastal Waters*. Date of elaboration: 2002-05. Date updated: 2019-11

- the black guillemot;
- the long-tailed duck;

and two natural habitats that constitute the area's conservation objectives (Tab. 7.21):

- Offshore sandbanks (1110);
- Reefs (1170).

Detailed information on the ornithofauna of the Słupsk Bank area and the BC-Wind OWF Area, including a presentation and discussion of the results of the research on water and migratory birds carried out for the purposes of the EIA Report, is included in Appendix 1 to the EIA Report (Volume III. Appendices).

Tab. 7.20. Sea birds constituting subjects of protection within the Słupsk Bank site (PLC990001)

Species	Type of population	Assessment of the area for the population*	Population size in the area [number of individuals]	
			Minimum	Maximum
Black guillemot <i>Cephus grylle</i>	Overwintering	C	98	556
	Transient	C	72	461
Long-tailed duck <i>Clangula hyemalis</i>	Overwintering	B	101148	231180
	Transient	B	76440	214374
Velvet scoter <i>Melanitta fusca</i>	Overwintering	B	5565	23611
	Transient	C	910	1789

* Class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; site assessment for population D (species is not a conservation concern)

** The SDF form incorrectly states population size. The values quoted here are from BirdLife International (<http://datazone.birdlife.org/site/factsheet/slupsk-bank-iba-poland/details>; accessed 16.04.2021) containing the data provided for the SDF form

Source: own compilation based on: SDF update (March 2024)

The Offshore sandbanks (1110) habitat within the Słupsk Bank (PLC990001) site is one of three such sites present in the PMA. The conventional habitat boundary is a 20 m isobath. In the Słupsk Bank, the sediment is predominantly sand and gravel with local rocks and glacial boulders.

The Reefs habitat (1170) is located in the northwestern part of the Słupsk Bank. It is a unique area in the southern part of the Baltic Sea due to the nature of the geological structure and type of rock substrate. So far, it is the only place of abundant occurrence of macroalgae overgrowing a rocky bottom distant from the shore identified in the Polish maritime areas.

Tab. 7.21 Natural habitats under protection in the Słupsk Bank area (PLC990001)

Habitat code	Name of habitat	Coverage [ha]	Representativeness ¹	Relative surface area ²	State of preservation ³	Overall assessment ⁴
1110	Offshore sandbanks	30926.65	A	A	A	A
1170	Reefs	14331.6	A	A	A	A

¹ Classification system for assessing representativeness: A – excellent, B – good, C – significant, D – irrelevant representativeness

² Class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$

³ Conservation status rating system: A – excellent, B – good, C – in average or poor condition

⁴ Overall rating system: A – excellent, B – good, C – significant

Source: own compilation based on: Słupsk Bank SDF (updated March 2024)

There is no protection plan for this area. A draft protection plan was developed in 2020 and is posted on the website of the Maritime Office in Szczecin.

Ostoja Słowińska (PLH220023)

Unlike the two previously described protected areas, Ostoja Słowińska (PLH220023) is a land-sea area. Its maritime boundary is approx. 37 km from the BC-Wind OWF Area. The maritime part of Ostoja Słowińska (PLH220023) covers a strip of coastal waters about 2 Mm wide within the boundaries of the Słowiński National Park. The marine area of Ostoja Słowińska (PLH220023) provides a habitat

for two species of marine mammals and five species of fish and lampreys associated with the marine environment (Tab. 7.22). Of the marine habitats, the rocky seabed in the analysed area is a subject of protection as it constitutes a natural habitat of Reefs (1170) – Tab. 7.23 – located in the western part of the area.

Tab. 7.22. Basic information on marine mammal, fish and lamprey species associated with the marine environment in the area of Ostoja Słowińska (PLH220023)

Species	Type of population	Assessment of the area			
		Population ¹	State of preservation ²	Insulation ³	Overall ⁴
Grey seal <i>Halichoerus grypus</i>	Moving	C	B	B	B
Harbour porpoise <i>Phocoena phocoena</i>	Moving	B	B	B	B
Twaite shad <i>Alosa fallax</i>	Moving	C	B	C	C
River lamprey <i>Lampetra fluviatilis</i>	Moving	B	B	C	B
Sabrefish <i>Pelecus cultratus</i>	Settled	C	B	C	C
Sea lamprey <i>Petromyzon marinus</i>	Moving	C	B	C	B

¹ Estimation of the population size of the species and its density in relation to the national population; class intervals: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; site assessment for population D (species is not subject to site protection)

² Conservation status rating system: A – excellent conservation status; B – good conservation status; C – average or degraded conservation status

³ Isolation assessment classification system: A – population (almost) isolated; B – population not isolated but occurring on the periphery of the species' range; C – population not isolated within an extensive area of distribution

⁴ Overall rating system: A – excellent; B – good; C – significant

Source: own compilation based on: SDF Ostoja Słowińska (updated March 2024)

Tab. 7.23. Basic information on natural habitats occurring in the marine part of the area of Ostoja Słowińska (PLH220023)

Habitat code	Name of habitat	Coverage [ha]	Representativeness ¹	Relative surface area ²	State of preservation ³	Overall assessment ⁴
1170	Reefs	402.06	B	C	A	B

¹ System of classification for assessing representativeness: A – excellent, B – good, C – significant, D – irrelevant representativeness

² Class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$

³ System of conservation status rating: A – excellent, B – good, C – in average or poor condition

⁴ General rating system: A – excellent, B – good, C – significant

Source: own compilation based on: SDF Ostoja Słowińska (2017)

No conservation plan has been adopted for this area.

Pobrzeże Słowińskie (PLB220003)

This site is a land area of 21819.43 ha, covering morphological forms occurring on the Gardnieńsko-Łebska Spit, including unique coastal barchans and the two largest brackish-water lakes, Łebsko and Gardno, together with adjacent meadows, peatlands, forests and coniferous forests. The Pobrzeże Słowińskie area (PLB220003), included in the list of areas of the Ramsar Convention, hosts at least 28 bird species from Annex I of the Birds Directive, but mostly related to onshore environments (Tab. 7.24). During the migration period, at least 1% of the migratory flyway populations of three waterbird species are present there: smew, bean goose and goosander. Cormorant, white-fronted goose and wigeon occur in relatively high numbers. A large population of the European herring gull also nests here. The subjects of protection in the area are the migratory populations of the white-fronted goose, the bean goose, the common pochard, the smew, the goosander and the cormorant, as well as the breeding population of the European herring gull. Of these species, only the European herring gull was included in the assessment of the impact of the BC-Wind OWF on seabirds. According to the area's standard data form, this population is 400 gulls (less than 1% of the migratory flyway population share).

Tab. 7.24 Basic information on the subjects of protection within the *Pobrzeże Słowińskie* site (PLB220003)

Species	Type of population	Assessment of the area for the population*	Population size in the area [number of individuals]	
			Minimum	Maximum
Boreal owl <i>Aegolius funereus</i>	Settled	D	1	1
Eurasian wigeon <i>Anas penelope</i>	Transient	D	-	-
Mallard <i>Anas platyrhynchos</i>	Transient	D	-	-
Greater white-fronted goose <i>Anser albifrons</i>	Transient	C	1000	6200
Bean goose <i>Anser fabalis</i>	Transient	A	3200	4500
Golden eagle <i>Aquila chrysaetos</i>	Producing offspring	B	1	1
Lesser spotted eagle <i>Aquila pomarina</i>	Producing offspring	D	1	1
Short-eared owl <i>Asio flammeus</i>	Settled	D	1	2
Common pochard <i>Aythya ferina</i>	Transient	C	1	1500
Eurasian bittern <i>Botaurus stellaris</i>	Producing offspring	D	2	4
Eurasian eagle-owl <i>Bubo bubo</i>	Settled	B	5	5
Dunlin <i>Calidris alpina</i>	Producing offspring	D	-	-
	Transient	D	140	140
European nightjar <i>Caprimulgus europaeus</i>	Producing offspring	D	30	30
Ringed plover <i>Charadrius hiaticula</i>	Producing offspring	C	10	10
White stork <i>Ciconia ciconia</i>	Producing offspring	D	15	25
Black stork <i>Ciconia nigra</i>	Producing offspring	D	1	1
Western marsh harrier <i>Circus aeruginosus</i>	Producing offspring	D	7	9
Hen harrier <i>Circus cyaneus</i>	Producing offspring	D	-	-
Montagu's harrier <i>Circus pygargus</i>	Producing offspring	D	4	5
Corn crake <i>Crex crex</i>	Producing offspring	C	200	250
Whooper swan <i>Cygnus cygnus</i>	Transient	B	560	560
Common crane <i>Grus grus</i>	Transient	C	7000	7000
White-tailed eagle <i>Haliaeetus albicilla</i>	Producing offspring	D	4	4
	Transient	D	10	30
European herring gull <i>Larus argentatus</i>	Producing offspring	B	400	400
Lesser black-backed gull <i>Larus fuscus</i>	Producing offspring	D	2	2
Smew <i>Mergus albellus</i>	Transient	B	1700	1700
Goosander <i>Mergus merganser</i>	Transient	C	1	2100
Black kite <i>Milvus migrans</i>	Producing offspring	D	1	1

Species	Type of population	Assessment of the area for the population*	Population size in the area [number of individuals]	
			Minimum	Maximum
Red kite <i>Milvus milvus</i>	Producing offspring	C	7	8
Osprey <i>Pandion haliaetus</i>	Producing offspring	D	1	1
European honey buzzard <i>Pernis apivorus</i>	Producing offspring	D	1	1
Great cormorant <i>Phalacrocorax carbo</i>	Producing offspring	C	200	200
Ruff <i>Philomachus pugnax</i>	Transient	D	380	380
Spotted crane <i>Porzana porzana</i>	Producing offspring	D	1	4
Little tern <i>Sterna albifrons</i>	Producing offspring	D	1	3
Common tern <i>Sterna hirundo</i>	Producing offspring	D	1	15

* Assessment of the population size of the species and its density in relation to the national population; class intervals: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; site assessment for population D (the species is not subject to site protection)

Source: own elaboration based on: SDF Pobrzeże Słowińskie (updated March 2024)

No conservation plan has been adopted for this area.

Słowiński National Park

The Słowiński National Park is one of Poland's two land and sea national parks. Its area is 32744 ha. The sea border of the area coincides with the Natura 2000 site Ostoja Słowińska (PLH220023). The main object of protection of this park is the Łebska Spit, which forms a complex of unique geomorphological forms and places where natural processes of coastal redevelopment take place. The park also contains valuable forest and non-forest communities and aquatic ecosystems, including the two largest seaside lakes – Gardno and Łebsko – and a 2 Mm wide coastal sea area. Conservation plans have been in force for the area since 2013.

Hoburgs bank och Midsjöbankarna (SE0330308)

The Hoburgs bank och Midsjöbankarna (SE0330308) site is approx. 63 km from the BC-Wind OWF Development Area. The site covers an area in the Central Baltic Sea and is located in the Swedish maritime areas, south of Öland and Gotland. Within its boundaries there are two habitats that constitute objects of protection: Offshore sandbanks (1110) and Reefs (1170) – Tab. 7.25. In the area of Hoburgs bank och Midsjöbankarna (SE0330308), populations of three bird species are protected: black guillemot, long-tailed duck and common eider (Tab. 7.26), as well as the harbour porpoise population (Tab. 7.27).

Tab. 7.25. Basic information on the natural habitats present in the marine part of the Hoburgs bank och Midsjöbankarna (SE0330308) site

Habitat code	Name of habitat	Coverage [ha]	Representativeness ¹	Relative surface area ²	State of preservation ³	Overall assessment ⁴
1110	Offshore sandbanks	220000	B	B	B	B
1170	Reefs	20000	B	C	B	B

¹ Classification system for assessing representativeness: A – excellent, B – good, C – significant, D – irrelevant representativeness

² Class ranges: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$

³ Conservation status rating system: A – excellent, B – good, C – in average or poor condition

⁴ Overall rating system: A – excellent, B – good, C – significant

Source: <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=SE0330308>

Tab. 7.26. Basic information on seabirds in the area of Hoburgs bank och Midsjöbankarna (SE0330308)

Species	Type of population	Assessment of the area for the population*	Population size in the area	
			Minimum	Maximum
Black guillemot <i>Cephus grylle</i>	Overwintering	C	1000	5000
Long-tailed duck <i>Clangula hyemalis</i>	Overwintering	A	200000	1000000
Common eider <i>Somateria mollissima</i>	Transient	C	5000	50000

* Assessment of the population size of the species and its density in relation to the national population; class intervals: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; site assessment for population D (the species is not subject to site protection)

Source: own elaboration based on <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=SE0330308>

Tab. 7.27. Basic information on marine mammal species associated with the marine environment in the area of Hoburgs bank och Midsjöbankarna (SE0330308)

Species	Type of population	Assessment of the area			
		Population ¹	State of preservation ²	Insulation ³	Overall ⁴
Harbour porpoise <i>Phocoena phocoena</i>	Transient	C	B	B	B

¹ Estimation of the population size of the species and its density in relation to the national population; class intervals: A: $100 \geq p > 15\%$, B: $15 \geq p > 2\%$, C: $2 \geq p > 0\%$; site assessment for population D (the species is not subject to site protection)

² System of conservation status assessment classification: A – excellent conservation status; B – good conservation status; C – average or degraded conservation status

³ System of classification for assessing isolation: A – population (almost) isolated; B – population not isolated but occurring on the periphery of the species' range; C – population not isolated within an extensive area of distribution

⁴ General rating system: A – excellent; B – good; C – significant

Source: <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=SE0330308>

7.5.2. Ecological corridors

An ecological corridor, according to the Nature Conservation Act, is an area that allows the migration of plants, animals or fungi. The network of ecological corridors linking the European ecological network of Natura 2000 in Poland was developed in 2011¹⁵³, however, no ecological corridors were indicated in the PMA.

According to the general classification of the migratory system of waterbirds in Eurasia, Poland, including its marine areas, is located within two large migration corridors: the East Atlantic and the Mediterranean-Black Sea ones. The migration strategy, as well as the migratory corridors of seabirds in the Baltic region, are very poorly understood. During summer, in July and August, sea ducks (mainly male common scoters) are observed migrating from the Gulf of Finland towards the molting areas located in the Danish straits. They are accompanied by common eiders and velvet scoters, but the numbers of both species are much lower than those of the common scoter. These birds only exceptionally stopover in the waters of the southern Baltic Sea. The autumn migration period of seabirds is very stretched out in time. Already from August, a number of waterbird species can be found within the PMA. Some of them only pass through and do not stay for the winter (e.g. terns of the genera of *Sterna* and *Chlidonias*), others are observed throughout the migration and wintering period (long-tailed ducks, razorbills, divers, grebes). In spring, large flocks of sea ducks (long-tailed ducks, velvet scoters, common scoters) are observed moving towards the breeding grounds and stopping over in the Polish Baltic zone.¹⁵⁴

No areas can be identified that could meet the criteria for ecological corridors for marine mammals found in the southern Baltic, either. Both seals and porpoises move in search of food, without preferring specific routes.

¹⁵³ Jędrzejewski W., Nowak S., Stachura K., Skierczyński M., Mysłajek R.W., Niedziałkowski K., Jędrzejewska B., Wójcik J.M., Zalewska H., Pilot M., Górny M., Kurek R.T., Ślusarczyk R., Projekt korytarzy ekologicznych łączących Europejską Sieć Natura 2000 w Polsce. Department of Mammal Research, Polish Academy of Sciences, Białowieża 2011

¹⁵⁴ Sikora A., Chylarecki P., Meissner W., Neubauer G. (eds.), Monitoring wetland birds during migration. Methodology guide. General Directorate for Environmental Protection, Warsaw 2011: 93-102

7.6. CULTURAL HERITAGE

During the geophysical survey conducted in 2020, a total of 6 wrecks were found in the BC-Wind OWF Area, which could be potential cultural heritage sites (Fig. 7.19). Two of them, i.e. SS001 and SS099, have been reviewed by the Director of the National Maritime Museum in Gdańsk. Three others, i.e. SS070, SS059 and SS066, are not cultural heritage sites according to the information from SIPAM, while the sixth site, SS086, requires verification (no information in SIPAM) (Tab. 7.28).

Tab. 7.28 List of potential cultural heritage sites in the area of the planned project

No.	Object	Name according to SIPAM or EPSA	Information
1.	SS001	EPSA B98.2, Site ID according to SIPAM WK-0055	Historic wreck – due to its scientific and historical value and good state of preservation, it is recommended to establish a protection zone of up to 50 m from the contour line of the wreck*
2.	SS086	No data available	No data available
3.	SS070	Site ID according to SIPAM WK-0571	Shipwreck – not a heritage site
4.	SS059	Site ID according to SIPAM WK-0570	Shipwreck – not a heritage site
5.	SS099	Site ID according to SIPAM WK-0572	Unknown wreck – recommended protection zone of min. 25 m from the contour line of the wreck*
6.	SS066	Site ID according to SIPAM WK-0171	Shipwreck – not a heritage site

* based on the opinion of the Director of the National Maritime Museum in Gdańsk dated 12.01.2023, decision number NMM/N-OD/ARL/3670/2022

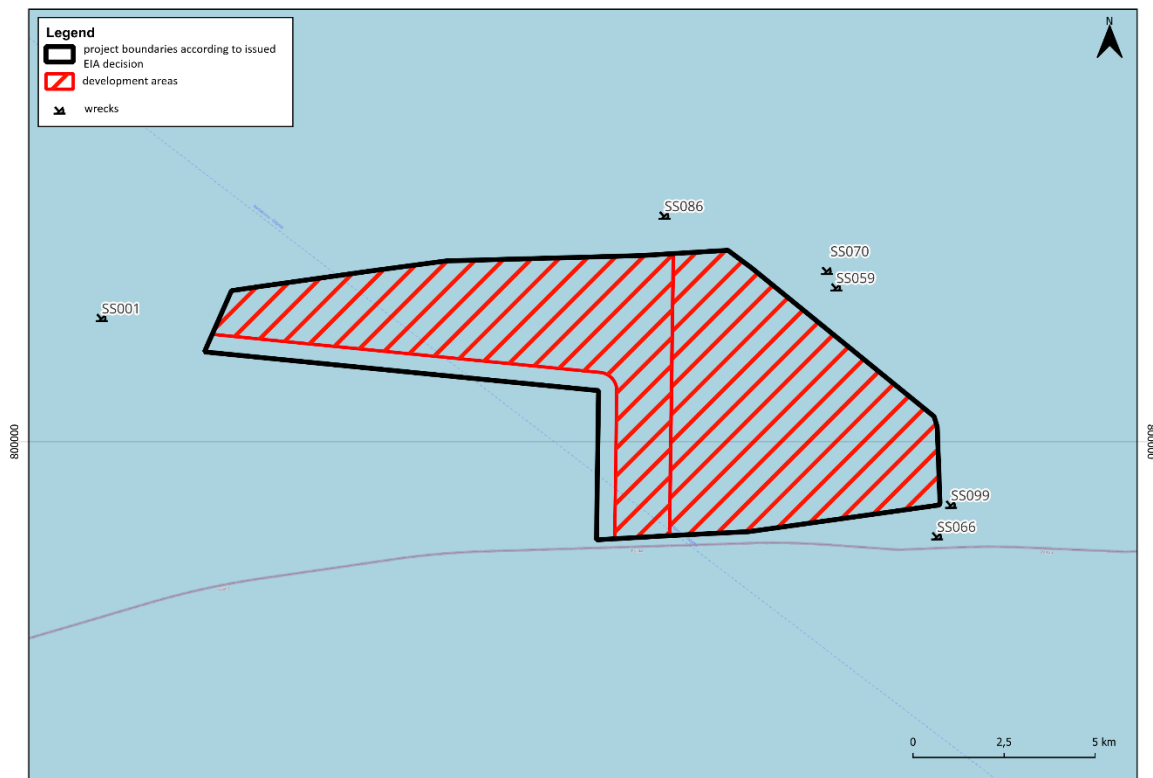


Fig. 7.19 Location of wrecks in the area of the planned project

Source: own elaboration

According to the opinion of the Director of the National Maritime Museum in Gdańsk¹⁵⁵ regarding the handling of historical monuments located within the BC-Wind OWF, object SS001 – the wreck numbered EPSA B98.2 – had already been surveyed by the National Maritime Museum in Gdańsk. As a result of conducted works, it was found that the wreck is the remains of a wooden merchant

¹⁵⁵ decision no. NMM/N-OD/ARL/3670/2022 of 12.01.2023

ship, dating back to the first half of the 19th century. A Card of Archaeological Monument was created for the wreck, which was submitted in 2012 to the Voivodeship Office for the Protection of Historical Monuments in Gdańsk. Another object, SS099 – wreck WK-0572 – had not been known so far, therefore it was placed under conservation protection until its historic value is verified. In accordance with the decision, protection zones have been established for both wrecks, prohibiting all investment activities (Tab. 7.28).

7.7. LANDSCAPE, INCLUDING CULTURAL LANDSCAPE

The location of the BC-Wind OWF covers an area located between approx. 23 and approx. 31 km from land. The landscape changes according to the state of the weather; on windless days, the sea is calm and steady, whereas with increased wind strength, reduced sunshine, increased cloud cover and increased humidity, including rainfall, the sea state, wave action and air clarity also change. Water vapour rises above the water, which also reduces visibility, making it difficult for an observer to determine the sea horizon. Land is rarely visible from the BC-Wind OWF Area.

People rarely stay in the BC-Wind OWF Area. Important customary and planned shipping routes pass within a few kilometres to several tens of kilometres of the BC-Wind OWF and its vicinity (fig. 7.20). These routes are traversed by tankers, container ships, freight and railway ferries and passenger ferries, passenger and cargo ships, freighters and others. There is a proposed new north-east shipping route corridor on the north side of the BC-Wind OWF Area, but it has not yet been established. In addition, the draft MSPPSA also envisages that some shipping will be diverted from the southern to the northern and eastern sides of the BC-Wind OWF.

The BC-Wind OWF is located in parts of two fishing squares, where there is fishing vessel traffic (Fig. 6.3.). Other closest land uses are oil and gas exploration and appraisal concession areas, and the closest production platform Baltic-Beta is located at a distance of more than 38 km, which is beyond the range of visibility from the BC-Wind OWF (fig. 7.20).

It has been estimated that there were more than 200 vessels per day in the zone up to 50 km from the BC-Wind OWF Area in 2018-2019, with up to several hours in the OWF's zone of visibility from the vessel (which is up to 50 km).

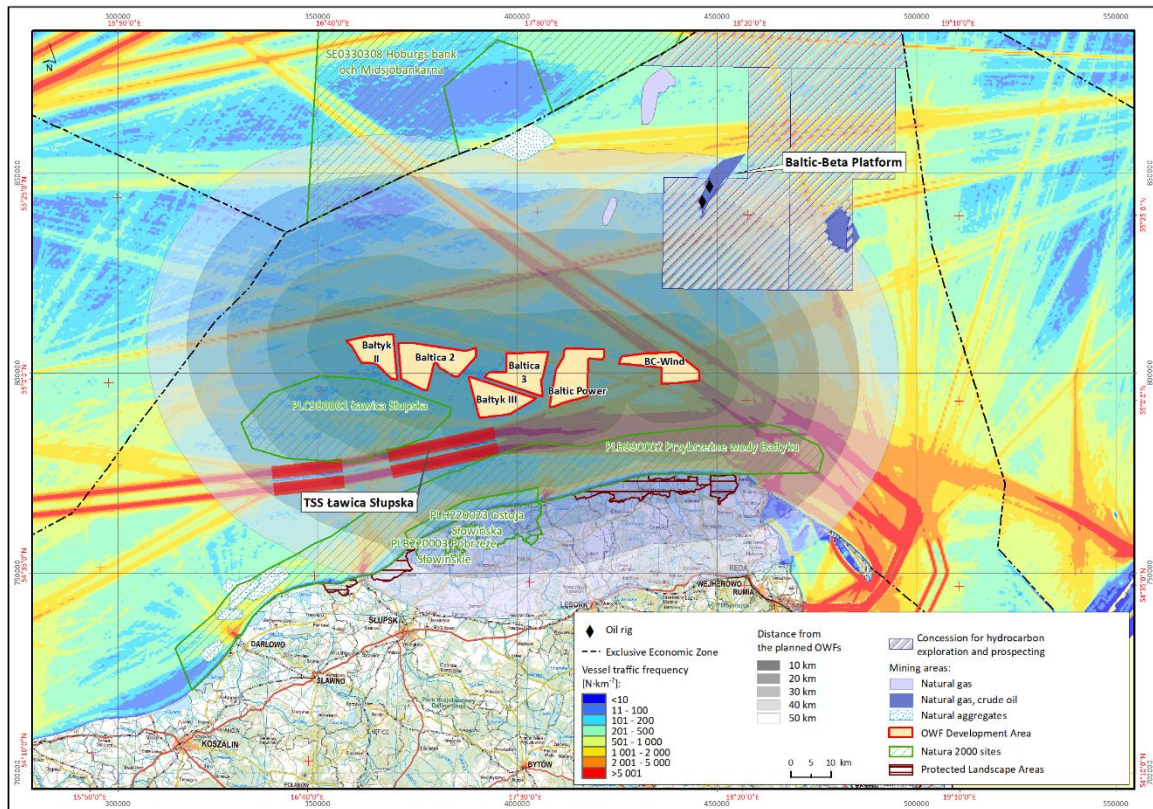


Fig. 7.20. Development and use of the surrounding water body; red colour – route sections the possible change of which requires international agreements and approval by the IMO of the BC-Wind OWF Area

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 173

The marine cultural landscape includes the anthropogenic development and use of both the sea and the seabed, which is only accessible to divers and underwater vehicle operators. The Baltic Sea landscape is not subject to classification and only the BALANCE project 'Baltic Sea Management – Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning' (2005-2007) developed a concept of submarine landscapes. There are no permanent development elements in and around the BC-Wind OWF Area.

Within the range of the potential impact zone of the OWF on the landscape, there is an area of land in the section from Łeba in the west to Jastrzębia Góra in the east. Due to the shape of the coastal zone, the BC-Wind OWF may be visible from the beaches in this section. According to the physicogeographic division of Poland¹⁵⁶, this is the Słowińskie Coast, forming a narrow strip of land along the shore of the Baltic Sea. The area is characterised by post-glacial relief. There are dune dikes from a few to several dozen metres above sea level, overgrown with forest, obscuring the view of the sea, marshes and wetlands, and coastal lakes with spits on the sea side. The landscape is varied, with narrow valleys of watercourses flowing into the sea. There are various protected areas, including landscape protection of the areas located within them. These are: the Protected Landscape Area 'Pas pobrzeże na zachód od Ustki', the Natural and Landscape Complex 'Ostoja Łabędzi' in Ustka, the Protected Landscape Area 'Pas pobrzeże na wschód od Ustki', the Słowiński National Park, the Landscape Reserve 'Mierzeja Sarbska', the Seaside Protected Landscape Area and the Seaside Landscape Park. In the analysed section, under special meteorological conditions, the BC-Wind OWF

¹⁵⁶ Kondracki J., *Geografia regionalna Polski*. Wydawnictwo Naukowe PWN, Warszawa 2002

will potentially be visible from higher observation points: the Czołpino lighthouse, dunes in Słowiński National Park, the Stilo lighthouse and towns: Ustka, Rowy, Łeba and Jastrzębia Góra.

7.8. CLIMATIC CONDITIONS AND AIR QUALITY

The southern Baltic Sea area is located in a humid-moderate climate belt with a significant Atlantic influence due to prevailing westerly circulations. As a result, winters are mild and warmer than in the northern part of Europe, while summers are cooler than in the southern part of Europe. It is characterised by westerly, north-westerly and south-westerly winds, ranging from weak to strong and very strong in stormy periods, and high air humidity.

The following parameters are recorded in the multi-year perspective, at sea and in the coastal zone: air (pressure, temperature and humidity), wind (direction and speed), sunshine, precipitation (amount and type), water (temperature and salinity) and hydrological and hydrodynamic conditions (sea level, flows and waves). The comprehensive measurements that have been carried out operationally for several decades by the IMWM-NRI at stations and metering stations and, for several years now, also at buoys anchored in the sea, can be particularly highlighted. Furthermore, the IMWM-NRI carries out monitoring measurements several times a year in the area of the Southern Baltic Sea, recording hydrophysical and physicochemical parameters of the sea in a designated network of points. Hydrological and meteorological measurements are also carried out by other scientific research units. At the Maritime Shore Laboratory in Lubiato, belonging to the Institute of Hydroengineering of the Polish Academy of Sciences, wind, air temperature and humidity, as well as mean sea level are measured, while the Institute of Oceanology of the Polish Academy of Sciences, at its monitoring station located at the pier in Sopot, records temperature, air pressure and humidity and insolation, as well as seawater temperature and salinity. As part of the SatBaltic project, carried out between 2010 and 2015, satellite measurements were made to determine sea and atmospheric characteristics in the form of maps showing, i.a., temperature distributions, ice caps, instantaneous water flow velocity, water mixing and water turbidity. In the last several years, in the MI GMU, within the framework of various research projects and at the request of investors, comprehensive recordings of parameters of the near-water layer of the atmosphere as well as hydrophysical and dynamic quantities in the entire depth section have been carried out in various places in the Polish economic zone of the Baltic Sea.

The presented research, combined with similar recordings made by services and research institutions of the Baltic countries, allows for the determination of current trends and predicted directions of changes in the basic climatic parameters of the southern Baltic Sea. In addition, information from simulation calculations of climatological numerical models of the global atmospheric circulation model available, among others, from research carried out within the BALTEX Assessment of Climate Change for the Baltic Sea Basin, Copernicus et al.

The climate specific to the coast and Polish sea areas can be classified as a coastal belt climate type, with small air temperature amplitudes, high humidity, mild winters, cooler summers and strong winds. The prevailing winds here are from the westerly and south-westerly direction. In the open sea areas, including the BC-Wind OWF area, the climatic conditions are characterised by the fact that the air temperature amplitudes are smaller and the average wind speeds are higher compared to the adjacent land areas.

On the basis of the available data and analyses, it is possible to present the most important forecasts for changes in individual atmospheric and water elements in the Baltic Sea area:

- The increase in air temperature here is faster than the global average increase, a trend that will continue;
- The temperature rise of the surface water is greater than that of its deeper layers, this can result in greater thermal stratification and stabilisation of the thermocline over the year;

- The projected changes in salinity are not clearly defined and depend on the one hand on changes in atmospheric circulation conditions and the volume of water exchange with the North Sea, and on the other on the volume of river water inflow – a decrease in salinity is projected;
- An increase in precipitation is forecast over the entire Baltic Sea basin in the winter season, while in the summer only in the northern part – the frequency of extreme precipitation will increase;
- In terms of sea level rise projections, the effects of global sea level rise will not be felt to any significant degree. This is due to the fact that the Baltic Sea, being a relatively small and shallow shelf sea, is connected to the North Sea by relatively narrow Danish straits, through which oceanic water exchange only incidentally takes place (these are called inflows). In addition, most of its area (in the northern part) is located within the Scandinavian plate, which is characterised by visible uplift processes (so-called isostatic processes), resulting in a decrease in the height of mean sea level. In the southern part, on the other hand, the influence of these processes is practically negligible and the height of the water level is mainly shaped by atmospheric circulation conditions. Increased dynamics in the near-water atmospheric layer may result in periodic strong rises in water levels in the coastal zone;
- Forecasts of wind climate change are subject to considerable uncertainty – it is assumed that with an increase in mean surface water temperature, there will be an increase in mean wind speed over sea areas;
- Changes in wave climate are mainly associated with an increase in the frequency and intensity of storm events – the number of extreme events is forecast to increase;
- Model calculations indicate that there will be an increase in areas of low oxygen in the water and anaerobic areas near the bottom.

Climate change projections for the area of Poland, including the coastal zone and maritime areas under the jurisdiction of the Polish state, as well as scenarios for adaptation measures aimed at mitigating and counteracting the effects of the changes, are the subject of intensive work conducted by the Ministry of the Environment (now the Ministry of Climate) and the Institute for Environmental Protection, i.a. within the framework of the 'Strategic adaptation plan for sectors and areas vulnerable to climate change until 2020 with an outlook until 2030'¹⁵⁷, and the KLIMADA project.

Taking into account the conclusions and recommendations relating to the coast and adjacent areas of the Baltic Sea, it has been concluded that the observed and predicted climate change will have a negative impact on the functioning of coastal zones. This is expected to be negatively impacted by periodic sea level rises, primarily resulting from an increase in the frequency and intensity of severe storms. In the case of the Baltic Sea, this refers to a possible increase in the number, intensity and duration of storm events, with an increase in the irregularity of these events, i.e. long periods of relative calm may be followed by a series of rapid successive storms of considerable strength.

An additional factor accelerating the coastal erosion process is the warming of winters, as a result of which a reduction in ice cover is to be expected to protect beaches from storm surges, and thus coastal erosion. Sea level change scenarios show that in the period of 2011-2030, the average annual sea level along the entire coastline will be approx. 5 cm higher than in the reference period of 1971-1990. Very important consequences of climate change will be an increase in the frequency of storm surge flooding and more frequent inundation of low-lying areas, as well as the degradation of coastal cliffs and the seashore, which will put strong pressure on the infrastructure located in these areas.

Due to an increase in average water temperature and increased inflow of biogenic pollutants (nitrogen and phosphorus compounds) to the sea, progressive eutrophication, especially at the water surface (algal blooms), will be a negative phenomenon.

¹⁵⁷ Ministry of Climate, *Strategic adaptation plan for sectors and areas vulnerable to climate change until 2020 with an outlook until 2030*, Warsaw 2013; available at: <https://bip.mos.gov.pl/strategie-plany-programy/strategiczny-plan-adaptacji-2020/>

Activities undertaken within the framework of adaptation of the coastal zone to climate change concern areas located along the coastline of the Baltic Sea. However, to date, there are no detailed recommendations outlining the scope of actions to counteract the effects of projected changes in climatic conditions relating to open sea areas, including installations and structures located there.

Meteorological conditions

The meteorological conditions of the sea areas encompassing the area of the BC-Wind OWF were determined on the basis of the parameters of the near-water layer recorded in the period from October 2019 to January 2021 by the automatic weather station located on the lidar buoy of the anchored metering station H_01. These are characterised by wind speed and direction, temperature, air pressure and humidity recorded by the automatic atmospheric measurement station (at a height of approx. 4 m above sea level). The basic statistical parameters obtained for the mentioned period are presented in the table below (tab. 7.29).

The presented meteorological parameter values do not differ from those that would be expected given the climatic characteristics of the southern Baltic areas.

Tab. 7.29. Characteristics of atmospheric parameters in the near-water marine layer for weather station H_01 from 21 October 2019 00:00 to 09 January 2021 00:00

Wind parameter	Value			Standard deviation	Median
	Average	Minimum	Maximum		
Wind speed [m/s]	7.4	0.0	20.2	-	7.2
Atmospheric pressure [hPa]	1010.0	976.3	1043.1	11.9	1010.5
Air temperature [°C]	9.8	-1.6	23.1	5.3	8.3
Air humidity [%]	82.5	36.4	99.9	9.6	84.1
Predominant wind direction [°]	W, WW, SW, SSW				

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 117

Air quality

Due to the lack of detailed information on current air quality parameters above the area of the sea intended for the construction of the BC-Wind OWF, the assessment of air quality in the near-water layer of the atmosphere refers to the information obtained from the measurements made by the Chief Inspectorate for Environmental Protection within the framework of State Environmental Monitoring for the nearest coastal station (Łeba). It should be kept in mind that due to the lack of significant sources of pollutant emissions above the area (industry, towns), air quality parameters should not be worse in relation to those measured on the shore. According to the results of the EnviSuM study¹⁵⁸, as well as thanks to the introduction of a limited emissions zone (SECA/NECA) in the Baltic Sea, the air quality over the Baltic Sea will improve.¹⁵⁹ In 2005, the Baltic Sea was included in the Sulphur Emission Control Area (SECA) as the first such area in the world, which caused the content of sulphur compounds in fuel to be significantly reduced. The International Maritime Organisation (IMO) also established the Baltic Sea as a NO (Nitrogen Oxide) Emission Control Area (NECA). The new regulations, applied to all ships after 2021, require an 80% reduction in nitrogen oxide emissions from current levels. This means that new vessels will have to be equipped with new systems or use liquefied natural gas (LNG) as fuel.

The assessment of air quality in Poland, including at coastal stations, is based on Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. On the territory of Poland, tasks related to the research and assessment of the

¹⁵⁸ Interreg Projects, EnviSuM study in Gothenburg proves sulphur emissions reduced by 70%, available at: <https://projects.interreg-baltic.eu/projects/envisum-16.html#story-234>

¹⁵⁹ HELCOM, 2018

state of the environment, including air quality monitoring, are carried out by the Chief Inspectorate of Environmental Protection within the framework of State Environmental Monitoring, the programme of which is developed by the Chief Inspector of Environmental Protection and approved by the Minister of the Environment. Within the framework of this programme, tasks related to the fulfilment of the requirements contained in EU regulations and Polish law, as well as international conventions signed and ratified by Poland, are carried out.

Due to the fact that air quality monitoring is carried out only in land areas, the results obtained from measurements for the Pomeranian Voivodeship, in particular for the coastal strip zone, were adopted as a reference point for the sea areas. In 2015, for the majority of substances measured by the Inspectorate of Environmental Protection, concentration criteria corresponding to class A were obtained (with the exception of the levels of particulate matter PM₁₀ and benzo(a)pyrene contained in PM₁₀).

No measurements were made in order to assess the air quality in terms of its content of greenhouse gases, dust concentrations and other harmful volatile substances for offshore areas covering the areas of the planned OWF. The closest place where monitoring of the mentioned air pollutants was performed was the shore station in Łeba. On the basis of the latest measurement data made available by the Voivodeship Inspectorate of Environmental Protection (VIEP) in Gdańsk in the report for 2018, the following substance concentrations were found:

- sulphur dioxide (SO₂) – the fourth maximum 24-hour concentration in 2018 was 5 µg·m⁻³ with a permissible value of 125 µg·m⁻³; this is the second lowest value recorded in Pomerania after Szadółki;
- nitrogen dioxide (NO₂) – the 24-hour average concentration in 2018 was 5 µg·m⁻³ with a permissible value of 40 µg·m⁻³; this is the lowest value recorded in the Pomeranian Voivodeship;
- ozone (O₃) – the number of days with an exceedance of the 8-hour average was 12, with a target value of 120 µg·m⁻³; this is the second highest value recorded in the Pomorskie Voivodeship.

According to the assessment contained in the VIEP report, the applicable target level criteria for the protection of human health and the protection of plants are met in the Pomeranian Voivodeship.

These levels of registered values result in the land area of the coastal zone in the region of Łeba having air cleanliness class A. Similar values should be expected for the coastal areas of the sea, especially as these areas are located at a considerable distance from land sources of sulphur dioxide and nitrogen dioxide emissions, hence these substances are emitted only by vessels, and the magnitude of these emissions depend on the traffic intensity and the type of vessel. The area of the BC-Wind OWF is devoid of any terrain obstacles hindering the spread of these substances. Therefore, the average air concentrations of the mentioned compounds should have significantly lower values. On the basis of ship traffic data for 2018-2019 using the IWRAP [IALA Waterway Risk Assessment Programme, official model of the International Association of Lighthouse Authorities (IALA) – an international organisation responsible for navigation safety], it was calculated that in the area encompassing the BC-Wind OWF (fig. 7.21), during the year, vessels consume more than 100000 Mg of fuel, emitting more than 300000 Mg of CO₂, more than 5000 Mg of SO₂, more than 9500 Mg of NO_x and more than 700 Mg of dust.

Given the parameters of the marine fuels used under current legislation, actual emissions from fuel combustion may be significantly lower than those calculated using IWRAP due to the establishment of emission control zones (SECA/ECA) in the Baltic Sea.

In the case of O₃, which has a higher value in the coastal area than in inland locations, it can be assumed that O₃ concentrations in the open sea will not be significantly different from those recorded in the coastal zone, although it can be assumed that due to lower transport emissions than on land (the precursors of O₃ are, i.a., nitrogen oxides from transport), these concentrations will also be negligible. The persistence of such O₃ concentrations is largely due to natural causes.

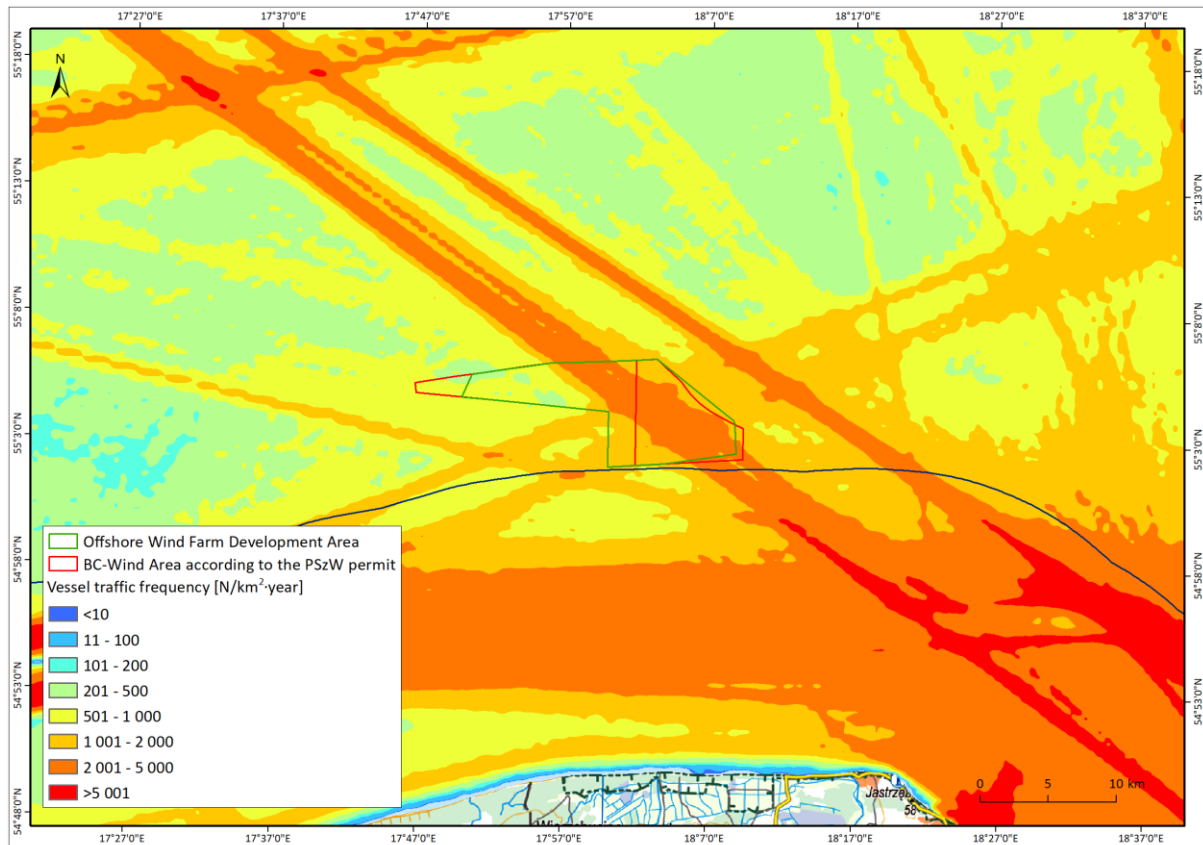


Fig. 7.21 Distribution of emissions from vessels in the vicinity of the BC-Wind OWF in 2018-2019; darker colour indicates higher relative emissions from fuel combustion of vessels

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 119

7.9. ACOUSTIC AND ELECTROMAGNETIC BACKGROUND

Acoustic background

Noise monitoring was carried out using the Wildlife Acoustics' SM4M standalone sound recorder in order to determine the baseline background sound level.

The results of the acoustic background monitoring carried out between December 2019 and January 2021 in the BC-Wind OWF Area indicate that underwater noise levels (and their ranges of variation) show values characteristic of the South Baltic area.^{160,161}

A comparison of the obtained results with model data obtained with the use of the BIAS Soundscape Planning Tool platform^{162,163} for the BC-Wind OWF Area showed that the results of background noise monitoring presented in this Report are in some agreement with the BIAS project results, which also confirm the seasonal variability of the noise level, as well as the occurrence of higher values of SPL sound pressure level in the winter season. The obtained results also show good agreement with the results of noise level surveys carried out in the neighbouring areas of the Bałtyk II OWF, the Bałtyk III OWF, the Baltica OWF or the Baltic Power OWF.

¹⁶⁰ Klusek Z., Lisimenka A., Seasonal and diel variability of the underwater noise in the Baltic Sea. *J. Acoust. Soc. Am.* 2016, 139 (4): 1537-1547.

¹⁶¹ Mustonen M., Klauson A., Andersson M., Clorennec D., Folegot T., Koza R., Pajala J., Persson L., Tegowski J., Tougaard J., Wahlberg M., Sigraý P., Spatial and Temporal Variability of Ambient Underwater Sound in the Baltic Sea. *Scientific Reports* 2019, 9 (1): 13237

¹⁶² Fyhr F., Nikolopoulos A., The BIAS soundscape planning tool for underwater continuous low frequency sound. *User Guide*, 2016

¹⁶³ Verfuß U., Nikolopoulos A., Folegot T., Sigraý P., Baltic Sea Information on the Acoustic Soundscape. *LIFE11 ENV/SE 841 - Layperson's report. Baltic Sea Information on the Acoustic Soundscape (BIAS)*, 2016

Detailed information is provided in Appendix 1 of the EIA Report (Volume III).

Electromagnetic field

Electromagnetic fields occurring in environment can be divided into natural fields and fields of anthropogenic origin (called artificial fields). Of the natural fields, the best recognised is the Earth's geomagnetic field, the intensity of which ranges from 16 to 56 A·m⁻¹. An electric charge accumulates on the Earth's surface, which is the source of the natural electric field. The value of the intensity of the Earth's natural electric field is, under moderate weather conditions, approx. 120 V·m⁻¹.

In the marine environment, the values of the electric field and the geomagnetic field are similar. There are no artificial sources of electromagnetic field in the BC-Wind OWF Area. The existing direct current transmission system between Poland and Sweden (SwePol Link) is located at a distance of several tens of kilometres from the planned OWF location.

Changes in natural electric fields have no direct effect on living organisms. Natural magnetic fields show differences depending on geographical location. They have a significant effect on some living organisms.

Electromagnetic fields from the passage of electric currents can alter the natural migratory behaviour of marine mammals and fish, and can also be a source of thermal energy input to the marine environment. No indicators have yet been developed with which to assess the state of the marine environment for descriptor W11, including indicator 11.4.1 'Intensity and spatial extent of electromagnetic and electric fields'. These factors are not currently monitored in the PMA.¹⁶⁴

7.10. MATERIAL GOODS AND PEOPLE

The population of the coastal counties in the Pomeranian Voivodeship, in the area closest to the BC-Wind OWF area, is characterised by a low birth rate and a high positive migration balance. In most of the coastal municipalities: Ustka (city and urban municipality), Smołdzino, Łeba, Wicko and Krokowa, onshore wind power plant complexes are located and planned due to i.a. very favourable wind conditions. Coastal areas are characterised by rich tourist and recreational values, including those related to the use of the sea. They are the basis for the livelihoods of a significant number of residents. This includes fishing, sea tourism, shipping, sea sports and other human activities related to the immediate vicinity of the sea.

The theoretically designated centre of the BC-Wind OWF is within distance of the nearest ports:

- Łeba – 45.5 km;
- Władysławowo – 40 km;
- Ustka – 93.0 km;
- Darłowo – 126.7 km.

Due to the size of the transport units and OWF construction units, the back-up facilities for the construction and decommissioning of the BC-Wind OWF could potentially be the ports in Gdańsk or Gdynia, which are approx. 110 km away. At the moment, a different location for the installation or service port cannot be ruled out, they could equally well be located in one of the foreign ports. The choice of the target location of the installation and service port is influenced by many factors and is not the subject of this analysis.

The BC-Wind OWF Area is partly located in the area of important habitually used and planned shipping routes and routes to fishing grounds. Their importance for Baltic shipping is evidenced by the number of nearly 600 vessels that used the BC-Wind OWF Area in 2019.

¹⁶⁴ Krzysiński W., *Update of the preliminary assessment of the state of the environment of marine waters*. Chief Inspectorate for Environmental Protection, Warsaw 2018; available at: http://rds.m.gios.gov.pl/images/aktualizacja_wstepnej_oceny_stanu_srodowiska_wod_morskich.pdf

Fishing activities take place in the BC-Wind OWF Area. The area is located in parts of two fishing squares: O8 and P8. Fishing issues in the area are described in detail in Chapter 6.2.

In conclusion, it should be noted that in the context of the current spatial development plan for the Polish maritime areas and the lack of planning restrictions for fisheries, the construction of the BC-Wind OWF is of minor importance for commercial and recreational shipping and fisheries.

8. MODELLING PERFORMED FOR THE VERIFICATION OF WWR 2024 IMPACTS

For the purposes of this EIA Report, modelling studies were performed again in order to:

- obtain information on the extent of the dispersion and concentration of suspended solids in the water as a result of the works disturbing bottom sediments (Appendix 2 to the EIA Report – Volume III);
- obtain information on the extent and intensity of underwater noise generated during the installation and construction works (Appendix 3 to the EIA Report – Volume III);
- obtain information on the potential number of collisions of migrating seabirds with the wind turbines (Appendix 4 to the EIA Report – Volume III).

In addition, based on the results of the seabird inventory, seabird density modelling was carried out in the study areas. The results of this modelling are presented in Appendix 1 of the EIA Report.

The modelling of the dispersion of suspended solids, underwater noise, wind turbine collisions and the conclusions of these studies in relation to the modelling performed in the 2021 EIA Report are briefly described below.

8.1. MODELLING OF THE DISPERSION AND CONCENTRATION OF SUSPENDED SOLIDS

The dispersion of suspended solids in the water may be caused by works connected with the preparation of the seabed for the foundation of structural elements of the OWF, as well as the burial of cables. In the case of the modelling redone for the purposes of this Report, it was not necessary to model the preparatory works for the foundation of structural elements, as the Investor has at this stage decided not to use gravity foundations. Therefore, the remodelling was performed for the burial of cables, which was not a part of the previous EIA Report of 2021.

The results of the mathematical modelling of the suspended solids dispersion during the burial of submarine cables connecting wind farms with the OSS are presented in Appendix 2 (Volume III).

The direction of the spread of the suspended solids is largely the result of three factors: Coriolis force (Ekman spiral) and seabed topography – affecting the direction of sea currents – and the speed and direction of cable burial-related dredging works assumed for the simulations. Marine water mass movement is characterised by high inertia and for this reason, the actual direction of the spread of suspended solids caused by the dredging works for the purpose of the investment will be determined by both current and past meteorological and hydrological conditions.

The area of water turbidity moves along the excavation route with the progress of the works. The highest values of suspended solids concentration occur in the immediate vicinity of the excavation and decrease as distance increases. The extent of the area of water turbidity depends on the speed of sea currents and the amount of debris inflow. The amount of suspended solids introduced into the water mass, in turn, depends on the excavation method used, the type of the bottom sediment in question, and the speed of the works. In the case of cohesive sediments, the extent of water turbidity, as well as the concentration of suspended solids, are greater than in the case of a sandy seabed.

On the basis of the modelling carried out for the adopted parameters of the jetting method (i.e. the method causing the highest water turbidity relative to the other methods considered), it was concluded that in the case of dredging works carried out on a sandy seabed at a set speed of 125 m/h, the spread of suspended solids may have a range of no more than 360 m from the axis of the excavation, while their concentration should not exceed the value of 30 mg/l. In the case of dredging works carried out at a set speed of 350 m/h, the spread of suspended solids may reach approx. 750 m from the axis of the excavation, while their concentration may exceed the value of 30 mg/l at a distance of approx. 220 m from the axis of the excavation and 100 mg/l in the immediate vicinity of the excavation.

In the case of dredging works carried out on a cohesive seabed at a set speed of 125 m/h, the spread of suspended solids reaches a range of more than 1500 m, while their concentration may exceed the values of: 30 mg/l at a distance of approx. 650 m from the axis of the excavation; 100 mg/l at a

distance of approx. 200 m from the axis of the excavation; and 200 mg/l in the immediate vicinity of the excavation. In the case of dredging works carried out at a set speed of 350 m/h, the spread of suspended solids has a reach of approx. 2100 m, while their concentration may exceed the values of: 30 mg/l at a distance of approx. 1100 m from the axis of the excavation; 200 mg/l at a distance of approx. 200 m from the axis of the excavation; and 500 mg/l in the immediate vicinity of the excavation.

In the case of dredging works carried out on a sandy seabed, water turbidity may last up to 6 hours, while if they are carried out on a cohesive seabed, it may last up to 14 hours. In the 350 m/h speed variant, the duration of water turbidity is shorter than in the 125 m/h speed variant.

The achieved results show that the spatial extent of the sediment deposition depends little on the speed variant of the cable burial-related dredging works – the amount of debris inflow has the real impact. In areas where the seabed is composed of cohesive sediment, the deposition range is greater than in areas characterised by a sandy seabed. Moreover, the thickness of the sediment layer formed after the complete sedimentation of the suspended solids introduced into the water basin does not exceed 0.2 mm if the works are carried out on a sandy seabed, while in the case of a cohesive seabed, the thickness of the newly formed sediment layer may reach 1.4 mm in the immediate vicinity of the excavation. At a distance of more than 150 m from the excavation, it does not exceed 1 mm, and at a distance of more than 350 m from the excavation, it does not exceed 0.5 mm.

In summary, the average thickness of the newly formed sediment layer after the completion of the works will not exceed 0.2 mm to 0.5 mm, which is comparable to the amount of suspended solids resulting from natural processes occurring throughout the year.

8.2. MODELLING OF UNDERWATER NOISE PROPAGATION

Underwater noise is generated during every phase associated with the construction, exploitation and decommissioning of an offshore wind farm (OWF). The greatest risks are linked to the underwater noise emitted during the construction phase due to the relatively high sound levels generated when piles are driven into the seabed. Marine organisms, such as fish and marine mammals, are sensitive to sound, hence the noise associated with the construction of an OWF may affect them over considerable distances.

A remodelling of underwater noise propagation during the construction phase was carried out for the purpose of the update of this Report (Appendix 3, Volume III). The modelling was performed under partially different assumptions, updated as per the current knowledge, which is why the results of this modelling are not comparable with the results of the modelling that was carried out in 2021.

Acoustic emissions associated with piling in the area of the BC-Wind OWF, located in the Polish EEZ, were researched for this report. The analysis was carried out for a wind turbine located in the eastern part of the BC-Wind OWF Area, during the spring period (April to June). The location of the source of the emissions was selected based on the predicted sound propagation characteristics during piling. The chosen location was selected due to having the most negative potential impact possible out of the 39 locations identified at the current stage of project implementation, i.e. on account of having the greatest foundation depth and being subject to difficult geological conditions. The majority of BC-Wind OWF foundations will be sited at shallower depths, so the range of the underwater noise produced during their piling will be smaller. Special attention was given to the Natura 2000 sites Ostoja Słowińska and Hoburgs bank och Midsjöbankarna, where harbour porpoise, a critically endangered and particularly noise-sensitive marine mammal species, is a subject of protection.

Based on the results of the performed acoustic modelling, impact ranges (in terms of distance from the sound source expressed in kilometres) of the noise were estimated for marine mammals (seals and porpoises) and fish with a swim bladder. The considered effects of the noise were behavioural response (change in behaviour), as well as hearing damage in the form of temporary and permanent

shift in hearing threshold (TTS, PTS) and reversible hearing damage in the case of fish with a swim bladder.

For the purposes of the modelling, 72 transects of a maximum length of 150 km each, extending in all directions, were selected. Depth profiles and the formation of the seabed along the transects were obtained from the EMODnet platform and verified with Investor data. Sound propagation velocity profiles were determined using publicly available databases. The geological profile of the seabed and the longitudinal wave velocity values used in the modelling were obtained from the Investor.

In the first stage, modelling of underwater noise propagation during piling in the BC-Wind OWF area was carried out in the form of sound source modelling. The calculations were performed for a monopile with a diameter of 11.5 m, for the IQIP S-5500 / IQ6 hammer with a driving energy of 5500 kJ. The calculated sound source level (sound level at a distance of 1 m) was expressed as the sound exposure level (SEL), i.e. the emitted acoustic energy (in dB re 1 $\mu\text{Pa}^2\text{s}$), and as the peak sound pressure level (in dB re 1 μPa). Values were determined for single pile strikes, as well as for the estimated maximum number of strikes required to drive one pile into the seabed. These levels were estimated for two different penetration depths. The values used in the modelling were as follows:

- SEL for one strike = 230.5 dB re 1 $\mu\text{Pa}^2\text{s}$ (1/3 of the penetration depth); 228.9 dB re 1 $\mu\text{Pa}^2\text{s}$ (2/3 of the penetration depth);
- peak SPL for one strike = 251.0 dB re 1 μPa (1/3 of the penetration depth); 248.9 dB re 1 μPa (2/3 of the penetration depth);
- cumulative SEL for all strikes = 265.6 dB re 1 $\mu\text{Pa}^2\text{s}$.

The cumulative SEL was calculated based on a 24-hour time interval, taking into account the total number of strikes needed to install the monopile. It should be noted that the numerical modelling of noise propagation and the potential ranges of noise impact on marine mammals resulting from piling was carried out with different assumptions for the two analysed variants. The WWR 2024 variant included a soft start method, an animal movement model, and a 24-hour exposure to sound generated during piling. The RAV 2024 model assumed a 1-hour exposure, static nature of the exposed organisms, and no gradual increase in sound levels.

Sound levels emitted with the use of a noise mitigation measure were also estimated. For this purpose, as an example, a combination of HSD (Hydro Sound Damper) and DBBC (Double Big Bubble Curtain) systems was considered in order to check whether it is possible to meet the sound thresholds for marine mammals for the assumed piling parameters. The level of achieved reduction was approx. 21 dB. Other methods may also be used assuming that adequate noise reduction is achieved, in accordance with the DEC.

Sound propagation modelling was performed for the 20 Hz – 4 kHz frequency range. Higher frequencies were estimated based on the results for 4 kHz and corrected for frequency-dependent propagation losses. Numerical modelling was performed using the model developed with the use of the MIKE Underwater Acoustic Simulator (UAS) software.

In order to estimate impact ranges for marine mammals, reviewed regulations were used for the criteria for TTS (temporary shift in hearing threshold) and PTS (permanent shift in hearing threshold). Behavioural criteria were developed based on a detailed literature review. In addition, an animal movement model and the ramp-up procedure were used in the analysis of construction noise. The so-called 'effective silence' was also applied, which is the threshold below which no accumulation of acoustic energy occurs in an animal.

For fish with a swim bladder, the noise criteria were taken from available expert guidelines and literature reviews. The generally accepted threshold of 186 dB re 11 $\mu\text{Pa}^2\text{s}$ (Popper et al., 2014) is currently the only reference point for determining the impact of piling on fish, but this is not a reliable threshold for Baltic fish due to the below:

- It was determined under laboratory conditions for freshwater fish;

- Observed responses and damage vary according to species and noise level;
- Fish show great variation in auditory sensitivity depending not only on the species, but also on the anatomy of the auditory system, the weight of the fish, and other aspects of their biology, such as preferred depths.

This means that the adopted threshold cannot be a universal threshold for impulse noise representing a limit of risk to fish. What is more, behavioural response (including escaping and/or remaining exposed to the noise and its accumulation) is also strongly dependent on both the sound pressure and frequency, and may vary according to sex, age, condition, functional stage and the importance of the area for the survival and/or reproduction of the fish. Despite the aforementioned disadvantages of adopting a threshold of 186 dB 11 $\mu\text{Pa}^2\text{s}$ for swim bladder fish, it was used for the purpose of the modelling, but its limitations should be taken into account when interpreting the results.

For fish without a swim bladder, a quantitative assessment was not feasible. Based on the results of recent studies on the effects of noise on fish without a swim bladder, it has been proven that for this group of fish the relevant auditory stimulus is particle motion, not pressure. Currently, there are no criteria that would form the basis for performing an impact assessment for fish without a swim bladder as a result of particle movement. Therefore, a qualitative assessment was carried out for this group of fish based on a review of available literature.

Analyses conducted for one strike SEL, without mitigation measures, indicated that impact ranges for the harbour porpoise were larger than for the grey seal and the common seal. For the harbour porpoise, the largest impact ranges were found for behavioural response, and for seals – for cumulative TTS. For the harbour porpoise, the maximum range for behavioural response exceeded the range of the model and was at least 150 km. For cumulative TTS, the maximum range of the impact was 102 km for the harbour porpoise and 72.2 km for seals. The range of the cumulative PTS reached 27.6 km for the harbour porpoise and 4.6 km for seals. The calculated impact ranges for TTS and PTS from a single strike had lower values and were 4.9 km and 0.3 km for the harbour porpoise and 0.3 km and 0.1 km for seals, respectively.

In the case of fish with a swim bladder, the largest impact ranges were also obtained for behavioural response, reaching at least 150 km, and for cumulative TTS – reaching 146 km. The impact ranges for cumulative reversible hearing damage reached a maximum of 16.5 km. The values obtained for TTS and reversible hearing damage from a single strike were low, reaching 1 km and 0.1 km, respectively.

Calculations made taking into account mitigation measures indicate a decrease in the impact ranges. With the use of a NRS, the range of behavioural response for the harbour porpoise dropped to 33.9 km, while for seals it dropped to 3.0 km. The cumulative impact ranges of TTS and PTS were reduced to a maximum of 0.1 km for both the harbour porpoise and seals.

For fish with a swim bladder, calculations assuming the use of a NRS showed that the maximum range of the behavioural response dropped to 65.7 km. For cumulative TTS, the ranges dropped to a maximum of 9.2 km, with up to 0.4 km for cumulative reversible hearing damage.

Calculations of noise propagation resulting from piling at several locations showed that the ranges of impact of all analysed noise exposure effects (behavioural response, TTS, PTS, and reversible hearing damage) increased with the increase number of piling noise sources. Such a trend was found in the case of all animals.

For the harbour porpoise, noise levels were determined at the border of the Natura 2000 sites Ostoja Słowińska and Hoburjs bank och Midsjöbankarna. These values were compared with the thresholds for TTS and PTS for the harbour porpoise. The threshold for cumulative TTS was exceeded at the border of the Swedish Natura 2000 site with the assumption of piling occurring simultaneously at two locations, with no mitigation measures applied. However, after taking mitigation measures into

account, all modelled SEL values at the border of the Natura 2000 sites fell below the level set in the environmental decision.

It was found that with the use of mitigation measures, the impact ranges of TTS, PTS and reversible hearing damage for all analysed taxa (seals and harbour porpoise) were maintained below 11 km, which meets the requirements indicated in the obtained environmental decision.

8.3 BIRD COLLISION RISK MODELLING

The modelling of the risk of bird collisions was created for the purpose of updating the decision on environmental conditions issued for the project entitled BC-Wind Offshore Wind Farm in 2022. The requested amendment of this decision concerns the specification of the parameters of the planned project, including primarily the final determination of the parameters of the power plants, the number of planned power plants, and the preliminary planning of their location. The specified parameters have slightly smaller values than those adopted in the DEC.

On the basis of the specified parameters of the BC-Wind OWF, the currently considered variant was selected, i.e. the variant selected for implementation (WWR 2024), which is a refinement of the variant for which the Investor obtained the DEC in 2022.

The indicated parameters could affect the potential for collisions with migratory birds, so a remodelling was carried out based on the data used in the 2021 Report, but using specified power plant parameters and locations.

The performed modelling has enabled a more precise identification of the potential impact of the BC-Wind OWF on migratory birds, as well as a comparison of predicted effects.

Wind turbines, both onshore and offshore, due to their size, have the potential to cause negative effects in the form of collisions between flying birds and wind turbine components. This applies in particular to the moving parts of the turbine, i.e. the rotor, including the blades. In order to determine the risk of collision in the form of the number of expected collisions, a basic model prepared by Band was used.¹⁶⁵ This model assumes that a certain proportion of birds flying through the study area are within the working range of the rotor. Estimating the risk of bird collisions requires quantitative data on birds migrating through the study area, as well as information on the parameters of individual wind turbines and the entire OWF. It is assumed that the probability of a collision with the rotor depends on the bird's body size (wingspan and wing area), the range and angle of the blades, the rotor speed and the bird's flight speed. In reduced visibility (low-level clouds, nighttime, dense fog), birds perceive an obstacle such as an OWF from a shorter distance than in conditions with good visibility, resulting in a higher collision risk. Both the variant proposed by the Investor and the alternative variant were analysed, with different ranges of clearance height between the lower reach of the rotor and the water surface.

Of all the analysed species, only for the crane was the impact related to collision risk assessed as moderate. For this species, the estimated maximum number of collisions was 14 individuals in the autumn for the RAV 2024. Modelling results for the WWR 2024 indicate lower collision values – a maximum of 8 individuals.

The impact in the form of collision risk was assessed to be of low importance for the long-tailed duck and the velvet scoter for all analysed variants. For these species, the risk of collision did not exceed single individuals.

In the case of geese, the risk of collision in the most realistic scenario of WWR 2024 with a collision avoidance rate of 99.0% concerned 4 to 5 individuals (for the RAV 2024 it was 5 to 9 individuals), but due to the very large populations of the species included in this category (estimated at more than 3.5 million individuals), the significance of the impact was assessed as insignificant.

¹⁶⁵ Band W., *Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Wind Farms. SOSS02 Project. Report for The Crown Estate, 2012*

For the remaining species, the significance of collision risk was assessed as negligible.

An estimate of the number of collisions possible in the case of cumulative impacts was made by multiplying the results obtained from collision risk modelling by a factor of 16.25, which takes into account the power of the seven other offshore wind farms relative to the BC-Wind OWF. For most species, mortality remains very low. The cumulative impact for the crane was calculated at a maximum of 91 individuals in the autumn for the WWR 2024 (for the RAV 2024, it was 227 individuals). Accordingly, the significance of the cumulative impact on the crane, despite the score being more than 2 times lower, was assessed as moderate, which is primarily related to the frequent flights of this species at collision altitudes and a fairly low rate of avoidance of the OWF (83%). The good population status of this species, even at maximum collision mortality values, will not change.

Detailed results and calculation methodologies for both the single BC-Wind OWF and the cumulative case including the BC-Wind OWF and other existing, ongoing and planned projects are presented in Appendix 4 of the EIA Report (Volume III).

9. IDENTIFICATION OF IMPACTS ON THE MARINE ENVIRONMENT OF THE VARIANT CHOSEN FOR IMPLEMENTATION (WWR 2024)

The variant selected for implementation by the Investor is based on a modification of the variant approved by the DEC, adapted to the current stage of design of the BC-Wind OWF. The parameters of the turbines and their number were modified, and foundation methods were limited. The technical parameters of the variant selected for implementation (to which the requested amendment of the DEC applies) are presented in Tab 4.2.

The variant selected for implementation ensures that the project's goal of producing electricity is achieved to the maximum extent possible, while optimising construction costs and taking into account the need to protect the environment.

In the variant selected for implementation, it is planned to use monopile-type foundations in all support structures, i.e. under wind turbines and the OSS. If it is not technically possible to install this type of foundation, it is planned to use a truss (jacket) type of foundation. The use of a truss-type foundation is associated with a shallower foundation depth and smaller pile diameter (so-called pinpiles are used), and thus potentially less environmental impact, so this assessment was carried out based on monopile-type foundations.

At this stage, the predetermined locations of 39 wind power plants and the OSS station, as well as the resulting placement of cables, have been included in the assessment. Geotechnical investigation was conducted for 46 sites, from which the 39 sites evaluated in this Report were selected, with a maximum of 34 power plants likely to be implemented. The assessment results on individual environmental components presented below for the WWR 2024 will not change if some (few) locations within the current development area are changed during design or implementation, which is treated as a non-significant change according to the Offshore Act.

The impact assessment was carried out separately for the construction phase, the exploitation phase, and the decommissioning phase of the OWF. The matrix of connections between the project parameters and impacts is presented in the table below:

Tab. 9.1. Matrix of connections between the project parameters and impacts

Parameter	Type of emission or disturbance															
	Overwater structures	Underwater structures	Heat	Electromagnetic field (EMF)	Overwater noise	Underwater noise	Waste	Light effects	Seabed disturbances	Suspended solids	Resuspension of pollutants	Resedimentation	Creation of an artificial reef	Water pollution	Air pollution	Increased traffic and collision risk
Number of wind turbines	X	X			X		X	X								X
Number of foundations or support structures		X				X	X		X	X	X	X	X	X		
Type of foundation or support structure and width of scour protection						X			X	X	X	X	X	X		
Diameter of the foundation or		X				X			X	X	X	X	X			

Parameter	Type of emission or disturbance															
	Overwater structures	Underwater structures	Heat	Electromagnetic field (EMF)	Overwater noise	Underwater noise	Waste	Light effects	Seabed disturbances	Suspended solids	Resuspension of pollutants	Resedimentation	Creation of an artificial reef	Water pollution	Air pollution	Increased traffic and collision risk
support structure																
Piling parameters						X										
Full height of the structure	X				X			X								X
Rotor diameter	X															
Length and type of cables		X	X	X						X	X	X				X
Depth and method of cable burial/laying			X	X		X					X					
Number and size of substations	X	X		X	X			X								
Organisation of technological processes (number of vessels, time)					X	X	X	X						X	X	X

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 102

9.1. IMPACT ON THE STRUCTURE OF THE SEABED

A significant element of the assessment of the impact of the project on the processes taking place on the seabed and the seabed itself is to determine the scale of impact intensity and impact range. The impact is considered significant if the change to the nature of the surface and the structure of the seabed is greater than the size of geomorphological forms potentially occurring on the seabed. The impact range determined as local, in geological and geomorphological terms, refers to spot changes (foundation works) or linear changes (laying of cables) to the topography and structure of the seabed and is no larger than the dimensions of forms possibly created in a given area.

The sensitivity, i.e. the response of the seabed topography and structure, is assessed on a five-step scale in accordance with the data from the table below (Tab. 9.2).

Tab. 9.2. Sensitivity of seabed topography to impacts resulting from the activities related to the construction of an OWF

Sensitivity	Description
Insignificant	No changes to the topography and structure of the seabed or changes similar to the ones observed to be caused by natural processes
Low	Changes that are noticeable, but do not alter the character of the topography and structure of the seabed; local range
Moderate	Changes that are noticeable and alter the character of the topography and structure of the seabed to a degree not affecting the general character of the area; local range

Sensitivity	Description
High	Changes that affect the topography and structure of the seabed, altering its character and affecting processes taking place on the seabed; local range, limited to the project area, possible small impact on the character of the topography of adjacent areas
Very high	Changes that significantly affect the topography and structure of the seabed in the analysed area, which may significantly affect geological and geomorphological processes of the project area and adjacent areas

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 182

9.1.1. Construction phase

Depending on its structure, the seabed may exhibit different sensitivity to the impact of the project during the construction phase. The seabed made of till and till with a stone cover is difficult to wash out and withstands morphological changes. A sandy, sandy and silty, and silty seabed is more susceptible to washout and material being moved over it, e.g. in the form of sandy waves. Thus, the elements of the OWF infrastructure may be uncovered or buried, both as a result of natural processes involving the movement of rock material along the seabed, and as a result of this movement being disrupted by the OWF infrastructure components.

Works associated with the construction of the project may cause the following types of impact on the seabed:

- changes in seabed structure due to: preparing the seabed for a foundation or support structure, laying of cables, levelling of the seabed along the cable route;
- changes in the morphology of the seabed will also occur as a result of possible piling of excavated rock originating from the preparation of the bottom for foundations or support structures (if boring is required);
- seabed level changes due to the deposition of rock material raised and moved during preparatory and construction works (from suspended solids) (the average thickness of the newly formed sediment layer after the completion of the works will not exceed 0.2 mm to 0.5 mm, which is comparable to the amount of suspended solids resulting from natural processes occurring throughout the year);
- pits forming in the seabed at the anchoring locations of vessels installing elements of the OWF infrastructure.

The overall impact of the project on the seabed and its structure during the construction phase was assessed to be negligible – the changes will be minor, over a small surface of the seabed, local (foundations or support structures of wind turbines) or linear (along the cable route).

9.1.2 Exploitation phase

During the exploitation phase, the planned project might cause different types of impacts on:

- local changes in seabed structure associated with the presence of the BC-Wind infrastructure components and their impact on the processes of sediment transport and deposition: seabed washouts upstream/downstream of the infrastructure components, formation of sediment accumulation upstream/downstream of the infrastructure components (sand drifts);
- pits forming in the seabed at the anchoring locations of vessels installing elements of the OWF infrastructure.

The resulting changes will be local and directly related to the immediate surroundings of the components of the infrastructure. The significance of this impact during the exploitation phase in WWR 2024 has been determined to be insignificant.

9.1.3. Decommissioning phase

Impacts occurring during the closure and decommissioning phase of the project will be similar to the impacts present during the construction phase (see Subchapter 9.1.1), but they will be less intense. The extent of interference in the seabed will not be as major as in the case of driving foundation

piles and/or support structures. Part of structural elements may be left on and in the seabed. Transmission cables may be completely or only partially removed or left in the seabed.

Changes within the seabed associated with the impact of the project will be local and, within the entire area occupied by the project, insignificant for the overall character of the seabed and its structure.

Depending on its geological structure, the seabed may exhibit different sensitivity to the impact of the project during its closure and decommissioning phase. Seabed composed of till and till with a stone cover is difficult to wash out and withstands morphological changes. Sandy, sandy and silty and silty seabed is more susceptible to washout and material displacement over it, e.g. in the form of sand waves. Thus, the elements of the BC-Wind infrastructure left in the seabed may be uncovered or buried as a result of both the natural processes transporting rock material over the seabed and as a result of this transport being disturbed by the remaining components of the BC-Wind infrastructure and changes in the seabed relief resulting from the removal of the BC-Wind infrastructure components.

The overall impact of the project during the closure and decommissioning phase can be preliminarily assessed to be negligible.

9.2. IMPACT ON GEOLOGICAL STRUCTURE, BOTTOM SEDIMENTS AND ACCESS TO RAW MATERIALS AND DEPOSITS

9.2.1. Construction phase

Works associated with the construction of the project may cause the following types of impact on geological structure and bottom sediments:

- a spot disturbance of the geological structure due to embedding elements of foundations or support structures of the power station (drilling or pile-driving of foundations or support structures, erection of support structures, laying or possible burial of cables, dredging works);
- local spot changes in the structure of the seabed where foundations are to be located, around their bases (placement of protective layers to prevent washout; for this purpose, crushed stone, stones and boulders are most often used; these actions cause a change in the subtractive composition of seabed sediments);
- pits forming in the seabed at the anchoring locations of vessels installing elements of the OWF infrastructure;
- the disturbance and sedimentation of suspended solids – during construction works, suspended solids will be disturbed locally, which will result in water turbidity. Suspended solids generated as a result of sediment disturbance during dredging works are deposited at the seabed depending on the water dynamics in the area. The disturbed sediment will move mainly within the area of the OWF and no further than a dozen kilometres from its boundaries (in trace amounts), and, during the deposition, it will cover the seabed with an average thickness of no more than 0.2 mm, which is comparable to the amount of suspended solids deposited as part of natural processes during the year.

Bottom sediments and geological structure

In geological terms, taking into account the nature of deposits forming the seabed surface of the area of the OWF, no significant changes in the nature of the deposits are expected. Changes/disturbances in the structure of bottom sediments will occur at specific points – places where monopile-type or optionally truss-type foundations will be used – or linearly, along the cable routes.

The BC-Wind OWF Development Area will not be greater than 78.71 km². Changes in the nature of surface sediments will concern the seabed intended for monopile-type foundations (optionally truss-type foundations) for 39 wind turbines and one OSS (maximum seabed occupation per one foundation: 2600 m²), with the proposed maximum diameter of 11.5 m per monopile (including the protective layer), which constitutes only 0.12% of the development area. Therefore, the impact on surface sediments will be negligible.

Changes in the nature of surface sediments when laying cables, with the expected length of cable routes amounting to approx. 100 km, depending on the method chosen for seabed cable burial, will concern from 0.2 km² (with the application of the jetting method, which causes a change in the nature of the seabed surface within a 1.2 m wide strip) to 0.75 km² (with the cable being buried through ploughing, which causes a change in the nature of the seabed surface within an up to 7.5 m wide strip), which constitute from 0.25% to 0.95% of the seabed surface of the development area, respectively. Therefore, the impact on surface sediments will be negligible.

Impact on the quality of bottom sediments and seawater

Water and seabed sediments constitute very important elements of the water ecosystem of the Baltic Sea, which is shallow and small, with limited water exchange through the narrow and shallow Danish straits. The surface of the sea is approx. 4 times smaller than that of its catchment area. Approx. 85 million people live in this area. Such conditions make every interference in the marine environment – fisheries, shipping, discharge of municipal and industrial wastewater, surface water runoff from industrial and agricultural areas, but also activity related to the operation and development of the seabed – affect the delicate ecological balance of the marine ecosystem.¹⁶⁶ Water and sediments in bodies of water are strictly connected with each other. A form of balance exists between the various components of the marine environment and, in particular, between water and seabed sediments. A change in one component (e.g. sediments) causes changes in the other (water), and vice versa.

Most pollutants (heavy metals and toxic organic compounds characterised by low solubility and slow degradation), which are released into the environment as a result of human economic activity and reach surface waters, are retained in sediments.¹⁶⁷ Sediments, however, are not only a place of deposition of persistent and toxic pollutants reaching the environment, but also a habitat, source of nourishment, breeding grounds and place of growth of numerous aquatic organisms. Contaminated sediments pose high risks to the biosphere, because some of the harmful substances contained in sediments may pass into the water as a result of chemical and biochemical processes, and be accessible to living organisms.^{168,169}

This Subchapter identifies, characterises and evaluates the impact of an OWF on the quality of seawater and bottom sediments. It was found that during their construction, offshore wind farms may cause various types of impacts on the discussed receptors (seawater and bottom sediments), including:

- the release of pollutants and nutrients from sediments to water,
- the increase in water turbidity and the spread of suspended solids,
- the contamination of water and seabed sediments with oil derivatives,
- the contamination of water and seabed sediments with antifouling agents,
- the contamination of water and seabed sediments with accidentally released municipal waste or domestic sewage,
- the contamination of water and seabed sediments with accidentally released chemicals and waste originating from the construction of the BC-Wind OWF.

Release of pollutants and nutrients from sediments into water

The disturbance of seabed sediments associated with the construction (placing) of foundations or support structures for the purposes of OWF facilities, anchoring of vessels or cable burial, is a process

¹⁶⁶ Uścińowicz S. (ed.), *Geochemia osadów powierzchniowych Morza Bałtyckiego*. Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Warsaw 2011

¹⁶⁷ Bojakowska I., *Kryteria zanieczyszczenia osadów wodnych*. Przegląd Geologiczny 2001, 49 (3): 213–218

¹⁶⁸ Fröstner U., *Inorganic pollutants, particularly heavy metals in estuaries*. Chemistry and Biochemistry of Estuaries 1980, 10: 307–348

¹⁶⁹ Bourg A., Loch J., *Mobilization of Heavy Metals as a Affected by pH and Redox Conditions*, [w:] Biogeodynamics of Pollutants in Soils and Sediments. Springer-Verlag, Berlin-Heidelberg 1995: 87–102

which contributes to pollutants passing from sediments into water.^{170, 171, 172, 173, 174} During construction works, substances including labile metal forms, POPs, i.e. PAHs and PCBs, nutrients (nitrogen and phosphorus compounds), will pass into the water.

The most important parameters influencing the impact level are: the dimensions and number of foundations and/or support structures, the length of cable sections and the width and depth of the cable excavation, the types and amount of pollutants accumulated in seabed sediments, and the type of rock material forming the seabed.

The passage of pollutants from sediments into water (and thus the change in the water quality) and the formation of long-lasting suspended solids depend on the type of sediment. The largest amount of pollutants and nutrients will be transferred to water from sediments with an increased organic matter content (e.g. silt and clay sediments with a higher concentration of metals and POPs). These deposits will also contribute to the formation of a greater amount of suspended solids, which will remain in the water for a long time. Intense resuspension may cause the release of nutrients immobilised in the sediment and contribute to eutrophication. In the case of sandy deposits with low organic matter content (e.g. coarse sandy sediments), the described processes will be less intense. These sediments are generally characterised by a small amount of fine fractions and low concentrations of metals and POPs. Therefore, it is estimated that the processes related to the release of nutrients and POPs will occur at low intensity in the entire area of the BC-Wind OWF.

It should be emphasised that the substances released from the sediment will pass into the water. However, within approx. 1 year from the completion of the construction activities, these substances will transfer back into sediments after reaching a state of equilibrium.

The impact of the of pollutants and nutrients released into the water was assessed for the works associated with the placement of foundations for the wind turbines and for the excavation works for the purposes of cable-laying.

For the construction of the wind turbines and the placement of the foundations, monopile technology was adopted as the most likely scenario. A truss-type foundation causes the resuspension of a smaller volume of suspended solids.

During piling, the vibrations caused by the operation of the hydraulic pile driver will liquefy the sediment around the monopile. With the assumption that piles with a diameter of 11.5 m will be driven into the seabed to a depth of several tens of metres, it is expected that sediment up to a depth of approx. 1 m, as well as in a radius of approx. 3 m around the pile, will be resuspended. The volume of the sediment disturbed during pile driving into the seabed was calculated using the following formula:

$$V_a = V_{tr. cone} - V_{cyl. III}$$

where:

V_a – volume of the sediment layer disturbed during pile driving into the seabed,

$V_{tr. cone}$ – volume of the truncated cone,

$V_{cyl. III}$ – volume of the cylinder III.

¹⁷⁰ Bojakowska I., *Kryteria zanieczyszczenia osadów wodnych. Przegląd Geologiczny* 2001, 49 (3): 213–218

¹⁷¹ Bourg A., Loch J., *Mobilization of Heavy Metals as a Affected by pH and Redox Conditions*, [w:] *Biogeodynamics of Pollutants in Soils and Sediments*. Springer-Verlag, Berlin-Heidelberg 1995: 87–102

¹⁷² Dembska G., *Metale śladowe w osadach Portu Gdańskiego. Praca doktorska. Wydział Biologii, Geografii i Oceanologii, Uniwersytet Gdański, Gdańsk* 2003

¹⁷³ Fröstner U., *Inorganic pollutants, particularly heavy metals in estuaries. Chemistry and Biochemistry of Estuaries* 1980, 10: 307–348

¹⁷⁴ Uścińowicz S. (red.), *Geochemia osadów powierzchniowych Morza Bałtyckiego. Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Warszawa* 2011

Once the values are substituted in the formula, the volume of the sediment disturbed during the driving of one pile into the seabed amounts to approx. 64 m³ of sediment per foundation. Taking into account the total number of foundations of 40, a total of approx. 2560 m³ of sediment will be resuspended (Tab. 9.3).

Sediment resuspension will also occur during excavation work for the purposes of cable-laying. Two technologies have been considered, i.e. ploughing, for which the width of the working area is largest, and jetting, for which turbidity levels are greatest. The cross section of the excavation that would be made for the cable by ploughing is a trapezoid with a 7.5 m base at the top and a 0.5 m base at the bottom, with an average depth of 2-3 m and a length of up to 100 km, which amounts to 800000 m³ of disturbed sediment (for the entire internal cable network). By contrast, using the jetting method will result in sediment disturbance in a trench that would be up to 2 m deep, with a trapezoidal cross section with a 2 m base at the top and a 0.6 m base at the bottom. Given the anticipated cable route length of up to 100 km, this will amount to 260000 m³ of disturbed sediment (for the entire internal cable network) (Tab. 9.3). This is the preferred scenario.

Moreover, during the construction of foundations and/or supporting structures and the installation of towers, seabed sediment disturbance due to anchoring of vessels will be observed. The anchoring process itself is short-term, affecting a small (local) area to a depth of approx. 3 m, so the volume of the disturbed sediment will be small.

On the basis of the assumptions listed above and the concentration of pollutants and nutrients found in the area of the OWF (Chapter 7.2), the size of their emission into the water was estimated for the WWR 2024.

The calculations assume the average dry sediment density of 1.6 g·cm⁻³ (1600 kg·m⁻³) and an average sediment moisture content of 18.6%. For the purpose of the calculations, the volume of sediments that will be disturbed per foundation during piling, i.e. 64 m³, was also assumed. To calculate the load of pollutants that may be transferred into the water during the laying of the internal cable network, the most unfavourable variant from the point of view of the amount of disturbed sediment was adopted, i.e. using the ploughing method for trenching, which can resuspend 8000 m³ of sediment per 1 km of cable, as well as the jetting method as the preferred method of cable burial, which would disturb a much smaller volume of sediment per one linear kilometre of the cable, i.e. 2600 m³.

The estimated amount of heavy metals, pollutants and nutrients that may be released in the WWR 2024 during the construction works for the BC-Wind OWF project is presented in Tab. 9.3.

In the case of indicators the concentration of which was found to be below the lower limit of quantification (LOQ) of the survey methods during the performed environmental surveys, the values of this limit (marked with '<' in Tab. 9.3) were applied to calculate the load (for illustrative purposes).

The table also presents, for comparative purposes, the loads entering the Baltic Sea annually with the rivers of Poland and with precipitation.¹⁷⁵ The results of the State Environmental Monitoring carried out by the CIEP in the years of 2003-2012 were also used. As it was shown, the estimated results obtained for the remobilisation of individual indicators are insignificant.

¹⁷⁵ Uścińowicz S. (red.), *Geochemia osadów powierzchniowych Morza Bałtyckiego*. Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Warszawa 2011

Tab. 9.3. Volume of pollutants and nutrients that may be released into the water during the construction of the BC-Wind OWF (WWR 2024)

Parameter	WWR 2024 (a total of 40 foundations*)	WWR 2024 cable routes (100 km) ploughing	WWR 2024 cable routes (100 km) jetting	WWR 2024 Total load released into the Baltic Sea during construction works (with ploughing)	WWR 2024 Total load released into the Baltic Sea during construction (with jetting)	Total load entering the Baltic Sea with rivers	Total load entering the Baltic Sea with precipitation
Volume of the disturbed sediment	2560 m ³	800000 m ³	260000 m ³	802560 m ³	262560 m ³	No data	No data
Mass of the disturbed sediment	4096 Mg	1280000 Mg	416000 Mg	1284096 Mg	420096 Mg	No data	No data
Dry mass of the disturbed sediment	3334 Mg	1041920 Mg	338624 Mg	1045254 Mg	341958 Mg	No data	No data
Lead (Pb)	8.1 kg	2521 kg	819.5 kg	2529.1 kg	827.6 kg	24000 kg	200000 kg
Copper (Cu)	2.0 kg	625 kg	203.2 kg	627.0 kg	205.2 kg	112000 kg	No data
Chromium (Cr)	2.8 kg	875 kg	284.7 kg	877.8 kg	287.5 kg	No data	No data
Zinc (Zn)	12.6 kg	3938 kg	1279.7 kg	3950.6 kg	1292.3 kg	No data	No data
Nickel (Ni)	1.46 kg	458 kg	148.8 kg	459.5 kg	150.3 kg	687000 kg	No data
Cadmium (Cd)	< 0.17 kg	< 52.1 kg	< 17 kg	< 52.3 kg	< 17.2 kg	2300 kg	7100 kg
Mercury (Hg)	< 0.03 kg	< 10.4 kg	< 3.4 kg	< 10.4 kg	< 3.4 kg	2100 kg	3400 kg
Arsenic (As)	< 4.2 kg	< 1302 kg	< 284.7 kg	< 1306.2 kg	< 288.9 kg	No data	No data
Congeners from the PCB group	< 0.002 g	< 0.52 g	< 0.17 g	< 0.5 g	< 0.2 g	260000 g	715000 g
Analytes from the PAH group	5.2 g	1615 g	524.6 g	1620.2 g	529.8 g	No data	No data
Phosphorus (P) assimilative	294 kg	91897.5 kg	29866.9 kg	92191.5 kg	30160.9 kg	9500000 kg (total P)	163000000 kg
Nitrogen (N)	< 66.7 kg	< 20838.2 kg	< 6772.2 kg	< 20904.9 kg	< 6838.9 kg	150000000 kg (total N)	5700000 kg

* with the OSS foundation taken into account

Source: own elaboration

The impact caused by the placement of large diameter pile and truss-type foundations will be minor due to the small area of the seabed, and the sediments therein, being subject to disturbance. In the case of cable trenching, the pollutant load will be greater due to the linear nature of the disturbance to the bottom, covering a much larger area.

A comparison of the estimated results of the resuspension of individual compounds shows that the total load of heavy metals, nutrients and pollutants will be negligible compared to the annual load contributed by rivers and with precipitation (Tab. 9.3).

At the same time, the disturbance of seabed sediments may slightly improve their quality (increasing oxygenation and decreasing the amount of pollutants and nitrogen compounds in the sediment due to its transfer to the water). Better oxygenation of sediments may reduce (limit) the transfer of phosphorus from the sediment, as this process takes place in anaerobic (reducing) conditions.¹⁷⁶

The sensitivity of the marine waters was assessed to be moderate.

The release of pollutants and nutrients from seabed sediments during the construction phase is a direct negative impact of a regional range, short-term, reversible or irreversible, repeatable during the construction phase, characterised by low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be insignificant for marine waters and negligible for seabed sediments.

Water turbidity and spread of suspended solids

In addition to the disturbance of sediments and the passage of pollutants and nutrients into the water, water turbidity will also occur during construction works due to resuspension. The degree of turbidity will depend on the type of sediment present in the seabed. In the case of clay and silt fractions (cohesive sediments), turbidity is expected to be more extensive and longer-lasting than in the case of sandy sediments (non-cohesive sediments).

An analysis of the dispersion of suspended solids was carried out only for the construction works associated with cable trenching and burial (Volume III, Appendix 2). During foundation placement and pile driving, the amount of disturbed sediment will be small.

Sediment resuspension was analysed only for the jetting method, which, from all excavation technologies considered by the Investor, will result in the largest sediment resuspension and turbidity. Several sections along the cable routes with different lithologies were designated for the analysis (Fig. 9.1 – A, B, C – cohesive sections, D, E, F – non-cohesive sections), located at different depths in the area of the planned project.

¹⁷⁶ Alloway B.J., Ayres D.C., *Chemiczne podstawy zanieczyszczenia środowiska*. Wydawnictwo Naukowe PWN, Warszawa 1999

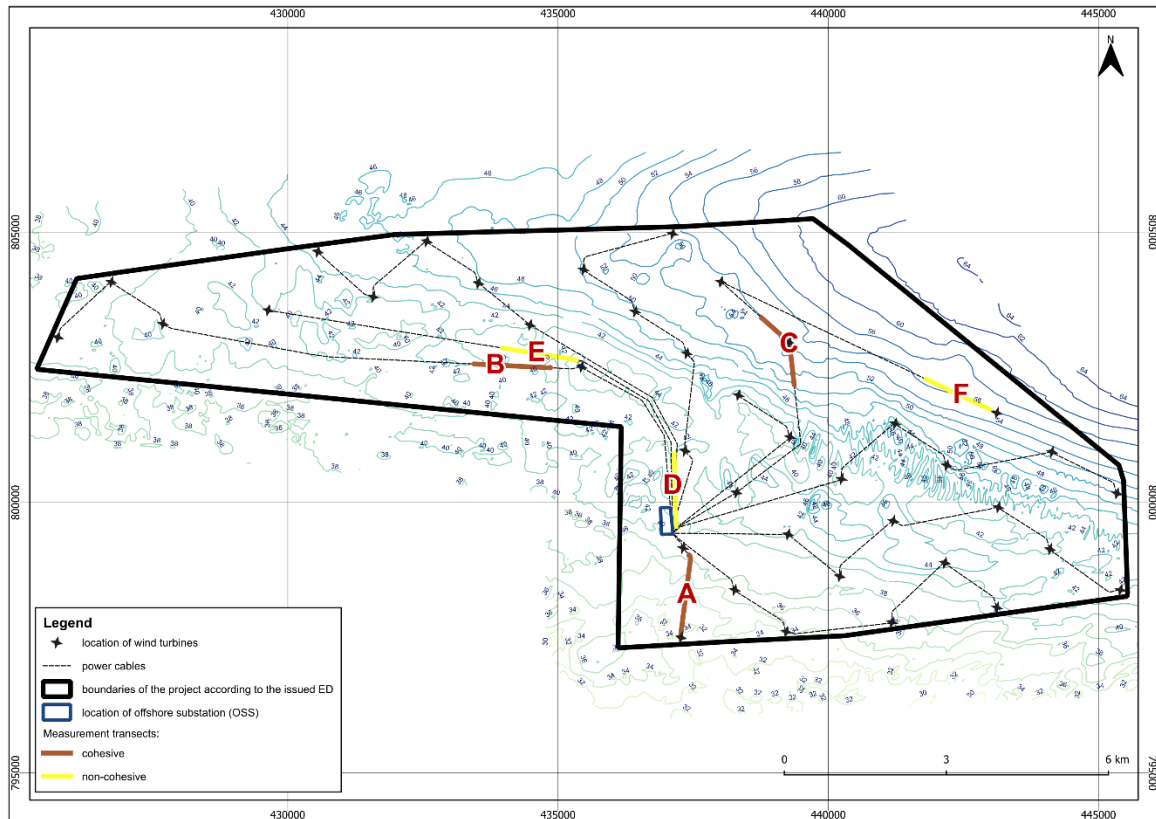


Fig. 9.1. Representative sections of the excavation routes selected for sediment dispersion modelling

Source: Cerkowniak G.R., Szmytkiewicz P., Cerkowniak M., *Modelling of Suspended Solids Dispersion during the Burial of Interconnection Cables in the Area of the BC-Wind OWF*, Gdańsk, June 2024 (Volume III, Appendix 2)

The following was assumed for the purposes of the modelling:

- from approx. 3% to 15% of the dredged material may pass into the water mass during the works, with the highest values associated with sections of cohesive seabed (clay, silt, loam);
- the cables will be laid at two dredging speeds, i.e. 125 m/h and 350 m/h (corresponding to the modelling scenarios of V125 and V350, respectively).

The analysis of the dispersion of suspended solids during the aforementioned works showed that the highest turbidity is to be expected on those sections of the route where cohesive sediments, with a high content of silt and clay fractions, are present in the core structure. These sections correspond to approx. 47.8% of the total length of the cable route. In the remaining part of the route, which is made up of non-cohesive sediments (mainly sandy sediments), approx. 3% of the dredged material will pass into the water mass. Taking the above into account, a total of approx. 29582.1 Mg of dry sediment is to be expected to pass into the water mass throughout the excavation works on the entire route (approx. 100 km) (Tab. 9.4).

Tab. 9.4. Amount of solids to undergo resuspension during cable burial using the jetting method

Parameters	Connection infrastructure		
	Sections of the CI (cohesive)	Sections of the CI (non-cohesive)	Total
Excavation length [km]	47.8	52.2	100
Dry mass of the disturbed sediment [Mg]	161862.3	176761.7	338624
Amount of the disturbed sediment to undergo resuspension [%]	15	3	-
Dry mass of the disturbed sediment in resuspension [Mg]	24279.3	5302.8	29582.1

Source: own elaboration

Extent of water turbidity

Based on the results of the performed modelling of the dispersion of suspended solids (Volume III, Appendix 2), it can be assumed that, depending on the characteristics of the affected seabed sediments, the maximum extent of water turbidity will range from approx. 750 m – for non-cohesive sediments – to approx. 2100 m – for cohesive sediments.

In the case of sections of non-cohesive sediment, the maximum extent of water turbidity in the water mass will be up to approx. 360 m from the axis of the excavation at the work speed of 125 m/h (Fig. 9.2), and up to approx. 750 m from the axis of the excavation at the work speed of 350 m/h (Fig. 9.4). The highest sediment concentration, reaching up to 100 mg/l, should be expected at a distance of 30 m to 40 m from the axis of the excavation, assuming the work speed of 350 m/h.

In the case of sections of cohesive sediment, the turbidity ranges will be greater and reach up to approx. 1500 m in the V125 scenario (Fig. 9.3) and up to approx. 2100 m in the V350 scenario (Fig. 9.5). Maximum concentrations, exceeding 200 mg/l, should be expected at a distance of approx. 80 m from the axis of the excavation at the work speed of 125 m/h, and up to approx. 200 m from the axis of the excavation at the work speed of 350 m/h.

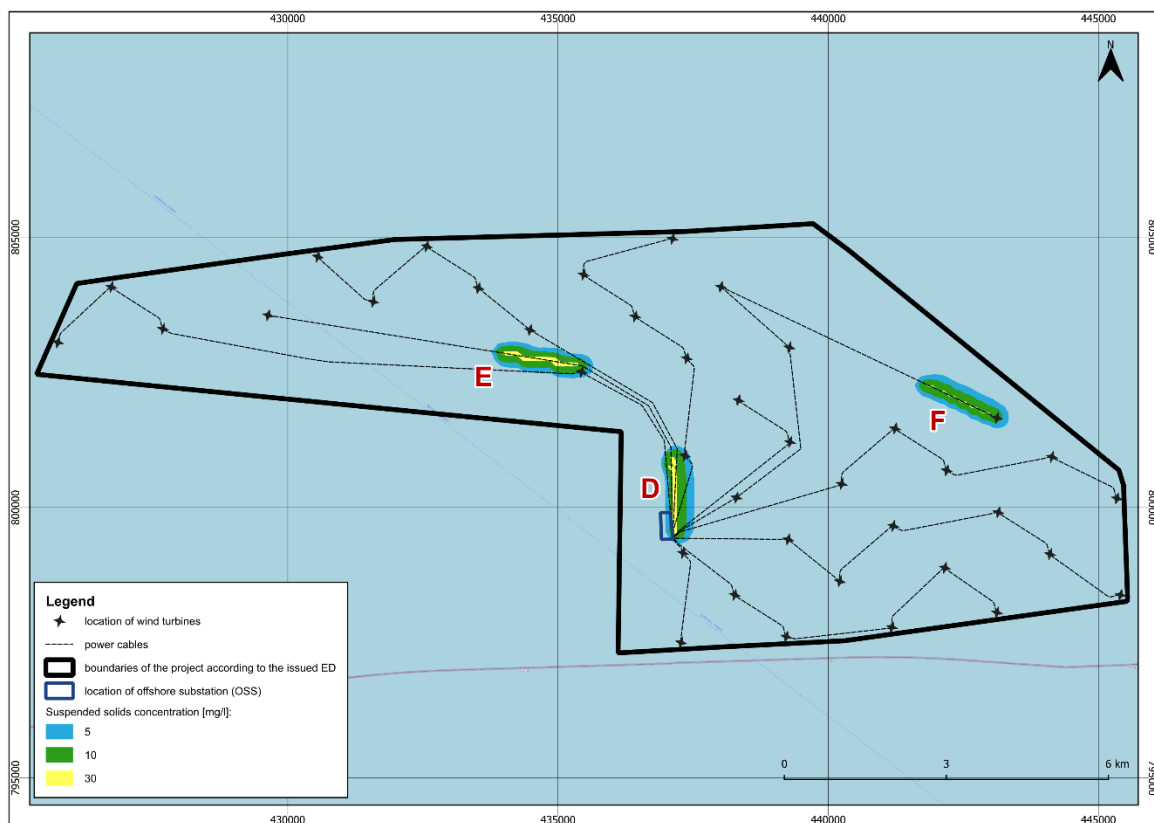


Fig. 9.2. Maximum concentrations of suspended solids in the entire water column during excavation work using the jetting method at a work speed of 125 m/h – non-cohesive sections

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

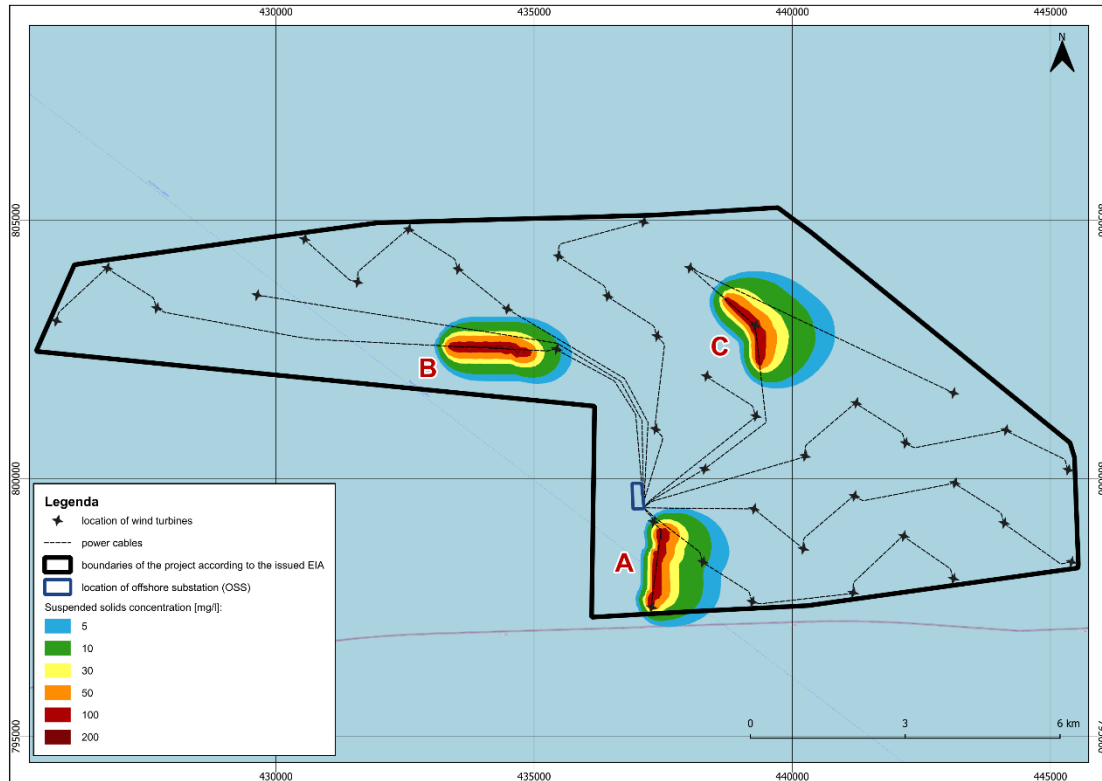


Fig. 9.3. Maximum concentrations of suspended solids in the entire water column during excavation work using the jetting method at a work speed of 125 m/h – cohesive sections

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

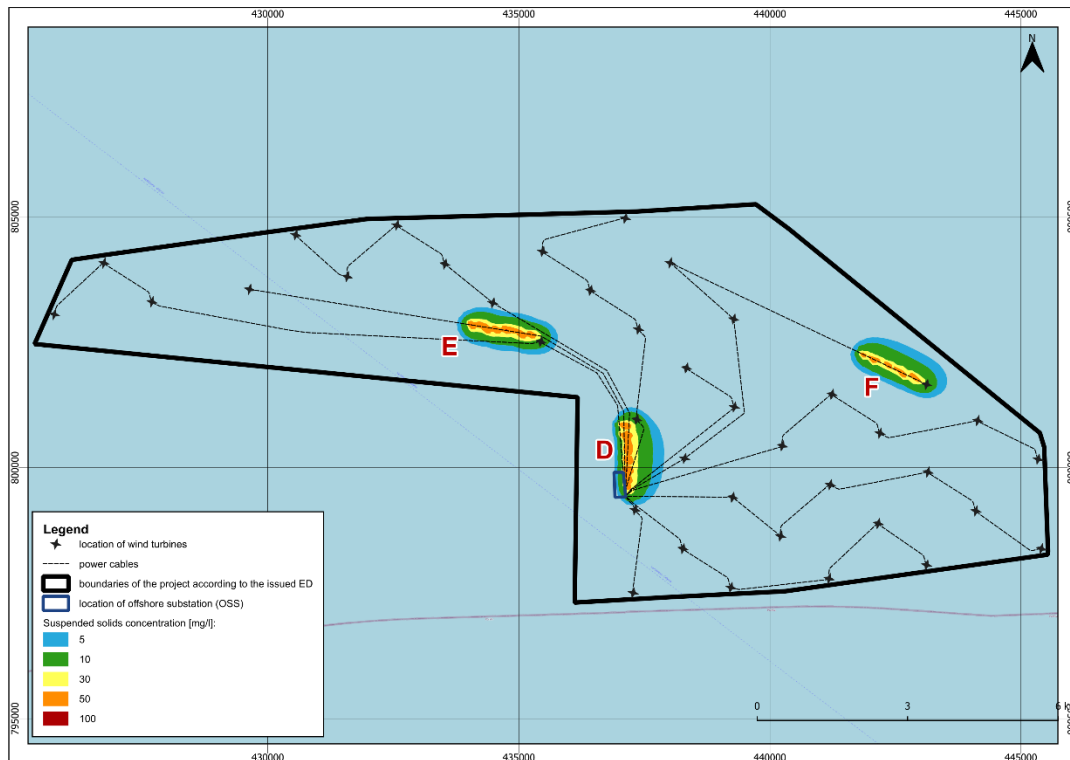


Fig. 9.4. Maximum concentrations of suspended solids in the entire water column during excavation work using the jetting method at a work speed of 350 m/h – non-cohesive sections

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

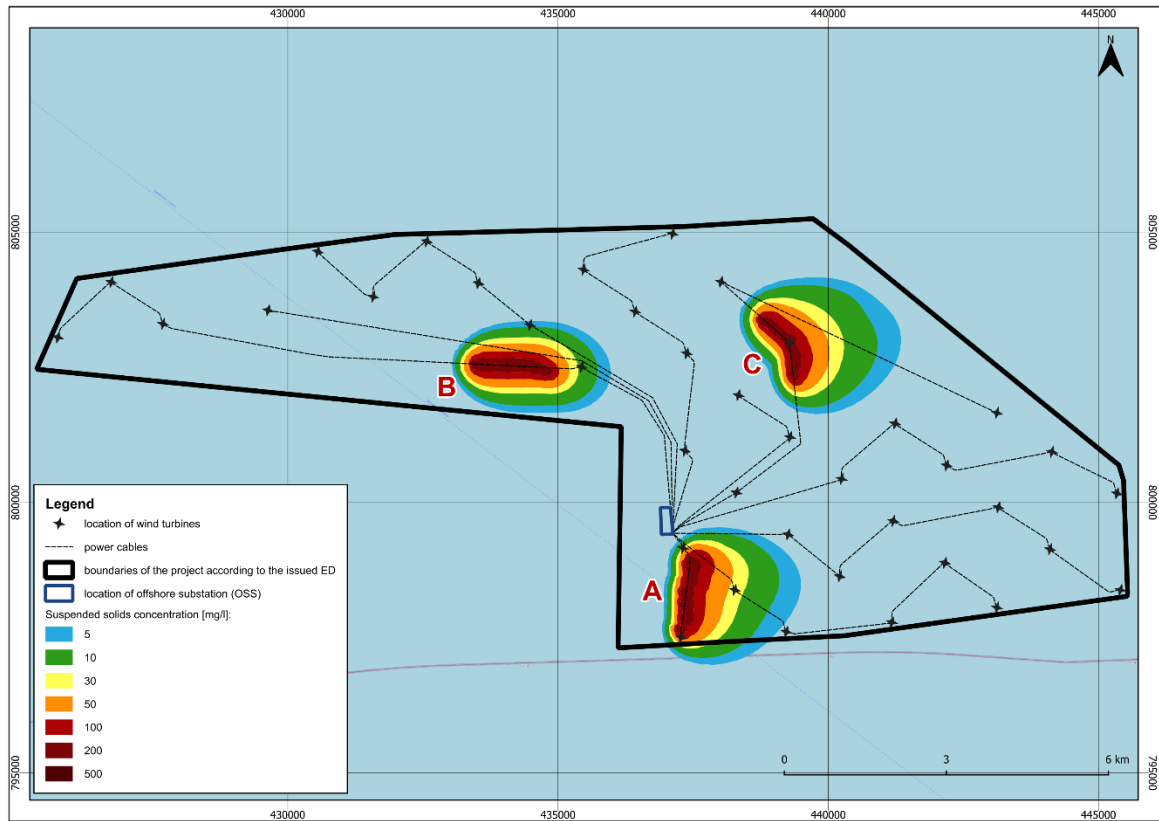


Fig. 9.5. Maximum concentrations of suspended solids in the entire water column during excavation work using the jetting method at a work speed of 350 m/h – cohesive sections

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

The maximum turbidity duration over which, at individual points of the route, the suspended solids concentration exceeds the background limit, which was assumed to be 5 mg/l¹⁷⁷ for the purposes of the modelling, will vary depending on the amount of disturbed sediment and the direction of the route. For the west-east aligned sections of the route (Fig. 9.6, Fig. 9.9, sections – B, C, E, F), the turbidity duration will be slightly longer than for the north-south aligned sections due to the suspended solids spreading along the route throughout the works with the prevailing wind direction from the western sector. In the case of sandy sections, the maximum turbidity duration will not exceed 6 h (Fig. 9.8, Fig. 9.9), while in the case of cohesive sections, enriched in silt and loam fractions, it will average up to 10 h, with a maximum of up to 14 h (Fig. 9.6, Fig. 9.7).

¹⁷⁷ however, this value may vary naturally from a few to several hundred mg/l

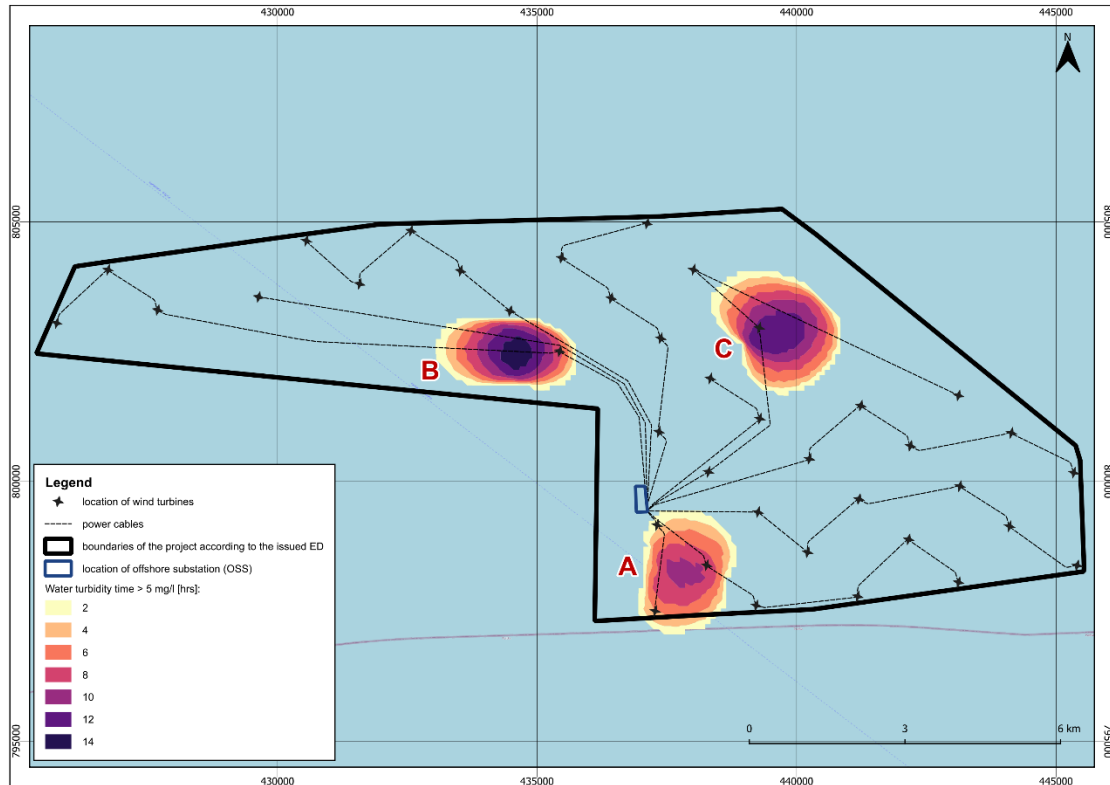


Fig. 9.6. Maximum water turbidity duration during excavation work using the jetting method at a work speed of 125 m/h – cohesive sections

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

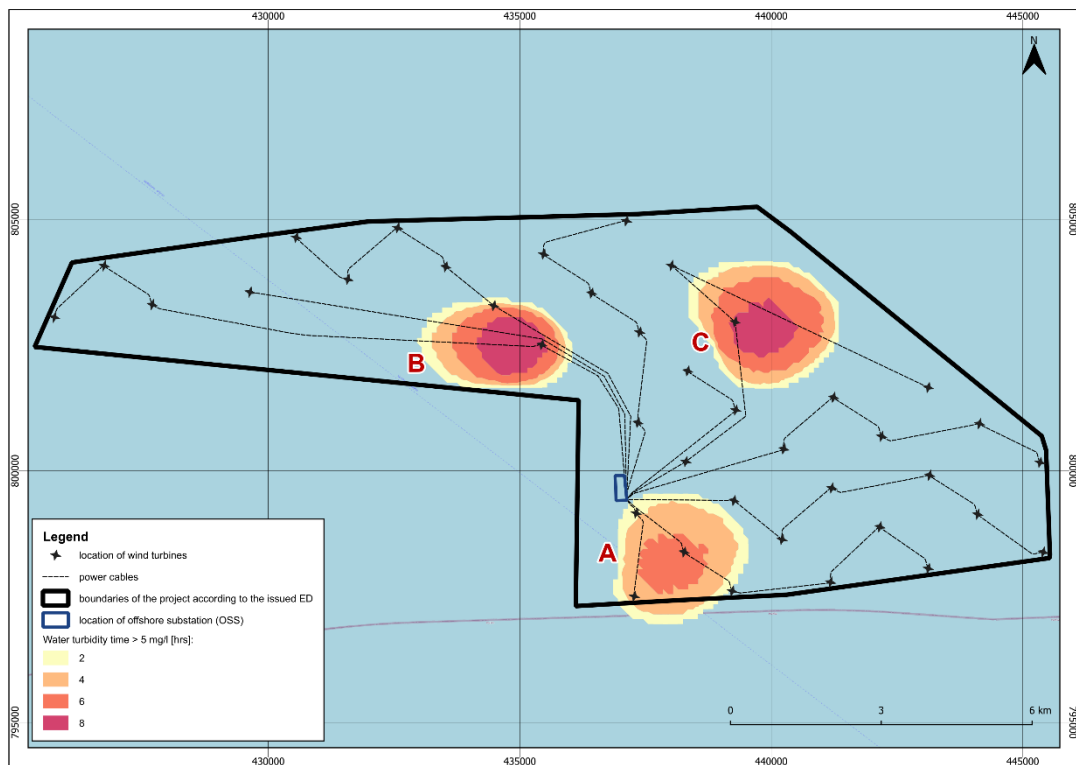


Fig. 9.7. Maximum water turbidity duration during excavation work using the jetting method at a work speed of 350 m/h – cohesive sections

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

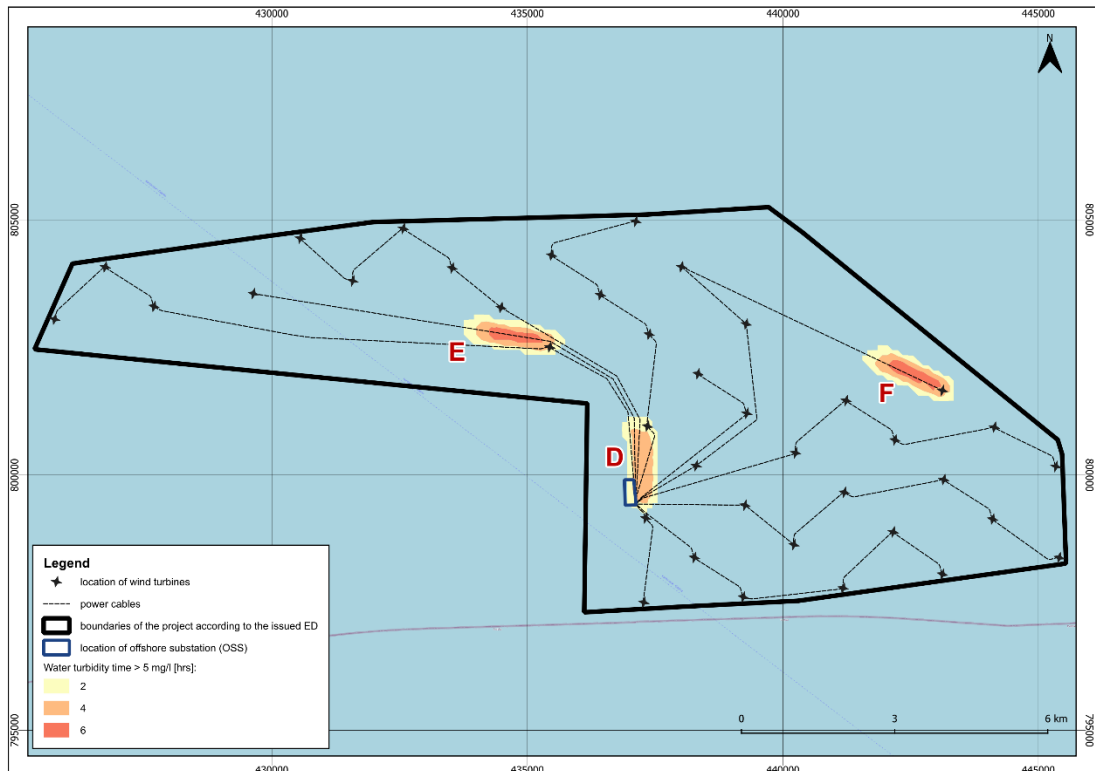


Fig. 9.8. Maximum water turbidity duration during excavation work using the jetting method at a work speed of 125 m/h – non-cohesive sections

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

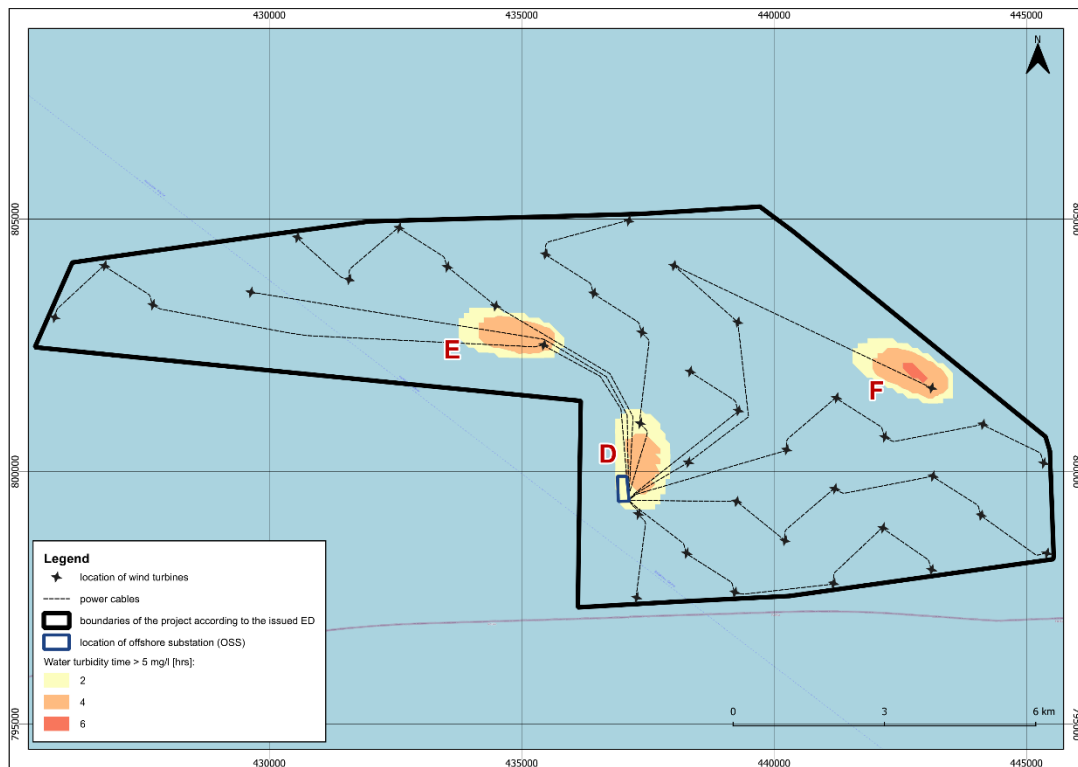


Fig. 9.9. Maximum water turbidity duration during excavation work using the jetting method at a work speed of 350 m/h – non-cohesive sections

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

Taking into account that the area of water turbidity will move along with the progress of the works, the concentration of suspended solids in the water depth will gradually decrease where the trench has been excavated. Water turbidity will therefore be a short-term, localised impact. As this modelling was carried out for cable routes that may still change, the overall impact range of the turbidity was assumed to reach a length of 2100 m from the buffer zone boundary of the planned project.

Following the completion of the works, suspended solids will undergo deposition on the seabed. In areas with a non-cohesive (sandy) bottom, the thickness of the newly formed sediment layer after the complete sedimentation of the suspended solids introduced into the basin will not exceed 0.2 mm, and 0.3 mm in the axis of the excavation (Fig. 9.10, Fig. 9. 11), while in the case of excavation work carried out on a cohesive bottom, this thickness may reach 1.4 mm in the close vicinity of the excavation, but will not exceed 1 mm at distances above 150 m from the excavation and 0.5 mm at distances above 350 m from the excavation (Fig. 9.12, Fig. 9.13).

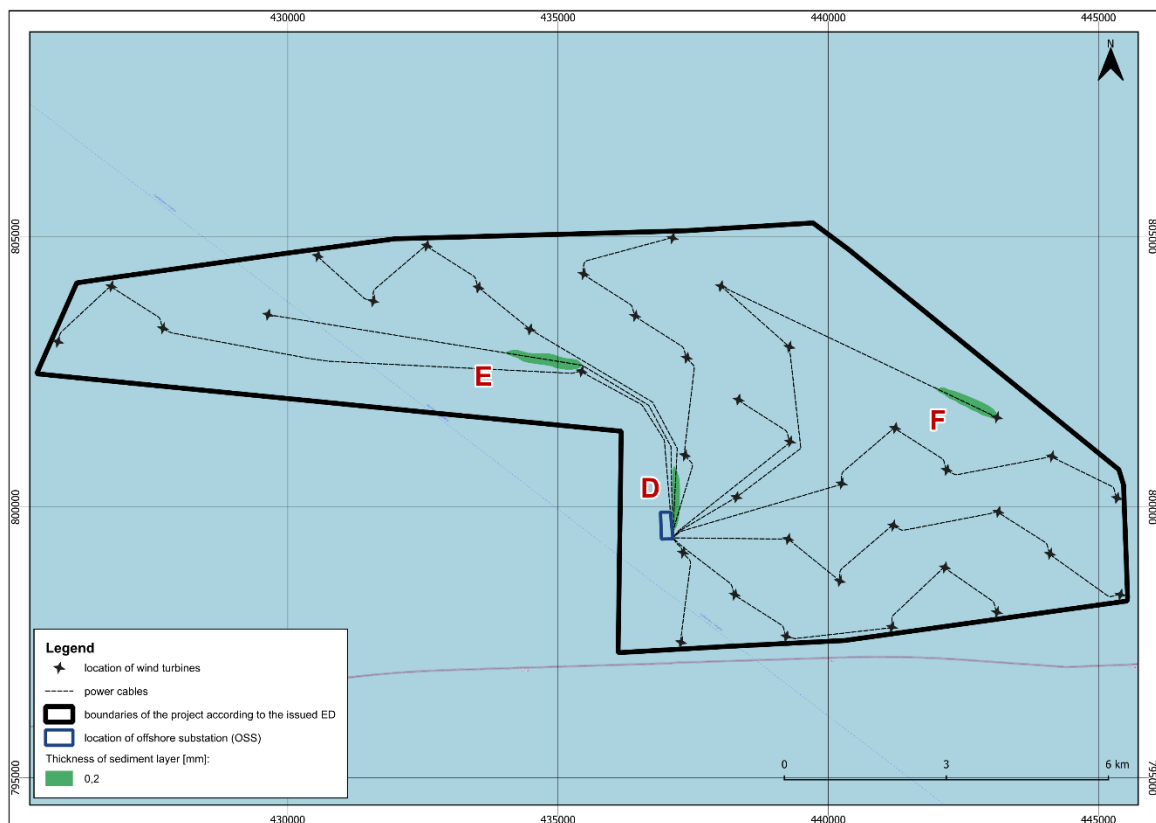


Fig. 9.10. Thickness of the newly formed sediment layer after the complete sedimentation of the suspended solids introduced into the basin during excavation work at a work speed of 125 m/h, on a non-cohesive seabed

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

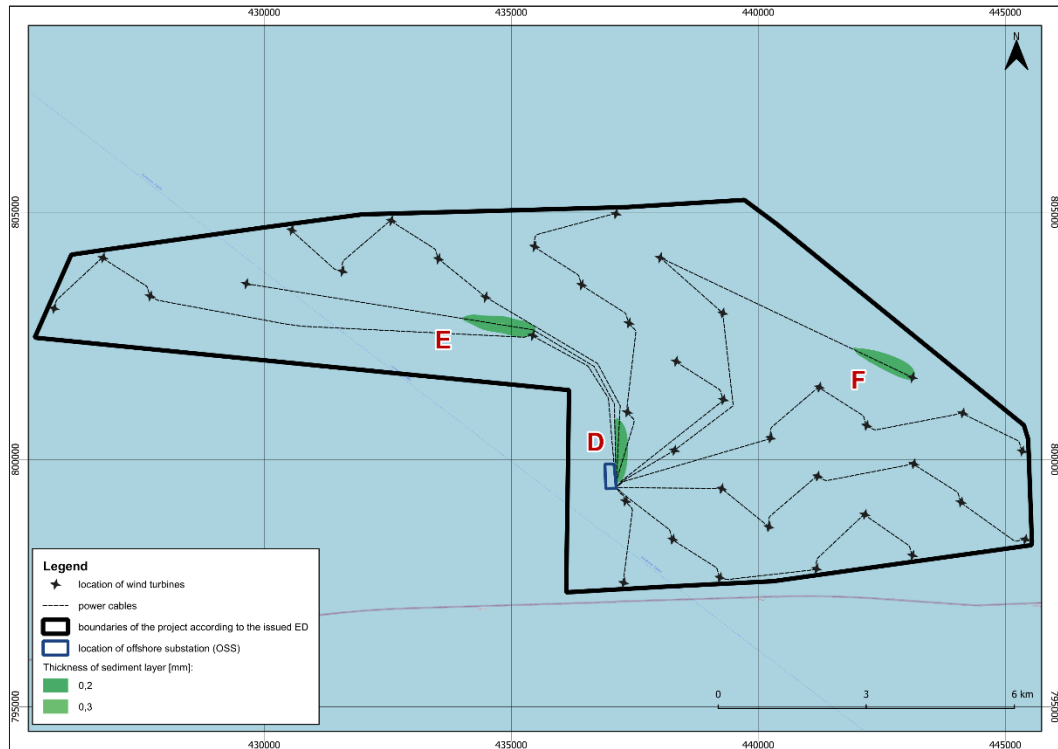


Fig. 9.11. Thickness of the newly formed sediment layer after the complete sedimentation of the suspended solids introduced into the basin during excavation work at a work speed of 350 m/h, on a non-cohesive seabed

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

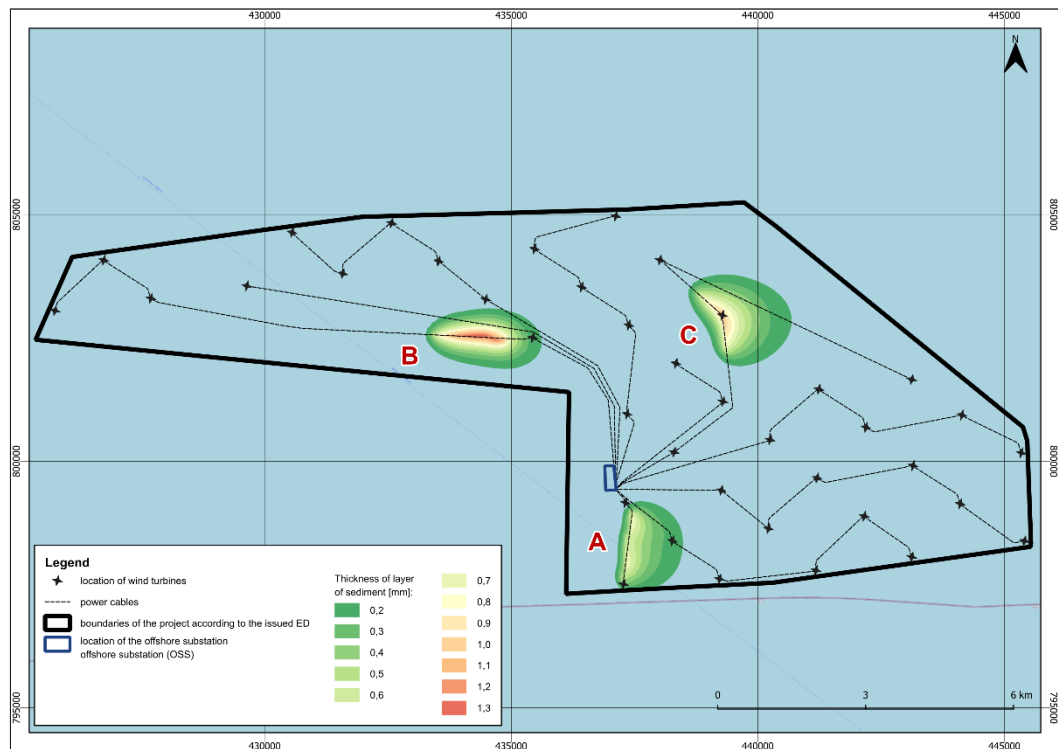


Fig. 9.12. Thickness of the newly formed sediment layer after the complete sedimentation of the suspended solids introduced into the basin during excavation work at a work speed of 125 m/h, on a cohesive seabed

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

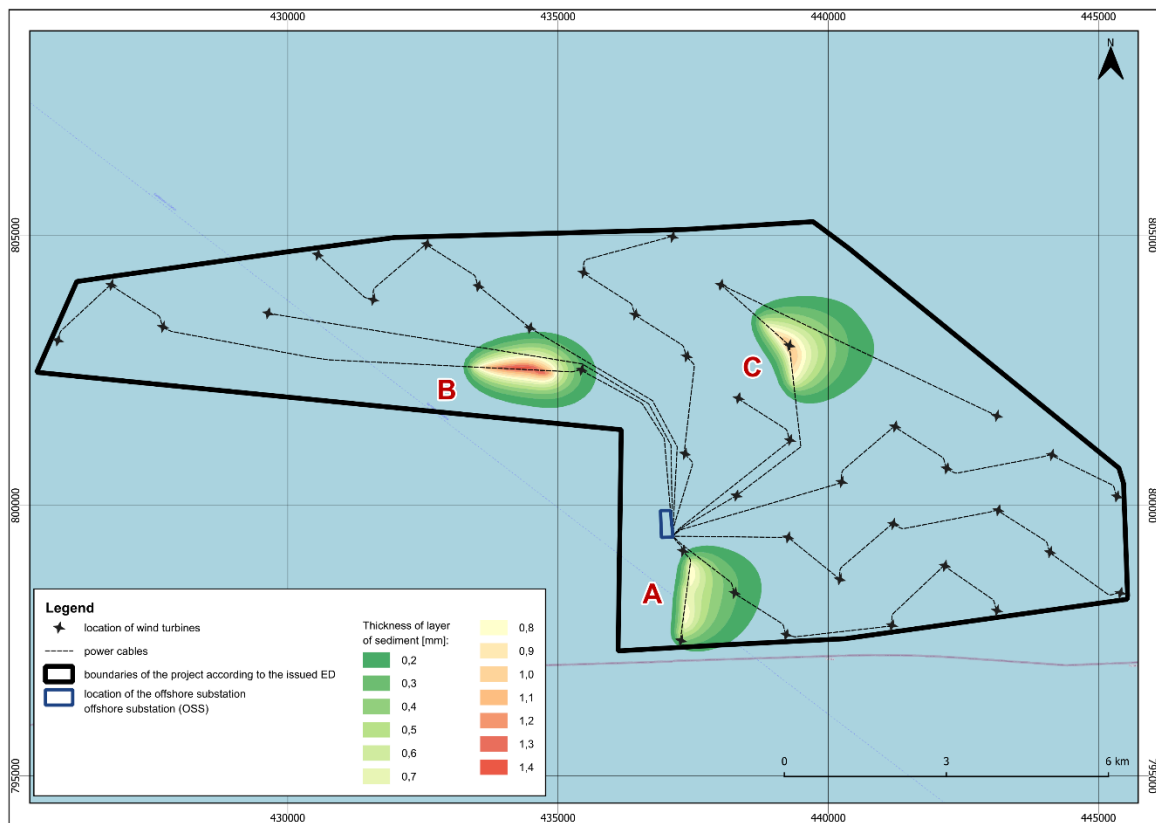


Fig. 9.13. Thickness of the newly formed sediment layer after the complete sedimentation of the suspended solids introduced into the basin during excavation work at a work speed of 350 m/h, on a cohesive seabed

Source: based on the report on suspended solids modelling (Volume III, Appendix.2)

Taking into account the level of turbidity caused by the works, as well as its spatial range, duration and the thickness of the newly formed sediment layer, the sensitivity of the marine waters was assessed to be moderate. The water turbidity caused by the resuspension of suspended solids during excavation work is a direct negative impact of a regional range, short-term, reversible, and of low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be insignificant for marine waters and negligible for seabed sediments.

Contamination of water and seabed sediments with oil derivatives during normal operation of vessels in the course of construction and at the time of their breakdown or collision

Pollutants entering water during normal operation of vessels form the second largest source of oil pollution at sea. This is the source of approx. 33% of oil released into the environment (mainly due to the increased maritime traffic in the Baltic Sea region).¹⁷⁸ In comparison, approx. 37% of the oil entering the sea is run-off from land brought by rivers, while tanker disasters only rank third (12%).

During the construction phase, vessels (ships, barges, etc.) will be used, from which small leaks of oil derivatives (lubricating oil, fuel oil, petrol, etc.) may occur during normal operation. To a minor extent, they may contribute to the deterioration of water quality.

¹⁷⁸ Kaptur G., Bałtyk cierpi – ratujmy go wszyscy. Czas Morza 1999, 2 (12): 23-27

It should be assumed that these will be small spills (I degree), up to 20 m³, if any. Visible traces of such contaminants may disappear spontaneously in favourable conditions, as a result of evaporation and dissipation in water. In practice, the size of these spills will be limited to the area of BC-Wind OWF.

The sensitivity of marine waters and seabed sediments to small spills of oil derivatives occurring during the normal operation of vessels was assessed to be insignificant.

Contamination of marine waters and seabed sediments with oil derivatives released during normal operation of vessels is a direct negative impact of a local range, momentary or short-term, reversible, repeatable, and of low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be negligible for marine waters and seabed sediments.

Leakage of oil derivatives resulting in the contamination of water and seabed sediments may also occur in emergencies (as a result of a breakdown or a collision of vessels, a construction disaster of one of the BC-Wind OWF facilities, as well as during maintenance works). Such events may contribute to the deterioration of coastal water quality (if the spill reaches the shore). In the event of a collision of vessels, a III degree spill can be expected, i.e. one above 50 m³, up to approx. 200 m³.

A visible effect of an oil spill is oil slick which, under the influence of gravity and surface tension, spreads at a speed depending on the type of oil and ambient conditions. The size of the spill is determined by such factors as oil volume, density, viscosity, temperature, wind speed and time. The estimated speed of oil slick movement in large water bodies is approx. 2-3% of the wind speed. It has been found that a spill of 1.6 t (1.8 m³) of oil spreading over the surface of 1 km², throughout one day, forms a dark film with a thickness of 2 µm. 40 kg of oil, on the other hand, causes a slick on the surface of 1 km² that has a film thickness of 0.05 µm.¹⁷⁹

Oil film formed on the water surface may cause:

- an impeded exchange of gases, especially of oxygen, between the water and the atmosphere;
- a 5-10% decrease in light intensity under the water surface (mainly due to the presence of heavy fractions of oil and sulphur), limiting photosynthesis;
- an increase in water temperature during the day as a result of light absorption by the oil layer.

While oil slick is spreading, other degradation processes are progressing, which lower the concentration of hydrocarbons on the water surface (e.g. the release of low molecular weight hydrocarbons). Heavier oil fractions may undergo sorption on the surface of organic and mineral suspensions, which may increase their specific gravity and gradually make them sink to the seabed. Thus, heavier oil fractions may be bound by seabed sediments, contaminating them. The susceptibility of seabed sediments to contamination depends on the grain size of the sediment and its compaction. Loose sandy sediments are more susceptible to contaminant absorption. Compact till sediments inhibit the penetration of contaminants into the sediment. However, due to the type of sediments present in the area of the BC-Wind OWF (characterised by a small amount of organic matter and low content of fine fractions), oil spills will not cause noticeable deterioration of their quality.

The probability of a breakdown or a collision of vessels in the Baltic Sea is low. Approximately 2 thousand vessels sail on the Baltic Sea every day (including 200 tankers transporting oil and other liquids), and the number of collisions and failures in recent years has remained more or less constant (with a slight increase), i.e. at approx. 120-190 accidents at sea every year. The majority of accidents in the Baltic Sea cause no contamination. The number of accidents involving contaminant release into water is up to 21 (which occurred in 2017) per year. However, it must be kept in mind that even one large-scale accident may seriously threaten the marine environment. In 2017, 139 vessel accidents occurred in the Baltic Sea area, 21 of which resulted in its contamination. None of the accidents that

¹⁷⁹ Gutteter-Grudziński J.M., *Studium efektywności odolejania okrętowych wód zęzowych z wykorzystaniem sekcji hydrocyklonów i koalescencyjnych przegród porowatych*. Wydawnictwo Naukowe Akademii Morskiej w Szczecinie, Szczecin 2012

resulted in water contamination and required a clean-up occurred in the area of the Polish EEZ.¹⁸⁰ 2017 saw 8 confirmed oil spills of less than 1 m³ in volume, one with a volume in the range of 1-10 m³ and one larger accident with a volume of 200 m³.¹⁸¹

In the southeastern Baltic Sea area, in which the analysed BC-Wind OWF Area can be included, the risk of a collision with a spill of over 5000 tonnes was estimated to be 1 incident in 1060 years, whereas the areas under the greatest threat are found around the Wolin and Rügen islands, as well as the Hel Peninsula.

During construction works, vessels sail at low speeds, and therefore the risk of damage to the fuel tank is very low. A vessel generally holds fuel in several tanks, which reduces the risk of a major leak in case of collision. Vessels used in the construction of wind farms may have fuel tanks with the total capacity of approx. 1200 m³. Assuming a breakdown or collision of the largest vessels used at the construction phase of the BC-Wind OWF (during inspections, maintenance and emergency repairs) and the destruction of the largest tanks of one vessel, no more than 200 m³ of fuel oil, 15 m³ of machine oil and approx. 2.5 m³ of hydraulic oil may be released from one vessel (in the worst-case scenario).¹⁸²

In the event of a construction disaster at the OWF (a wind turbine falling over or a vessel colliding with the wind turbine or a substation), a leak of fuel oil (up to 100 m³), machine oil (up to 15 m³), hydraulic oil (up to 2.5 m³) or transformer oil (up to 80 m³) may occur.

The most important parameters affecting the level of impact are: the type and amount of oil derivatives released, weather conditions, and the type of rock material forming the seabed.

The sensitivity of both receptors may be high in case of emergency or collision.

Moreover, a plan will be prepared for the BC-Wind OWF to prevent risks and contamination during the construction, exploitation and decommissioning of the OWF. This plan should specify the potential area under the threat of various breakdown and disaster scenarios, as well as the methods of preventing and eliminating oil spills. Such a plan (Oil Pollution Prevention Plan) in its preliminary version has been agreed upon with the Ministry of Infrastructure, and its next version will be presented to the Maritime Office in Gdynia prior to submitting the application for the BC-Wind OWF construction permit.

Contamination of seawater or seabed sediments with oil derivatives released in an accident is a direct negative impact of regional range, short-term, reversible, repeatable, and of high intensity.

The significance of this impact during the construction phase of the WWR 2024, due to the random and sporadic nature of breakdowns and collisions, was assessed to be insignificant for marine waters and seabed sediments.

Accidental contamination of seabed sediments and waters with antifouling agents containing organotin compounds (e.g. TBT)

Hulls of vessels are protected against fouling with biocides, which may contain e.g. copper, mercury and organotin compounds (e.g. TBT). These substances may pass into the water and eventually be contained in the sediment. It should be assumed that the release of those compounds will be limited due to their dilution in the water. Among the substances listed, organotin compounds are the most harmful (toxic) to aquatic organisms. The use of TBT (the most harmful substance) in antifouling paints is now prohibited¹⁸³, but the presence of those compounds in older vessels cannot be ruled out.

¹⁸⁰ HELCOM, Report on shipping accidents in the Baltic Sea from 2014 to 2017, 2018; available at: <https://helcom.fi/media/publications/Report-on-shipping-accidents-in-the-Baltic-Sea-from-2014-to-2017.pdf>

¹⁸¹ HELCOM, Report on shipping accidents in the Baltic Sea from 2014 to 2017, 2018; available at: <https://helcom.fi/media/publications/Report-on-shipping-accidents-in-the-Baltic-Sea-from-2014-to-2017.pdf>

¹⁸² Veldhuizen P., Meijer B., Truijens J., Vree D., Gockel P., Lammers L., Track S., 2009 Polenergia Offshore Wind Developments for projects Middle Baltic II and Middle Baltic III. High Level Technical Design Options Study. Royal HaskoningDHV – Enhancing Society Together. Version 1 – initial concept. Rev. 2.0 – 4 February, 2014

¹⁸³ International Convention on the Control of Harmful Antifouling Systems on Ships (Journal of Laws of 2008 No. 134, item 851)

The sensitivity of marine waters and seabed sediments to biocides released from hulls was assessed to be medium.

Vessels (ships, barges, etc.) will be used at each phase of the project and their hulls may release certain amounts of antifouling substances into the water during normal operation. Consequently, they can contaminate sediments. To avoid this, at every stage of the project it is recommended to use vessels the hulls of which have not been coated with antifouling paint containing TBT. This will eliminate this most harmful impact on aquatic organisms.

The most important parameters influencing the level of impact are the type and amount of the antifouling substances released, as well as the type of rock material forming the seabed.

The sensitivity of both receptors is moderate.

Contamination of water or seabed sediments with antifouling substances during the construction phase forms a direct negative impact of a local or regional range, short-term, reversible, repeatable during the construction period, and of low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be negligible for marine waters and seabed sediments.

Contamination of seabed sediments and waters by accidental release of municipal waste or domestic sewage

At each phase of the project, waste will be generated on vessels and at the onshore site facilities (located in the port supporting the project implementation) – mainly municipal and other waste, not directly related to the construction process, as well as domestic sewage. Waste and sewage may be accidentally released into the sea while being received from vessels by another vessel and during a breakdown, resulting in a local increase in nutrient concentrations and the deterioration of water and sediment quality. However, the contaminants should rapidly disperse, which will stop them from contributing to a permanent environment deterioration in the area of the project. The sensitivity of marine waters and seabed sediments to this type of impact is assessed to be low.

The most important parameters affecting the level of this impact are the type and quantity of the waste or sewage released, weather conditions, as well as the type of rock material forming the seabed.

The sensitivity of both receptors is negligible.

The contamination of seawater or seabed sediments with municipal waste or domestic sewage is a direct negative impact of a local range, short-term or momentary, reversible, repeatable during the construction phase, and of low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be negligible for marine waters and seabed sediments.

Contamination of seabed sediments and waters by accidentally released chemicals and waste from the construction of the OWF

During the construction of the OWF, waste directly related to the construction works will be generated on vessels, at onshore site facilities (located in the port handling the implementation of the project), and at the project site. These may include, i.a., damaged parts of OWF components, cement, joint grouts, mortars, machine fluids and other chemical substances used or replaced during construction works. They may be accidentally released into the sea.

This waste is mainly generated during the construction and decommissioning phases [most often waste from group 17 of the Annex to the Regulation of the Minister of Climate of 2 January 2020 on the waste catalogue (Journal of Laws of 2020, item 10)]. Waste produced during the construction phase will include e.g. cable scrap, sanitary waste from ships, flammable waste, oil and chemical waste, as well as construction waste. Waste should be neutralised in accordance with the applicable regulations concerning industrial waste.

The most important parameters affecting the level of this impact are the type and quantity of waste or sewage released, weather conditions, and the type of rock material forming the seabed.

Bulk cement is packed in bags of approx. 1 m³ each. It was assumed that during reloading activities, approx. 5 m³ of this product may sink. Grouts, mortars and other binders often contain hazardous substances. For example, epoxy (two-component) binders contain various proportions of: epoxy resin, alkyl-glycidyl ethers, and polyaminoamides. When released into water, these substances, due to their high density (approx. 1.3 g cm⁻¹), sink and deposit on the seabed. They are considered a serious threat as they cannot be easily removed from the seabed and are toxic to marine organisms.

Generally, for projects such as the BC-Wind OWF, a detailed plan is prepared to prevent the risks and contamination generated during the construction, operation and decommissioning of the OWF, which contains mitigating measures and a procedure to be followed in case of such events.

The sensitivity of both receptors in the case of this impact is moderate.

The contamination of seawater or seabed sediments connected with the OWF construction works is a direct negative impact of a local range, short-term or momentary, irreversible, repeatable during the construction period, and of medium intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be negligible for marine waters and insignificant for seabed sediments.

Access to raw materials and deposits

The BC-Wind OWF Area is located within the prospective crumbstone raw material area II – the Baltic seabed coastal zone. This area occupies more than 91% of the BC-Wind OWF Area, i.e. 79.1 km², including 27.82 km² in the prospective sand area (the northeastern part of the area) and 51.28 km² in the prospective sand and sand and gravel area (the remaining part of the area).

The construction of the planned project will cause a local interference with prospective deposits due to the placement of foundations for the wind turbines and the preparation of the seabed, as well as the laying/burial of cables. In the course of the aforementioned works, surface occupation and restricted access to areas of crumbstone raw materials will occur. Given the occupation of the BC-Wind OWF Development Area in the field of the aforementioned deposit, an area of 79.1 km², representing only 2.2% of its total area, will be excluded from exploitation.

Given the small area occupied by the BC-Wind within the crumbstone raw material area II, the impact can be assessed as negligible.

9.2.2. Exploitation phase

Changes within the seabed associated with the impact of the project will be local and, within the entire area occupied by the project, insignificant for the overall character of the seabed and its structure.

No changes in the geological structure of the seabed are expected during the exploitation phase of the project. The overall impact of the project during the exploitation phase can be assessed as negligible.

Impact on the quality of bottom sediments and seawater

During the exploitation of the BC-Wind OWF, works affecting the quality of water and seabed sediments will be carried out in its area. These will mainly be service works and interventions in case of an emergency situation.

It was found that during their exploitation phase, offshore wind farms may cause various **types of impacts** on the discussed receptors (water and seabed sediments). These include:

- pollutants and nutrients passing from sediments to water, water turbidity,
- contamination with oil derivatives,
- contamination with antifouling agents,
- contamination with accidentally released municipal waste or domestic sewage,

- contamination with accidentally released chemicals and waste originating from operating and servicing the BC-Wind OWF,
- contamination with compounds from anti-corrosion agents,
- temperature change of seabed sediments and seawater through the reception of heat from transmission cables.

Release of pollutants and nutrients from sediments into water, water turbidity

During the exploitation of the BC-Wind OWF, works causing the disturbance of seabed sediments (including water turbidity), e.g. the maintenance of foundations and cables or the anchoring of vessels, will be carried out. They will boost the transfer of pollutants and nutrients from sediments to water.

Labile metal complexes, organic pollutants, i.e. PAHs and PCBs, as well as nutrients (nitrogen and phosphorus) may enter the water.

Since the seabed sediment in the surveyed area is characterised by a low content of harmful substances (metals, PAHs, PCBs, TBTs) and nutrients, the risk of their transfer to water is low (it will slightly deteriorate the water quality). The sensitivity of water and seabed sediments to this impact was assessed to be negligible.

The release of pollutants and nutrients from seabed sediments and the resulting turbidity during the exploitation phase is a direct negative impact of a local range, short-term, reversible, repeatable during the exploitation phase, and of low or medium intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be insignificant for marine waters and negligible for seabed sediments.

Contamination of water and seabed sediments with oil derivatives during normal operation of vessels in the course of construction and at the time of their breakdown or collision

During normal operation of vessels when carrying out service works on power stations, leakages of various types of oil derivatives (lubricating and diesel oils, petrol) may take place.

These may slightly contribute to the deterioration of water quality. Heavier oil fractions may undergo sorption on the surface of organic and mineral suspended solids, which will increase their specific gravity and make them gradually sink to the bottom. There, they may also be bound within seabed sediments.

During the maintenance of wind farm components, leakages of various types of oil derivatives may occur while the components are being replaced during the service works on wind turbines and substations. Transformers should be equipped with devices minimising such risk – tight oil pans – and the rainwater drainage system should be equipped with an oil derivatives separator.¹⁸⁴ If such solutions are applied, no significant spills outside the facility are expected.

The contamination of marine waters and seabed sediments with oil derivatives released during the normal operation of vessels during the exploitation phase of the BC-Wind OWF is a direct negative impact which is local, temporary or short-term, reversible, repeatable during the exploitation phase, and of low intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters and seabed sediments, whereas in the case of a breakdown or collision, it was assessed to be moderate.

Accidental contamination of water and seabed sediments with antifouling agents containing TBT

¹⁸⁴ Southall B.L., Finneran J.J., Reichmuth C., Nachtigall P.E., Ketten D.R., Bowles A.E., Ellison W.T., Nowacek D.P., Tyack P.L., Marine mammal noise exposure criteria. Updated scientific recommendations for residual hearing effect. *Aquatic Mammals* 2019, 45 (2): 125-232

The contamination of water and/or seabed sediments with antifouling substances during the exploitation phase is a direct negative impact of a local range, short-term, reversible, repeatable during the exploitation phase, and of low intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters and seabed sediments.

Contamination of water and seabed sediments by accidental release of municipal waste or domestic sewage

The sensitivity of both receptors is negligible.

Contamination of water or seabed sediments with municipal waste or domestic sewage is a direct negative impact of a local range, which is short-term or momentary, reversible, repeatable during the exploitation phase, and of low intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters and seabed sediments.

Contamination of water and seabed sediments with accidentally released chemicals and waste from the operation of the OWF

During the exploitation phase of the OWF, the maintenance of its facilities will be carried out. The possibility of small quantities of waste or operating fluids being accidentally released into the sea cannot be excluded.

The waste most frequently generated in this phase of the project is waste from groups 13, 15, 16 and 17 of the Annex to the Regulation of the Minister of the Environment of 2 January 2020 on the waste catalogue (Journal of Laws of 2020, item 10).¹⁸⁵ It is necessary to comply with the required procedures concerning waste handling.

The sensitivity of both receptors in the case of this impact is moderate.

Contamination of water and/or seabed sediments related to the process of the operation of the OWF is a direct negative impact of a local range, short-term or momentary, non-reversible, repeatable during the exploitation phase, and of low intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters and seabed sediments.

Contamination of water and seabed sediments with compounds from anti-corrosion agents

Steel elements of foundations and/or support structures of the wind turbine and substations will corrode in the marine environment. Therefore, it will be necessary to apply appropriate safeguarding measures.

The most common anti-corrosion protection method used in the marine environment is cathodic protection. It can be implemented as galvanic or electrolytic protection.

Galvanic cathodic protection consists of the installation of aluminium and/or zinc anodes on foundations or support structures. The anodes gradually wear out and the aluminium or zinc is transferred to water and accumulates in the seabed sediments.

Zinc is the most commonly used steel protector against seawater. Its current efficiency reaches 90% at a relatively low production cost. The disadvantage of zinc is a small potential difference compared to steel, amounting to approx. 0,25 V. Zinc (Zn) is used as pure metal (99.99%, with a limited

¹⁸⁵ Southall B.L., Finneran J.J., Reichmuth C., Nachtigall P.E., Ketten D.R., Bowles A.E., Ellison W.T., Nowacek D.P., Tyack P.L., Marine mammal noise exposure criteria. Updated scientific recommendations for residual hearing effect. *Aquatic Mammals* 2019, 45 (2): 125-232

pollutant content of Fe, Cu and Pb) or as a metallic matrix containing: Zn + 0.1%-0.15% Hg, Zn + 0.12%-0.18% Al + 0.05%-0.1% Cd, Zn + ca. 0.5% Al + ca. 0.1% Si.¹⁸⁶

Aluminium is used only in the form of alloys: with zinc (3%-6% Zn), with tin (0.1%-1% Sn), with Zn + In, Zn + Hg, Zn + Sn. The current efficiency of these alloys is high, ca. 80%. Aluminium alloys are used in the same manner as zinc. They belong, next to zinc and its alloys, to low-potential protectors¹⁸⁷.

The advantages of the galvanic cathodic method are the independence from current sources, ease of installation, possibility of local protection and low impact on neighbouring structures. However, the most important disadvantages include: the irreversible loss of anode material, the possibility of contamination of the environment with corrosion products of the protector, the limited use due to the environmental resistance, and the low protective current.

In the initial period of operation, the emission of zinc and aluminium from anodes will not be observed. This process will take place over time and will progress with the increasing degree of damage to the protective coating on the components subject to corrosion protection. It is assumed that the entire anodes dissolve during the period of approx. 20 years. The metals in question will first be transferred to water, in which they can undergo precipitation and accumulate in the sediment. This applies in particular to aluminium compounds, as their solubility in natural waters (with pH of approx. 8) is very small. They will be largely adsorbed by seabed sediments in the form of stable compounds. Zinc compounds may be present in water longer than aluminium, as most of them are soluble in water. Zinc will be adsorbed and co-precipitated with hydrated Fe, Mn and Al oxides, present in sediments, however, this process will take place slowly due to the low content of silty minerals in the area of the BC-Wind OWF, which favour zinc adsorption.¹⁸⁸

Ecotoxicity tests have shown a significant toxicity of aluminium to aquatic organisms such as algae, fish and first-order consumers.¹⁸⁹ Excess aluminium causes decalcification and deformation of bones, as well as anaemia and hardening of cellular membranes.¹⁹⁰ Harmful effects on fish are probably associated with the process of precipitation of this metal on gills as a result of defensive mechanisms (e.g. release of neutralising compounds Al^{+3}).¹⁹¹ The biological role of aluminium for humans has not yet been fully discovered, but it is suspected that it may cause Alzheimer's disease. Aluminium accumulates in the brain.^{192, 193}

Zinc is one of the more mobile metals in sediments, influenced by its replaceable forms as well as its binding with organic substances.¹⁹⁴ It regulates the metabolism of carbohydrates and proteins in plants. Its excess ($100-400 \text{ mg} \cdot \text{kg}^{-1}$ depending on the species) causes the development of chlorosis and necrosis. This phenomenon is related to iron shortage and photosynthesis inhibition. In vertebrate organisms, zinc also contributes to the metabolism of proteins and carbohydrates, to the detoxification of heavy metals in cells, and to the increases in the activity of enzymes and hormones. Zinc has also a positive effect on brain activity, tissue regeneration and wound healing. On the other hand, in the case of acute zinc poisoning, copper blood deficit, hypocalcaemia, pancreatic inflammation, vomiting, diarrhoea and kidney damage may occur.¹⁹⁵

¹⁸⁶ Surowska B., *Wybrane zagadnienia z korozji i ochrony przed korozją*. Politechnika Lubelska, Lublin 2002

¹⁸⁷ Surowska B., *Wybrane zagadnienia z korozji i ochrony przed korozją*. Politechnika Lubelska, Lublin 2002

¹⁸⁸ Alloway B.J., Ayres D.C., *Chemiczne podstawy zanieczyszczenia środowiska*. Wydawnictwo Naukowe PWN, Warszawa 1999

¹⁸⁹ Klöppel H., Fliedner A., Kordel W., *Behaviour and ecotoxicology of aluminium in soil and water – review of the scientific literature*. Chemosphere 1997, 35: 353-363

¹⁹⁰ Migaszewski Z.M., Gałuszka A., *Podstawy geochemii środowiska*. Wydawnictwa Naukowo-Techniczne, Warszawa 2007

¹⁹¹ Kabata-Pendias A., Pendias H., *Biochemia pierwiastków śladowych*. PWN, Warszawa 1993

¹⁹² Epstein S.G., *Human exposure to aluminium*. Environ. Geochem. Health 1990, 12 (1-2): 65-70

¹⁹³ Migaszewski Z.M., Gałuszka A., *Podstawy geochemii środowiska*. Wydawnictwa Naukowo-Techniczne, Warszawa 2007

¹⁹⁴ Kabata-Pendias A., Pendias H., *Biochemia pierwiastków śladowych*. PWN, Warszawa 1993

¹⁹⁵ Migaszewski Z.M., Gałuszka A., *Podstawy geochemii środowiska*. Wydawnictwa Naukowo-Techniczne, Warszawa 2007

In the case of electrolytic cathodic protection, the protected object becomes a cathode of an electrolytic cell supplied with direct current from an external source. The anode used in this circuit is most often insoluble. The most durable anode materials used in this method are platinum and titanium electrodes covered with a 2-3 μm platinum layer. When electrolytic cathodic protection is used, no impact on the quality of water and sediments is observed.

If electrolytic cathodic protection is used, metal (Al, Zn) emissions to the water environment will not be observed due to the use of insoluble anodes. This impact was not assessed.

The most important parameters affecting the impact level are the type and quantity of released elements, the water quality in the project area, and the type of rock material forming the seabed.

The sensitivity of both receptors in the case of this impact is moderate.

Contamination of the environment with aluminium or zinc released during the exploitation phase with the use of galvanic cathodic protection is a direct negative impact of a local range, long-term, irreversible, permanent, and of medium intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters and seabed sediments.

Temperature change of seabed sediments and seawater through the reception of heat from transmission cables

The electric current flowing through a power cable causes its heating related to power losses due to resistance, in accordance with Joule's law. As the temperature of the cable increases above the ambient temperature, the transfer of heat commences from the cable to the surrounding environment.

A precise quantification of the dissipated heat is difficult because of phenomena such as conductivity, convection and heat radiation, subject to various physical laws.¹⁹⁶

Increasing the temperature of sediments in which the cable is buried and the interstitial waters (the water filling the spaces between sand grains in the sediment) may cause:

- increased bacterial activity resulting in accelerated decomposition of organic matter;
- a decrease of oxygen content in water;
- a release of harmful substances, including metals, from sediment into water;
- adverse effects on benthic organisms.

The most important parameters affecting the impact level are the depth of cable burial and the type of seabed.

For example, in the operating Nysted Offshore Wind Farm, the temperature increase emitted by the transmission cable (132 kV) buried at a depth of 1 m did not exceed 1.4°C in the layer of 20 cm above the cable, and the temperature changes were already imperceptible on the seabed surface.¹⁹⁷ This cable was buried in gravel sediment, which tends to cause much higher heat loss in interstitial spaces between sediment grains than in the case of fine-grained sediment.¹⁹⁸ Both types of sediment are common in the area of the BC-Wind OWF. It should be assumed that the dissipation of heat (24·h⁻¹·m⁻¹ on the cable surface) emitted by inner-array 33 or 66 kV cables belonging to the BC-Wind OWF will be smaller than (or, at most, similar to) that recorded in the Nysted OWF.

Heating of the seabed sediment and interstitial waters may also favour the transfer of metals from the sediment to the water depth and accelerate the processes of decomposition of organic pollutants in the seabed sediment. In fact, benthic fauna is naturally adapted to large, seasonal

¹⁹⁶ Rakowska A., Grabowski A., Stiller J., *Oddziaływanie linii kablowych najwyższych napięć prądu przemiennego (AC) na środowisko. Instytut Elektroenergetyki Politechniki Poznańskiej, Poznań 2006*

¹⁹⁷ Merck T., *Assessment of the environmental impacts of cables. Biodiversity Series No. 437/2009. OSPAR Commission, London 2009*

¹⁹⁸ Merck T., *Assessment of the environmental impacts of cables. Biodiversity Series No. 437/2009. OSPAR Commission, London 2009*

temperature changes and is insensitive or shows very low sensitivity to a temperature increase of 2°C.¹⁹⁹ According to the standards proposed by the German Federal Agency for Nature Conservation, the increase of temperature caused by the heat emission of an OWF transmission cable in a layer 20 cm below the seabed, which is the main habitat of the infauna, must not exceed 2°C.

The heat emission above the BC-Wind OWF cables in the sediment will be local and the effect will be imperceptible if the cable is buried deeper than 1 m, which is compliant with the technical assumptions of the project for the inner-array power cables, which are to be buried at a depth of up to 3 m.

Heat emission from the cables is a direct, negative impact of a local range, long-term, irreversible, constant during the exploitation phase, and of difficult to determine intensity due to the lack of data. There is a limited number of field surveys and literature reports on operational submarine cables and the increase in temperature of seabed sediment and near-seabed water layer caused by them, as well as the impact of this phenomenon on their quality.

Therefore, it is only possible to estimate the significance of this impact during the exploitation phase.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for seawater and seabed sediments.

Impact on the access to raw materials and deposits

The planned project is located within the prospective crumbstone raw material area II – the Baltic seabed coastal zone. The presence of the components of the BC-Wind infrastructure will prevent access to the area and its possible exploitation.

Given the occupation of the BC-Wind OWF Development Area in the field of the aforementioned deposit, an area of 79.1 km², representing only 2.2% of its total area, will be excluded from exploitation.

Given the small area occupied by the BC-Wind within the crumbstone raw material area II, the impact during the exploitation phase of the WWR 2024 can be assessed as negligible.

9.2.3. Decommissioning phase

Impacts occurring during the closure and decommissioning phase of the project will be similar to the impacts present during the construction phase (see Subchapter 9.2.1), but they will be less intense. The extent of interference in the seabed will not be as major as in the case of driving foundation piles and/or support structures into the seabed. Some structural elements may be left on and in the seabed. Transmission cables may be completely or only partially removed or left in the seabed.

Changes within the seabed associated with the impact of the project will be local and, within the entire area occupied by the project, insignificant for the geological composition of the seabed and the structure of its deposits.

Depending on its structure, the seabed may exhibit different sensitivity to the impact of the project during its closure and decommissioning phase. The seabed composed of till and till with a stone cover is difficult to wash out and withstands morphological changes. A sandy, silty, and silty seabed is more susceptible to washout and material displacement over it, e.g. in the form of sand waves. Thus, the elements of the BC-Wind infrastructure left in the seabed may be uncovered or buried as a result of both the natural processes transporting rock material over the seabed, and as a result of this transport being disturbed by the remaining components of the BC-Wind infrastructure and changes in the seabed relief resulting from the removal of the components of the BC-Wind infrastructure.

¹⁹⁹ Birklund J., Anholt Offshore Wind Farm. Benthic Fauna. Baseline Surveys and Impact Assessment. Final Report. DHI Group, 2009

The overall impact of the project during the closure and decommissioning phase can be preliminarily assessed to be negligible.

9.3. IMPACT ON MARINE WATERS, INCLUDING THE QUALITY OF MARINE WATERS

9.3.1. Construction phase

Impact on the quality of marine waters

Construction works undertaken during the construction phase may cause various types of impacts on water and its quality, such as:

- the release of pollutants and nutrients from sediments to water,
- the increase in water turbidity and the spread of suspended solids,
- the contamination of water with oil derivatives,
- the contamination of water with antifouling agents,
- the contamination of water with accidentally released municipal waste or domestic sewage,
- the contamination of water with accidentally released chemicals and waste originating from the construction of the BC-Wind OWF.

The impacts listed above are described further in Subchapter 8.2.1. The key findings are cited below.

Release of pollutants and nutrients from sediments into water

The disturbance of seabed sediments associated with the construction (placing) of foundations or support structures for the purposes of OWF facilities, anchoring of vessels or cable burial, is a process which contributes to pollutants passing from sediments into water.

The sensitivity of the marine waters was assessed to be moderate.

The release of pollutants and nutrients from seabed sediments during the construction phase is a direct negative impact of a regional range, short-term, reversible or irreversible, repeatable during the construction phase, characterised by low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be insignificant for marine waters.

Water turbidity and spread of suspended solids

The water turbidity caused by the resuspension of suspended solids during excavation work is a direct negative impact of a regional range, short-term, reversible, and of low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be insignificant for marine waters.

Contamination of water with oil derivatives during normal operation of vessels in the course of construction and at the time of their breakdown or collision

The sensitivity of marine waters to small spills of oil derivatives occurring during the normal operation of vessels was assessed to be insignificant.

Contamination of marine waters with oil derivatives released during normal operation of vessels is a direct negative impact of a local range, momentary or short-term, reversible, repeatable, and of low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be negligible for marine waters.

Leakage of oil derivatives resulting in the contamination of water may also occur in emergencies (as a result of a breakdown or a collision of vessels, a construction disaster of one of the BC-Wind OWF facilities, as well as during maintenance works). The sensitivity of marine waters can be high in emergency or collision situations.

Contamination of seawater with oil derivatives released in an accident is a direct negative impact of regional range, short-term, reversible, repeatable, and of high intensity.

The significance of this impact during the construction phase of the WWR 2024, due to the random and sporadic nature of breakdowns and collisions, was assessed to be insignificant for marine waters.

Accidental contamination of marine waters with antifouling agents containing organotin compounds (e.g. TBT)

The sensitivity of marine waters to biocides released from hulls was determined to be moderate.

Contamination of water with antifouling substances during the construction phase forms a direct negative impact of a local or regional range, short-term, reversible, repeatable during the construction period, and of low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be negligible for marine waters.

Contamination of waters by accidental release of municipal waste or domestic sewage

The sensitivity of waters to this impact is negligible.

The contamination of seawater with municipal waste or domestic sewage is a direct negative impact of a local range, short-term or momentary, reversible, repeatable during the construction period, and of low intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be negligible for marine waters.

Contamination of waters by accidentally released chemicals and waste from the construction of the OWE

The sensitivity of waters in the case of this impact is moderate.

The contamination of seawater connected with the OWE construction process is a direct negative impact of a local range, short-term or momentary, irreversible, repeatable during the construction period, and of medium intensity.

The significance of this impact during the construction phase of the WWR 2024 was assessed to be negligible for marine waters.

9.3.2. Exploitation phase

Impact on the quality of marine waters

During the exploitation of the BC-Wind OWE, works affecting the quality of marine waters will be carried out in its area. These will mainly be service works and interventions in case of an emergency situation.

It was found that during their exploitation phase, offshore wind farms may cause various **types of impacts** on the waters. These include:

- pollutants and nutrients passing from sediments to water, water turbidity,
- contamination with oil derivatives,
- contamination with antifouling agents,
- contamination with accidentally released municipal waste or domestic sewage,
- contamination with accidentally released chemicals and waste originating from operating and servicing the BC-Wind OWE,
- contamination with compounds from anti-corrosion agents,
- temperature change of the waters through the reception of heat from transmission cables.

The impacts listed above are described further in Chapter 8.2. The key findings are cited below.

In addition, due to the presence of OWF structures, water velocities, flow directions and water pressure in the immediate vicinity may be modified.

Release of pollutants and nutrients from sediments into water, water turbidity

During the operation of the BC-Wind OWF, works causing the disturbance of seabed sediments (including water turbidity), e.g. the maintenance of foundations and cables or the anchoring of vessels, will be carried out. They will boost the transfer of pollutants and nutrients from sediments to water.

The sensitivity of waters to this impact was assessed to be negligible.

The release of pollutants and nutrients from seabed sediments and the resulting turbidity during the exploitation phase is a direct negative impact of a local range, short-term, reversible, repeatable during the exploitation phase, and of low or medium intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be insignificant for marine waters.

Contamination of water with oil derivatives during normal operation of vessels in the course of construction and at the time of their breakdown or collision

The contamination of marine waters with oil derivatives released during the normal operation of vessels during the operation of the BC-Wind OWF is a direct negative impact which is local, temporary or short-term, reversible, repeatable during the exploitation phase, and of low intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters – or moderate in the case of a breakdown or collision.

Accidental contamination of water with antifouling agents containing TBT

The contamination of water with antifouling substances during the exploitation phase is a direct negative impact of a local range, short-term, reversible, repeatable during the operation of the OWF, and of low intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters.

Contamination of water by accidental release of municipal waste or domestic sewage

The sensitivity of marine waters to this impact is negligible.

Contamination of water with municipal waste or domestic sewage is a direct negative impact of a local range, which is short-term or momentary, reversible, repeatable during the exploitation phase, and of low intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters.

Contamination of water with accidentally released chemicals and waste from the operation of the OWF

The sensitivity of marine waters in the case of this impact is moderate.

Contamination of water related to the process of the operation of the OWF is a direct negative impact of a local range, short-term or momentary, non-reversible, repeatable during the exploitation phase, and of low intensity.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters.

Contamination of water with compounds from anti-corrosion agents

The sensitivity of marine waters in the case of this impact is moderate.

Contamination of the environment with aluminium or zinc released during the exploitation phase with the use of galvanic cathodic protection is a direct negative impact of a local range, long-term,

irreversible, permanent, and of medium intensity. However, this impact will not occur as no galvanic cathodic protection will be used. Anti-corrosion coatings and active cathodic protection will be utilised instead, which do not generate any waste.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for marine waters.

Temperature change of seawater through the reception of heat from transmission cables

Heat emission from the cables is a direct, negative impact of a local range, long-term, irreversible, constant during the exploitation phase, and of difficult to determine intensity due to the lack of data.

The significance of this impact during the exploitation phase of the WWR 2024 was assessed to be negligible for seawater and seabed sediments.

Impact on the dynamics of marine waters

As part of the assessment of the impact of the project on marine waters, wave motion and sea currents were analysed. The results of the performed measurements show that in the area of the BC-Wind OWF, the velocities and directions of water flows constantly change. As a result of the construction of offshore wind farms in this area, these flows may change. This may be influenced by factors such as:

- the number of wind farms, the distance between them, and their distribution arrangement;
- the dimensions and shape of individual OWF towers;
- the type and dimensions of foundations or support structures;
- flow field characteristics (velocities, prevailing directions, etc.);
- the structure of the seabed, with particular consideration of surface gradients and natural obstacles.

As a result, the velocities and directions of water flow and pressure in the direct vicinity of each structure may change, which will manifest itself in a local increase in water flow velocity due to the narrowing of the flow stream and formation of whirlpools around the structure. The whirlpools can be formed both downstream and directly upstream the obstacle. The range of the support structure impact on water flows in the water depth is only equal to several diameters of this structure, i.e. not more than several dozen metres. However, the distances between individual wind turbines will amount to at least 4 rotor diameters, i.e. they will exceed the range of this impact several times. This means that overlapping of these impacts should not be expected and that the disturbances will only be local.

The resulting modifications of the wave motion can be noticed only in the close vicinity of individual wind turbines. However, these are of local nature and should not occur outside the area of the BC-Wind OWF.

Wind waves on the free sea surface, encountering obstacles in the form of wind turbine towers, flow around them while losing part of their energy. If the diameters of the OWF towers are smaller than one fifth of the length of the waves propagating in their direction²⁰⁰, such towers may be treated as streamlined structures. This means that they will not cause a significant disturbance of the wave field. Otherwise, the waves, approaching the structure from the windward side, will be partially refracted, and on the leeward side – diffracted, i.e. subject to symmetrical deflection of the wave radius behind the encountered obstacle. There is no wave motion in the shadow area, i.e. directly behind the obstacle encountered by the waves, but water whirlpools may occur in such places. However, upstream the construction, the refracted waves interfere with the incoming waves, as a result of which standing waves are formed. As a consequence, when applying the linear theory for simplification reasons, vertical orbit velocities double immediately upstream the structure. If the duration of these waves is long enough to affect the seabed, they may, in connection with sea currents, contribute to entraining the sediment from the seabed and, consequently, lead to erosion in the immediate vicinity of the foundation or support

²⁰⁰ Massel S. (red.), *Poradnik hydrotechnika. Obciążenia budowli hydrotechnicznych wywołane przez środowisko morskie*. Wydawnictwo Morskie, Gdańsk 1992

structure. The resulting disturbances of wave motion can only be noticed in the leeward zone. However, these are of local nature and should not occur outside the area of the BC-Wind OWF. The impact of wind turbines on the wave field and the sea current field will be local and will not be of primary significance for these elements.

The BC-Wind OWF is located outside of the Słupsk Furrow marine area, through which oxidised and more saline waters from the North Sea are transported, and which, after rare, but very important for the Baltic Sea ecosystem inflows, propagate through the Słupsk Furrow to the Gdańsk and Gotland Deeps. The BC-Wind OWF will not affect these processes.

The significance of the impact of the BC-Wind OWF on the dynamics of marine waters during the exploitation phase of the WWR 2024 was assessed to be negligible.

9.3.3. Decommissioning phase

During the decommissioning phase, most of the OWF facilities will most likely be removed from the seabed, in accordance with international regulations for offshore systems and structures (United Nations Convention on the Law of the Sea – UNCLOS). These regulations define the conditions for the removal of components and systems of offshore wind farms in continental shelf areas and Exclusive Economic Zones. Decommissioning works should be carried out in such a manner that they do not hinder navigation and do not adversely affect the marine environment.

These standards also define exceptional situations in which there is no obligation to completely remove infrastructure components. It is possible to leave such components when:

- the weight of the foundation in the air exceeds 4000 tonnes or it is located at a depth of more than 100 m, provided that it does not hinder the use of maritime areas for the purposes of other sectors of the economy;
- the removal of the components is technically impossible or too expensive;
- there is a threat to the life of the OWF decommissioning personnel;
- the decommissioning involves an unacceptable risk of pollution to the marine environment.

In certain locations, such as straits or archipelago waters, used for international navigation, it is necessary to completely remove the systems and structures of the facilities, without any exceptions.

If some components are left on the seabed, relevant surveys should be carried out to determine whether the remnants of the OWF will not interfere with vessel traffic and will not have a negative impact on biotic and abiotic elements of the environment. It must be ensured that the construction elements left on the seabed will not be relocated under the influence of waves, tides, currents and storm surges, posing a risk to marine navigation.

The impacts on the discussed receptors (water and seabed sediments), to occur during the decommissioning phase of the BC-Wind OWF, are expected to be identical to those to occur during the construction phase (see Subchapter 8.3.1).

Release of pollutants and nutrients from sediments into water

As a result of the disturbance of seabed sediments during the decommissioning of the OWF, pollutants and nutrients may be released.

During the extraction of foundations and/or support structures and cables from the seabed, the impact on the quality of marine waters will be similar to that caused by embedding the foundation and/or support structures in the seabed during the construction phase. If foundations and/or support structures remain in the seabed sediment, the impact on the quality of marine waters will be negligible.

The release of pollutants and nutrients from the sediment into the water during the decommissioning phase has a direct negative impact of a regional range, short-term, reversible, repeatable, and of medium to large intensity, depending on the location.

The significance of this impact during the decommissioning phase of the WWR 2024 was assessed to be insignificant for the quality of marine waters.

Contamination of water with oil derivatives during normal operation of vessels in the course of construction and at the time of their breakdown or collision

As a result of intense traffic of ships and vessels during the decommissioning of the OWF, small oil spills and breakdowns or collisions may occur.

Contamination of marine waters and seabed sediments with oil derivatives released during the normal operation of vessels is a direct negative impact of a local range, momentary or short-term, reversible, repeatable, and of low intensity.

The significance of this impact during the decommissioning phase of the WWR 2024 was assessed to be negligible for the quality of marine waters.

Contamination of seawater with oil derivatives released in an accident is a direct negative impact of a regional range, short-term, reversible, repeatable, and of high intensity.

The significance of this impact at the decommissioning phase of the WWR 2024, due to the random and sporadic nature of breakdowns and collisions, was assessed to be low or moderate for the quality of marine waters.

Accidental contamination of marine waters with antifouling agents

Contamination of water with antifouling substances during the decommissioning phase is a direct negative impact of a local or regional range, short-term, reversible, repeatable during the decommissioning period, and of low intensity.

The significance of this impact during the decommissioning phase of the WWR 2024 was assessed to be negligible for the quality of marine waters.

Contamination of waters by accidental release of municipal waste or domestic sewage

Contamination of water with municipal waste or domestic sewage is a direct negative impact of a local range, short-term or momentary, reversible, repeatable during the decommissioning period, and of low intensity.

The significance of this impact during the decommissioning phase of the WWR 2024 was assessed to be negligible for the quality of marine waters.

Contamination of waters by accidentally released chemicals and waste from the decommissioning of the OWF

During the decommissioning of the OWF, it seems inevitable that marine waters will become contaminated with waste from the process. The significance of this impact will depend on the method adopted for these works (ref. description of the decommissioning phase).

All waste should be neutralised in accordance with the applicable regulations concerning industrial waste.

Contamination of water related to the process of decommissioning the OWF is a direct negative impact of a local range, short-term or momentary, non-reversible, repeatable during the decommissioning period, and of moderate intensity.

The significance of this impact at the decommissioning phase of the WWR 2024 was assessed to be negligible for the quality of marine waters.

9.3.4. Impact on the state of the marine environment of the construction and exploitation phases according to the MSFD

The assessment of the impact of the project on the state of the marine water environment was carried out with regard to the current assessment of the state of marine waters based on the results of

research on biological and physico-chemical elements of the waters, obtained as part of the State Environmental Monitoring.

The status of the waters of the 27 sub-area Eastern Gotland Basin, within which the planned project is located, was taken into account.

The assessment of the status of the marine environment of sub-area 27 shows that good status has been achieved in the attributes: D1/D4 biodiversity/food chains – phytoplankton, zooplankton and chlorophyll a, D8 pollutants and pollution effects – radionuclides and micronucleus test and D9 harmful substances in fish and seafood – heavy metals. In the remaining attributes, good environmental status was not achieved or not assessed (Tab.9.5).

Tab. 9.5. Assessment of the state of the marine environment in 2022 (good environmental status – GES, inadequate environmental status – subGES, n.d. – no data, n.a. – indicator not applicable)

Sub-area	Sub-area name	D1/D4							D6	D3	D5	D8				D9		D10
		Fish – PMF]*	Fish – LFI	Fish – key species and trophic	Phytoplankton	Zooplankton	Macrozoobenthos	Chlorophyll a				Radionuclides	Heavy metals	POPS	Micronucleus test	Heavy metals	POPS	
27	Eastern Gotland Basin	—	subGES	—	GES	GES	subGES	GES	subGES	subGES	subGES	GES	subGES	subGES	GES	GES	subGES	n.d.

D1 – Biodiversity, D3 – Commercially exploited fish and invertebrate species, D4 – Food chains, D5 – Eutrophication, D6 – Seabed integrity, D8 – Contaminants and pollution effects, D9 – Harmful substances in fish and seafood, D10 – Marine litter

Source: Zalewska and Kraśniewski (eds.), 2023

The assessment of the impact of the planned project on water quality was made under the assumption that the current state of the waters does not deteriorate, with reference to the assumed environmental objectives with targeted measures to achieve a good environmental status for the marine environment. The current set of environmental objectives for marine waters was adopted by the Regulation of the Minister of Infrastructure of 25 February 2021 on the adoption of an update of the set of environmental objectives for marine waters (Journal of Laws of 2021, item 569).

In the table below, with the individual environmental objectives assigned to the respective features, the potential impact of the planned project was analysed only for the construction and exploitation phases (Tab. 9.6). Impacts during the decommissioning phase of the project will be similar to those during the construction phase, but of a lower intensity.

Tab. 9.6. Assessment of impact on environmental targets set for individual features of marine waters

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
I. STATUS FEATURES					
1.	Feature D1 – Biodiversity is maintained. The quality and occurrence of habitats and the distribution and diversity of species correspond to the prevailing physiographic, geographic and climatic conditions of the Baltic Sea region.	Reduce or maintain anthropogenic pressure at a level that ensures the maintenance of natural habitats in which the natural biodiversity of the biotic elements present is maintained, including in fisheries, and habitat protection within Natura 2000 sites is ensured.			
		Criterion D1C1 (baseline):	Comprehension of the extent of by-catch of species listed in Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Official Journal of the EU L 20 of 26 January 2010, p. 7, as amended), hereinafter referred to as the Birds Directive, and Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Official Journal of the EU L 206, 22 July 1992, p. 7, as amended – Polish Special Edition, Chapter 15, Vol. 2, p. 102), hereinafter referred to as the Habitats Directive, in order to implement measures to minimise its effects and to restore and maintain natural, stable populations of species.	Not applicable.	Not applicable.
		Criterion D1C2 (core):	Maintenance of populations of the species listed in the Birds Directive and the Habitats Directive, corresponding to natural physical, geographical and climatic conditions, by aiming to reduce the main factors that reduce the	Impact on Natura 2000: - The BC-Wind OWF Area is located outside the boundaries of the protected areas indicated in the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2004, No. 92, item 880, as amended) including	During the exploitation phase, impacts within habitats, feeding and spawning grounds will be associated with: - the generation of continuous noise by operating wind turbines (permanent impact) and vessels

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
			abundance or welfare of the populations of these species, such as bycatch in fishing nets, direct elimination from the environment or the introduction of biogenic, synthetic, non-synthetic substances and energy sources, including underwater noise.	the European ecological network Natura 2000 (Natura 2000 sites are located at a distance of from 11.45 to 63.6 km); - As a result of the assessment of the impact of the planned project on Natura 2000 sites and the coherence of the Natura 2000 network, taking into account the range and nature of impacts, both from the BC-Wind OWF and in the case of cumulative impacts with impacts from other projects, it was indicated that no Natura 2000 sites are within the range of impacts; - No impacts particularly affect the objects of conservation (ichthyofauna, bird species, harbour porpoise and marine habitats) for the protection of which there were established areas, within these areas.	(intermittent impact) performing maintenance work; - the creation of new habitats – the reef effect; - the creation of barriers on migration routes; - the risk of collision with the OWF wind power plants.
		Criterion D1C3 (secondary):	Maintenance of population status of the species listed in the Birds Directive and the Habitats Directive, corresponding to natural physical, geographical and climatic conditions, by reducing the main pressures such as disturbance of species, direct elimination from the environment, including bycatch in nets, and the introduction of biogenic, synthetic and non-synthetic substances into the environment.		Fish: - noise: the impact of noise during the exploitation phase will not be as significant as during the construction phase, the significance of this impact was assessed to be negligible for all examined fish species; - the area of the BC-Wind OWF does not constitute important spawning grounds; herring spawning may occur in the area, but a possible disturbance of the spawning process will not affect the recruitment of this species at the population level; - the reef effect – new habitats: support structures, together with the stone cover, will create an artificial reef which, through the colonisation by benthic communities, can create a rich food base, shelter and favourable conditions for the reproduction of many fish species; the significance of the impact was assessed to be negligible for all fish species;
		Criterion D1C4 (primary):	The geographical distribution and range of species listed under the Birds Directive and the Habitats Directive should be given a near-natural range and condition by aiming to reduce the main pressures, such as disturbance of species, direct elimination from the environment, including by-catch in nets, or the introduction of biogenic, synthetic and non-synthetic substances into the environment.	During the construction phase, impacts within habitats, feeding and spawning grounds will be associated with: - the generation of impulsive noise (piling of foundations) and continuous noise (vessels underwork); - the turbidity of the water column during excavation works; - the passage of pollutants and nutrients from sediments into water during installation works; - the disturbance of space above the marine area.	
		Criterion D1C5 (core):	Reduction of pressure factors associated with permanent and temporary changes within habitats and the introduction of nutrients, synthetic, non-synthetic substances and energy, including underwater noise. Taking steps to revitalise degraded marine areas and protect threatened biotopes.	Fish: - noise: during the works, fish will be	- creation of a barrier: the presence of the OWF structure may constitute a migration barrier for economically important fish, the routes of which run through the area of the planned project;

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				scared and disturbed – the base reaction of the fish will be to escape to work sites; - these impacts will be negative, direct, short-term, and will go beyond the BC-Wind OWF noise area (regional); - the significance of this impact was assessed as moderate for all fish species; - in the case of protected fish (presence of larvae in the area of the project), the impact will be local; - in the context of spawning grounds, the impact will be negligible – the OWF area does not constitute significant spawning grounds (no cod or flounder spawning occurs in the area); - turbidity of the water column - during construction works, the turbidity of the water column will increase; - due to the avoidance reaction of adult fish, sublethal rather than lethal impacts should be expected; - the increase in the concentration of suspended matter will affect small areas in relation to feeding areas, and the impact of this factor will be short-term and local; - this impact was considered negligible for all studied species of fish; - resuspension of pollutants – as sediment is disturbed, pollutants will pass into the water; - due to the low concentrations of pollutants in the sediment, the significance of this impact was considered negligible for all species of fish;	- due to the possibility of active movement of fish, the structures will not significantly disrupt migration processes; - the significance of impact was assessed to be negligible for all surveyed fish species. Marine mammals: - noise: when the turbines are in operation, the vibrations generated by the generator and gearbox will be transmitted through the foundation/supporting structure into the water; - considering the installation of newer turbines with direct drive technology, the level of generated noise will be lower, especially underwater; - noise impact in the context of the harbour porpoise and grey and common seals was assessed to be of minor significance; - maintenance works will result in an increase in continuous noise levels, but this impact will be locally limited and of short duration, and was therefore assessed to be of minor significance; - the reef effect – the creation of an additional habitat with the presence of additional objects in the water, support structures that will form artificial reefs, potential feeding areas – was assessed to be of minor and negligible significance. Migratory birds: - barrier formation: the presence of the OWF will cause a barrier effect

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				- the impacts listed above will affect small areas in relation to the entire area of spawning and feeding grounds; - these impacts were considered negligible for all studied species of fish. Marine mammals: - noise: during pile driving works, the response of these species to the generated impulse noise will be to move away from the piling area – the works will also cause a disturbance in foraging and a change in mating behaviour; - sound levels generated during pile driving, despite the rare occurrence of mammals (seals and the harbour porpoise) in the area of the BC-Wind OWF, were assessed as significant; - the application of the soft start method and noise reduction systems will reduce the range of the impact of the noise; - the significance of these impacts will change, i.e.: for grey and common seals to minor to moderate, for the harbour porpoise to moderate; - continuous noise emissions from ship traffic during the construction phase are assessed to be of minor importance; - turbidity in the water depths: an increase in turbidity will be of a short-term duration, - this impact was assessed to be of minor significance.	on routes of migratory birds; - forcing a rerouting to avoid the BC-Wind OWF will lengthen migratory routes by 0.5% to 1%; - this impact was considered to be negligible for all groups of birds and species in the analysed area; - collision risk: the presence of the OWF will increase the risk of collisions (bird mortality); - the significance of this impact for a group of 19 migrating bird species was assessed as minor for the long-tailed duck, the common scoter and the velvet scoter, insignificant for geese, and negligible for the remaining bird species. Seabirds: - barrier formation – the operation of the OWF will result in the disturbance and displacement from the habitat of some birds residing in the area occupied by the power plants; - this impact was found to be negligible for the European herring gull, moderate for the razorbill and the guillemot, and significant for the long-tailed duck, the velvet scoter and common scoter; - wind turbine structures will act as a barrier to birds moving locally between feeding and resting areas – this impact will mainly affect migrating birds; - this impact was assessed to be negligible for the European herring gull, moderate for the razorbill and the guillemot, and significant for the long-tailed duck, the velvet scoter and the common scoter;

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				Migratory birds: - disturbance of space: during the construction phase, there will be a gradual disturbance of the space above the marine area; - the effects of this impact will be greater during the exploitation phase; - for the construction phase, this impact was assessed to be of minor significance. Seabirds: - noise: the presence and movement of vessels will be a major cause of disturbance to birds; - as a result of noise generation, there will be disturbance to fish, which constitute a base food source for diving ichthyophages; - this impact is considered negligible for the European herring gull, moderate for the razorbill and the guillemot, and significant for ducks – the long-tailed duck, the velvet scoter and the common scoter; - turbidity in the water depths – an increase in turbidity will result in a decrease in water clarity, which may cause difficulties for bird hunting, resulting in the displacement of birds preferring clearer waters; - this impact will be short-lived and its impact will be cancelled out by other, more intense disturbance causing birds to leave the area; - disturbance of space: during construction there will be a gradual disturbance of the space above the marine area, which will increase the	- risk of collision: the presence of the OWF will increase the risk of collision (bird mortality); - this impact will be direct, negative, and of local range; - this impact was assessed as negligible for the European herring gull, minor for the razorbill and the guillemot, moderate for the velvet scoter and the common scoter, and significant for the long-tailed duck. Impacts of a significant nature, mainly affecting birds (mainly ducks), will occur at a local level and, at the scale of the entire basin, will not result in deterioration of water status in terms of maintenance of habitat biodiversity.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				risk of collisions; - the effect will increase as more wind turbines are erected; - this impact is considered negligible for the European herring gull, moderate for the razorbill and the guillemot, and significant for ducks – the long-tailed duck, the velvet scoter and the common scoter. Impacts of a significant nature, mainly affecting birds (mainly ducks), will occur at a local level and, at the scale of the entire basin, will not result in a deterioration of water status in terms of maintenance of habitat biodiversity.	
		Criterion D1C6 (core):	Reduction of pressures from nutrient, synthetic, non-synthetic and organic matter inputs, to restore the natural structure and function of pelagic habitats.	The project does not affect the structure and function of the habitats of phytoplankton, zooplankton and cyanobacteria.	Not applicable.
		Criterion D6C4 (core):	Same as objectives for feature D6.	The loss of benthic habitats will occur in the whole Eastern Gotland Basin as a result of the construction works (laying of foundations, seabed cleaning and cable burial) in a total area of 2.6 km ² , which constitutes 0.02% of the area of the basin; the benthic habitats will recover within a few years and the level of biodiversity will be maintained due to the presence of the same species in the project area.	In the whole Eastern Gotland Basin, due to the installation of foundations/support structures and their protection by stone cover, there will be a permanent change to the seabed in an area of 0.104 km ² , which constitutes only 0.001% of the area of the basin; the newly created habitat will be colonised by organisms living in the area of the planned project, partially compensating for the habitat loss during construction.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				The impact will not cause a deterioration of the state of waters in terms of the biodiversity and functioning of benthic ecosystems.	The impact will not cause a deterioration of the state of waters in terms of the biodiversity and functioning of benthic ecosystems.
		Criterion D6C5 (core):	Same as objectives for feature D6.	- During the construction works, due to the disturbance of the seabed sediments, the resuspension of nutrients, pollutants and heavy metals will occur; - Due to low concentrations of the substances listed above in sediment, as well as the insignificant sensitivity of the representatives of the soft and hard seabed macrozoobenthos occurring in the area of the BC-Wind OWF, the passage of contaminants from the sediments to the water was assessed to be a negligible impact; - The aforementioned impacts will not adversely affect the abundance of macrozoobenthos and its species structure. The impact will not cause a deterioration of the state of waters in terms of the biodiversity and functioning of benthic ecosystems.	- During the exploitation phase, works causing local disturbance of seabed sediments will be carried out, e.g. the servicing of foundations, cables, and anchoring of vessels; - Due to the small scale of the seabed intervention works, compared to the construction phase, and the low concentrations of nutrients, contaminants and heavy metals in the sediment, this impact was assessed to be insignificant. The impact will not cause a deterioration of the state of waters in terms of the biodiversity and functioning of benthic ecosystems.
2.	Feature D4 – Occurrence of elements of the marine food chain in numbers and diversity at levels that ensure species diversity and maintain full reproductive capacity.	Reduce the impact of human activities to a level that allows the ecosystem to reach a state where all components of the marine trophic chain exhibit a natural and stable level of abundance and diversity, and where the productivity of the biotic components guarantees the proper functioning of the trophic network.			

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
		Criterion D4C1 (primary):	Limiting the introduction of nutrients and organic matter and the scale of exploitation of species listed in the Birds Directive and the Habitats Directive to a level that ensures the maintenance of natural diversity within trophic groups.	The construction of the planned project is not associated with the exploitation of species listed in the Birds and Habitats Directives, and impacts associated with the release of nutrients from the sediments into the water during construction works will be negligible due to their low concentrations.	The operation of the planned project is not associated with the exploitation of species listed in the Birds and Habitats Directives, and impacts associated with the release of nutrients from the sediments into the water during maintenance works will be negligible due to their low concentrations.
		Criterion D4C2 (primary):	Limiting the introduction of nutrients and organic matter and the scale of exploitation of species listed under the Birds Directive and the Habitats Directive to a level that ensures a balance in abundance between trophic groups.	In relation to the potential impact of the project on the different components of the trophic chain, an assessment was made of the impact on biodiversity and the structure of the trophic network, taking into account the pressures that will occur during the construction of the planned project.	In relation to the potential impact of the project on the different components of the trophic chain, an assessment was made of the impact on biodiversity and the structure of the trophic network, taking into account the pressures that will occur during the operation of the planned project.
		Criterion D4C3 (secondary):	Environmental objective: not to increase the pressure from nutrient and organic matter inputs and the scale of exploitation of species listed under the Birds Directive and the Habitats Directive to a level that ensures that the natural size distribution of individuals in the trophic group is maintained.	During the construction phase, impacts on the biodiversity of individual organism groups and the functioning of the trophic network will be related to: - the destruction and disturbance of benthic habitats; - the turbidity of the water column; - noise generation; - the barrier effect.	During the exploitation phase, impacts on the biodiversity of individual organism groups and the functioning of the trophic network will be related to: - the presence of artificial reefs formed by support structures protected by stone cover; - the presence of wind turbines.
		Criterion D4C4 (secondary):	Environmental objective: not to increase the pressure from nutrient and organic matter inputs and the scale of exploitation of species listed under the Birds Directive and the Habitats Directive to a level that ensures the natural productivity of trophic groups is maintained.	Macrozoobenthos: - the most negative impact causing a change in the biodiversity is the disturbance of the bottom and the structure of bottom sediments; - destruction of the seabed for foundations/supporting structures and cable excavations will cover a maximum of approx. 1.1 % of the	Macrozoobenthos: - the presence of support structures will create favourable conditions for the development of animal and plant epiphytic organisms; - as a result, there will be an increase in species diversity. Fish: - the presence of support structures will result in an increase in

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				construction area of the BC-Wind OWF; - the impact will not cause a significant change in the qualitative and quantitative structure of the benthic communities. Fish: - impacts that reduce diversity will be related to scaring and deterring fish due to noise generation and the increased concentration of suspended solids in the water depths; - a localised decline in diversity may occur throughout the construction period. Marine mammals: - impulse noise will be generated during piling in the construction phase; - due to the use of noise reduction systems, mammalian biodiversity will not be affected by construction works. Seabirds: - during construction works in the area of the BC-Wind OWF and its immediate vicinity, there may be a temporary change in the species structure of birds; - the most sensitive birds will be displaced and the number of ducks will gradually decrease as the works progress; - after the completion of the construction and the commencement of the operation of the OWF, some of the more	biodiversity; - a new habitat will be created, providing favourable conditions for the existence and reproduction of many fish species; - in addition, the reduction or cessation of fishing in the area of the OWF (legal regulations) may have a positive impact on biodiversity. Marine mammals: - the reef effect may contribute to an increase in the abundance of fish in the OWF area and, consequently, also marine mammals. Seabirds: - due to the presence of the wind turbines, the risk of collisions and mortality of seabirds will increase; - birds will be scared away and displaced from their habitats in the area occupied by the power plants; - the OWF may constitute a barrier on the migration routes for birds moving between Natura 2000 sites – this impact may be significant for sensitive seabird species; - adaptation of birds to the new conditions will result in changes in the structure and spatial distribution of birds (the number of long-tailed ducks may decrease, while the number of gulls and cormorants may increase); - the impact will be local, related to the area of the BC-Wind OWF and the buffer zone. The impact will be of local character and will not cause the

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				sensitive species (razorbill, sea ducks) may leave the area of the BC-Wind OWF and move to neighbouring feeding grounds; - due to the local range of the impact, limited to the area of the investment, the impact is considered insignificant. The impact will be of local character and will not cause the deterioration of water status in terms of the proper functioning of the trophic network.	deterioration of water status in terms of the proper functioning of the trophic network.
II. PRESSURE FEATURES					
3.	Feature D2 – Maintain alien species introduced into marine ecosystems as a result of human activities at levels that do not adversely alter those ecosystems.	Reduce the spread of alien species introduced into the environment as a result of human activities to ensure that alien species occur at levels that do not disturb the structure and functioning of the ecosystem, in particular for specific groups of species, areas particularly vulnerable to introduction and general habitat types, by taking appropriate action.			
		Criterion D2C1 (core):	Reduction of pressure from the introductions of alien species and limiting the potential for newly introduced alien species to spread from their original introduction sites.	Not applicable.	- The use of a stone cover around the monopile/truss structure, as well as the structure itself, will provide additional substrate on the seabed (will create a new habitat – the reef effect), which could potentially cause the appearance of alien species; - The effect of colonisation of stone covers and support structures by alien species is unlikely, due to the distance of the OWF from the land (approx. 25 km); - Areas that are particularly vulnerable to alien species are seaports, where ships call, the ballast water and hulls of which may be contaminated with plant and animal organisms; - Most likely, the new substrate will

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
					be colonised by native species, commonly found in the OWF area, which will partly compensate for the benthic communities destroyed during the construction works; - This impact was assessed to be insignificant. This impact will not cause the deterioration of water status in terms of the introduction of alien species.
		Criterion D2C2 (secondary):	Minimisation of new introductions of alien species and the scale of dispersal of alien species to reduce their negative impacts on ecosystem structure and functioning.	Not applicable.	Not applicable.
		Criterion D2C3 (secondary):	Reduction of the impact of invasive species to a level that ensures only minimal or no noticeable negative impact on the environment.	Not applicable.	Not applicable.
4.	Feature D3 – Maintain populations of all commercially exploited fish and shellfish within safe biological limits and distribution of these fish and shellfish populations by age and abundance indicative of good status.	The aim is to maintain commercially exploited fish and shellfish populations within safe biological limits consistent with natural conditions by ensuring that all commercially exploited fish stocks are exploited at or below the maximum sustainable yield level, ensuring that all commercially exploited fish are within safe biological limits, and by limiting or maintaining the exploitation of fish stocks at a level that maintains their full reproductive capacity and full range of age and size individuals.			

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
		Criterion D3C1 (core):	Maintenance of exploitation of all commercially exploited fish stocks at or below the maximum sustainable yield level, ensuring that all commercially exploited fish species are within safe biological limits.	The planned project is not related to fish and shellfish exploitation during its construction phase. - Due to the construction works, there will be restrictions on fish exploitation within 2 fishing squares through which the planned project runs, i.e. O8 and P8; - The development area of the BC-Wind OWF is of minor importance as a fishery for the main economically important species; therefore, there will be no reduction and deterioration of the populations of commercially exploited fish present in the area of the planned project; - In terms of fisheries, the impact will be negative (resulting from the fact that there are restrictions), direct and long-term (the assumed duration of the construction phase is 2 to 3 years – a maximum 5 years), and local; - the impact was assessed to be of minor significance. The impact will not cause the deterioration of water status in terms of population maintenance of commercially exploited fish.	The planned project is not related to fish and shellfish exploitation during its exploitation phase. - Due to the occupation of the marine area by the BC-Wind OWF, the area may be excluded from fishing; - If fishing is prohibited or restricted, the pressure on fishing species will decrease and fishing mortality will be reduced, which may contribute to an increase in the production of certain fish species; - This will be a permanent impact, local in nature, and will not cause a disturbance to commercially exploited fish populations; - This impact was assessed to be insignificant. The impact will not cause the deterioration of water status in terms of population maintenance of commercially exploited fish.
		Criterion D3C2 (core):	Maintenance of exploitation of all commercially exploited fish stocks at a level that ensures they remain at full reproductive capacity.	Not applicable.	Not applicable.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
		Criterion D3C3 (primary):	Limiting the exploitation of all commercially exploited fish stocks to a level that ensures that the full natural range of ages and sizes of individuals in the population is achieved.	Not applicable.	Not applicable.
5.	Feature D5 – Reduce human-induced eutrophication to the minimum, in particular adverse effects such as biodiversity loss, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters.	Maintain the inflow of annual nitrogen and phosphorus loads into the Baltic Sea through rivers and atmospheric deposition below the maximum inflow values (MAI) established under the regional arrangement (HELCOM), which will allow a reduction of nutrient concentrations in the sea to levels not exceeding acceptable threshold values, which are in accordance with the recommendations of existing national and European Union legislation, and which guarantee the achievement or maintenance of a good environmental status and do not cause adverse effects in the form of excessive algal growth, elevated concentrations of chlorophyll 'a' in the water column, decreased transparency of seawater and oxygenation levels in the bottom waters, which consequently promote the proper development of pelagic and benthic habitats.			
		Criterion D5C1 (baseline):	Maintenance of the current downward trend in the level of annual nitrogen and phosphorus loads deposited to the Baltic Sea by the waters of the Vistula River, the Oder River, the Pomeranian rivers and the Pomeranian Coastal Region, as well as the downward trend in the intensity of atmospheric deposition of nitrogen and phosphorus, in order to achieve a reduction in the concentrations of nutrients to levels not exceeding permissible threshold values, which are in accordance with the recommendations of the applicable national and international legal acts and which guarantee the achievement or maintenance of good environmental status.	Not applicable.	Not applicable.
		Criterion D5C2 (baseline):	Environmental objective: to maintain the decreasing trend of nitrogen and phosphorus compound inflows to the sea influencing the reduction of	Not applicable.	Not applicable.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
			excessive algal growth and, consequently, to reduce the concentrations of chlorophyll 'a' in the water column below acceptable threshold values, which are in line with the recommendations of the applicable national and international legislation.		
		Criterion D5C3 (secondary):	Environmental objective: to maintain a declining trend of nitrogen and phosphorus inputs to the sea to reduce excessive plankton growth, including toxic cyanobacteria blooms.	Not applicable.	Not applicable.
		Criterion D5C4 (secondary):	Maintenance of a decreasing trend in the inflow of nitrogen compounds, phosphorus compounds and organic matter into the sea, resulting in seawater clarity not reducing below acceptable threshold values, which are in line with the recommendations of existing national and international legislation, leading to the disturbance of submerged vegetation.	Not applicable.	Not applicable.
		Criterion D5C5 (baseline):	Achievement of a higher level of oxygenation in bottom waters, particularly in the deep sea, as a result of maintenance of the downward trend in the input of nitrogen and phosphorus compounds to the sea, which will translate into a reduction in the occurrence of conditions that increase oxygen consumption from bottom waters, mainly due to an excessive increase in the production of organic matter, resulting in the absence of negative impacts on seabed dwelling organisms and adjacent waters and reducing the	Not applicable.	Not applicable.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
			occurrence of internal recurrent enrichment of the ecosystem in phosphorus released from sediments.		
		Criterion D5C6 (secondary):	Reduction of the excessive proliferation of opportunistic macroalgae, leading to an imbalance in the benthic community, by maintaining the decreasing trend of nitrogen and phosphorus inputs to the sea.	Not applicable.	Not applicable.
		Criterion D5C7 (secondary):	Maintenance of the decreasing trend of nitrogen and phosphorus inputs to the sea in order to reduce adverse impacts resulting from decreased seawater transparency and reduced oxygenation of bottom waters, which will translate into an increase in the proportion of perennial species in the macrophyte community at the sites and an increase in the depth range of their occurrence.	Not applicable.	Not applicable.
		Criterion D5C8 (secondary):	Maintenance of the decreasing trend of nitrogen and phosphorus inputs to the sea in order to achieve an improvement in the state of the macrozoobenthic community at sea.	Not applicable.	Not applicable.
6.	Feature D6 – Maintain the integrity of the seabed at a level that ensures that the structure and function of benthic ecosystems are protected and not adversely affected in particular.	Reduce cumulative pressure on the seabed to a level that allows benthic habitats to function at near-natural levels.			
		Criterion D6C1 (primary):	Reduction of pressures associated with seabed loss.	- During construction works, the seabed structure will be disturbed and disrupted in the areas intended for foundations/supporting structures and cable trenches;	- There will be a permanent loss of benthic habitat at the site due to the presence of support structures, protected by stone cover, in the seabed;

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				- Taking into account the resulting disturbance, only 3.31% of the development area will be affected; - Due to the small scale of the interference and the localised extent, the impact is considered to be of minor significance. This impact will not cause the deterioration of water status in terms of the functioning of benthic ecosystems.	- These structures will create an additional substrate on the bottom – a new habitat (the reef effect); - Both the stone cover and the support structures will be colonised by native species, commonly found in the OWF area, which will partly compensate for the benthic communities destroyed during the construction works; - Loss of habitat is a negative impact, but due to its local extent, it was considered insignificant. This impact will not cause the deterioration of water status in terms of the functioning of benthic ecosystems.
		Criterion D6C2 (primary):	Reduction of physical pressures associated with seabed disturbance.	- Sediment resuspension and water turbidity will occur during construction works; - The sensitivity of macrozoobenthos habitats to this impact was assessed as insignificant for soft-bottom macrozoobenthos and low for hard-bottom macrozoobenthos; - The resulting impact will be of short-term duration and is comparable, in terms of reaching maximum suspended solids concentrations in the water depth, to concentrations that may occur naturally during storms. This impact will not cause the deterioration of water status in terms of the functioning of benthic ecosystems.	Same as above.
		Criterion D6C3 (core):	Reduction of cumulative pressures on habitats.	Same as above.	Same as above.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
		Criterion D6C4 (core):	Reduction of habitat loss to maintain a near-natural range.	The loss of benthic habitats will occur in the whole Eastern Gotland Basin as a result of the construction works (laying of foundations, seabed cleaning and cable burial) in a total area of 2.6 km², which constitutes 0.02% of the area of the basin; the benthic habitats will recover within a few years and the level of biodiversity will be maintained due to the presence of the same species in the project area. This impact will not cause the deterioration of water status in terms of the functioning of benthic ecosystems.	In the whole Eastern Gotland Basin, due to the installation of foundations/support structures and their protection by stone cover, there will be a permanent change to the seabed in an area of 0.104 km², which constitutes only 0.001% of the area of the basin; the newly created habitat will be colonised by organisms living in the area of the planned project, partially compensating for the habitat loss during construction. This impact will not cause the deterioration of water status in terms of the functioning of benthic ecosystems.
		Criterion D6C5 (core):	Reduction of the negative impact of anthropogenic pressures associated with, i.a., the introduction of biogenic, synthetic, non-synthetic substances and organic matter into the environment in order to maintain habitats, especially benthic habitats, in a near-natural state.	- During the construction works, due to the disturbance of the seabed sediments, the resuspension of nutrients, pollutants and heavy metals will occur; - Due to low concentrations of the substances listed above in sediment, as well as the insignificant sensitivity of the representatives of the soft and hard seabed macrozoobenthos occurring in the area of the BC-Wind OWF, the passage of contaminants from the sediments to the water was assessed to be a negligible impact; - The aforementioned impacts will not adversely affect the abundance of macrozoobenthos and its species structure. This impact will not cause the deterioration of water status in	- During the exploitation phase, works causing local disturbance of seabed sediments will be carried out, e.g. the servicing of foundations, cables, and anchoring of vessels; - Due to the small scale of the seabed intervention works, compared to the construction phase, and the low concentrations of nutrients, contaminants and heavy metals in the sediment, this impact was assessed to be insignificant. This impact will not cause the deterioration of water status in terms of the functioning of benthic ecosystems.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				terms of the functioning of benthic ecosystems.	
7.	Feature D7 – A permanent change in hydrographic characteristics that does not adversely affect marine ecosystems.	The environmental objectives for feature D7 were set at a general level for each of the assessment criteria contained in Commission Decision 2017/848 and at a specific level for the indicators used for the assessment in the update of the preliminary assessment of the environmental status of marine waters.			
		Criterion D7C1 (secondary):	Reduction of pressures associated with permanent changes in hydrographic conditions.	No changes of hydrographic conditions (including changes of wave and current activity) will occur during construction works. This impact will not cause the deterioration of water status in terms of hydrographic conditions.	- In the case of scouring protection in the form of stone cover in the area of monopiles/truss-type foundations, a localised impact on sediment transport and sedimentation processes is possible: scouring of the bottom in front of/behind BC-Wind infrastructure components, accumulations of sediment in front of/behind the infrastructure components (sand drifts); - This impact is considered to be very localised, limited to the locations of the aforementioned facilities; - Due to heat emission from the cables, there will be an increase in temperature in the surrounding area; - The emission of heat by the cables of the BC-Wind OWF in the sediment will be local and the effect will not be perceptible if the cable is buried deeper than 1 m, which is in accordance with the technical assumptions of the project for cable lines, which are to be buried to a depth of approx. 3 m; - These impacts are considered to be insignificant. This impact will not cause the deterioration of water status in

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
					terms of hydrographic conditions.
		Criterion D7C2 (secondary):	Reduction of cumulative pressures on habitats.	Same as above.	Same as above.
8.	Feature D8 – Maintain concentrations of pollutants at a level that does not cause marine pollution.	For each criterion of feature D8, an environmental objective has been defined taking into account all the elements included in that criterion.			
		Criterion D8C1 (primary):	Reduction or maintenance at current levels of inputs of pollutants from marine sources, including the application of measures to minimise releases of pollutants resulting from acute events, and land-based inputs to the marine environment, with the aim of achieving or maintaining concentrations of pollutants in biotic and abiotic components of the marine ecosystem at levels not exceeding acceptable threshold values, below which the likelihood of adverse effects of hazardous substances on marine organisms is minimal and which comply with the recommendations of existing national and international legal instruments and which ensure the achievement or maintenance of good environmental status.	- During the construction works, sediment will be disturbed, thus causing the resuspension of labile forms of metals, nutrients and pollutants present in it; - The disturbance of sediments and resuspension of contaminants will be a short-term process, and due to the very low concentrations of the aforementioned substances in the sediment, when passed into the water column, they will not adversely affect the quality of the water; - This impact was assessed to be insignificant. This impact will not cause the deterioration of water status in terms of pollution from marine sources.	- During the exploitation phase, anti-corrosion protection – cathodic protection – will be applied to the foundation/support structures. Cathodic protection can be galvanic or electrolytic; - In the case of applying galvanic protection – aluminium or zinc anodes – during the operation of the OWF, the anodes will gradually degrade and cause Al and Zn to pass into the water and accumulate in sediments – the Investor has decided against using this method; - This process will continue over the years (it is assumed that complete dissolution of the anodes occurs in approx. 20 years); - Aluminium or zinc contamination is a direct, negative impact of a local range, long-term, irreversible, permanent, of medium intensity; - The significance of this impact is considered to be negligible; - In the case of applying electrolytic cathodic protection, there will be no emission of metals (Al, Zn) to the

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
					aquatic environment due to the use of insoluble anodes; - The significance of this impact was assessed to be negligible. This impact will not cause the deterioration of water status in terms of pollution from marine sources.
		Criterion D8C2 (secondary):	Areas selected for long-term exposure to pollutants: the impact of pollutants on marine biota organisms at different levels: molecular, cellular, tissue, organ, individual, population taking into account cumulative and synergistic effects is at a level that guarantees the proper functioning of the organisms taking into account the preservation of normal physiological functions and thus guarantees the preservation of normal species structure and habitat range.	Same as above.	Same as above.
		Criterion D8C3 (baseline):	Polish sea areas defined by national borders: the occurrence of pollution emergencies involving pollutants as defined in Article 2(2) of Directive 2005/35/EC of the European Parliament and of the Council of 7 September 2005 on ship-source pollution and the introduction of penalties, including criminal penalties, for pollution offences, including oil and similar constituents, is reduced to a minimum through the implementation of appropriate measures at operational level and security systems.	- During construction works, there may be a release of pollutants as a result of: incidents at sea (collision, contact, grounding), oil spills, release of municipal waste or domestic sewage, release of biocidal substances, release of hazardous substances; - The probability of the occurrence of the aforementioned events is extremely low, therefore the effects of these accidents were assessed as negligible; - In the event of a potential occurrence of the aforementioned events, appropriate actions will be implemented at the operational and protection system level in order to neutralise pollution and minimise its	- During the operation of the BC-Wind OWF, there may be a release of pollutants as a result of: incidents at sea (collision, contact, grounding), oil spills, release of municipal waste or domestic sewage, release of biocidal substances, release of hazardous substances; - The probability of the occurrence of the aforementioned events is extremely low, therefore the effects of these accidents were assessed as negligible; - In the event of a potential occurrence of the aforementioned events, appropriate actions will be implemented at the operational and protection system level in order to

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
				impact on marine organisms in the shortest possible time. - This impact will not cause the deterioration of water status in terms of marine pollution; - This impact will not cause the deterioration of water status in the context of pollution and its impact on species structure.	neutralise pollution and minimise its impact on marine organisms in the shortest possible time. - This impact will not cause the deterioration of water status in terms of marine pollution; - This impact will not cause the deterioration of water status in the context of pollution and its impact on species structure.
		Criterion D8C4 (secondary):	Areas of occurrence of contaminants of an abrupt nature: the impact of pollutants from releases resulting from abrupt events on the structure of species (listed in Table 1 in Part II of the Annex to Commission Decision 2017/848) and the extent of habitats (listed in Table 2 in Part II of the Annex to Commission Decision 2017/848) is reduced to a minimum by implementing measures and safeguards to eliminate the occurrence of abrupt pollutants.	Same as above.	Same as above.
9.	Feature D9 – Maintain levels of contaminants in fish and shellfish intended for human consumption that do not exceed the levels specified in standards or regulations for levels of these substances.	To reduce or maintain at current levels the input of pollutants from various marine and terrestrial sources entering the marine environment in order to achieve or maintain concentrations of pollutants in fish and seafood intended for human consumption at levels not exceeding limit values that comply with the standards and recommendations of existing national and European Union legislation and that guarantee the safety of consumption and the achievement or maintenance of good environmental status.			
		Criterion D9C1 (primary):	For Polish marine areas: FAO 27.3d.25 (ICES 25*) (ICS: International Council for the Exploration of the Sea fishing grounds): concentrations of the contaminants or groups of contaminants listed in Commission Regulation (EC) No. 1881/2006 of	Same as above.	Same as above.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
			19 December 2006, setting maximum levels for certain contaminants in foodstuffs (OJ L 364, 20.12.2006, p. 5, as amended) measured in the specified matrices do not exceed the permitted levels defining the thresholds laid down in that Regulation. Concentrations of substances or groups of substances other than those listed in the aforementioned Regulation which may have a regional pollution effect and which have been identified at regional level as being relevant for the assessment of the environmental status, do not exceed the thresholds defined regionally or nationally.		
10.	Feature 10 – Maintain waste characteristics and quantities at a level that does not cause harm to the marine, transitional and coastal water environment.	Reduce the amount of newly emerging and deposited solid waste in the marine environment, from a variety of terrestrial and marine sources, to levels that guarantee the proper functioning of the ecosystem, taking into account the natural resilience of the ecosystem, or to eliminate newly emerging waste altogether.			
		Criterion D10C1 (primary):	Achievement of decreasing trends in solid waste, excluding micro-waste, falling into one of the categories: artificial polymeric materials, rubber, fabric and textiles, paper and cardboard, processed or treated wood, metal, glass and ceramics, chemicals, unidentified waste and food waste, occurring on the shoreline, floating on the surface of the water and deposited on the seabed, with a particular focus on waste characterised by extreme harmfulness or a very long degradation period, by taking appropriate action including appropriate legislation, waste	- Waste generated during the construction phase will be collected and disposed of by specialised companies authorised to conduct this type of activity; - No pollution of the marine environment with waste will occur This impact will not cause a deterioration of water status in the context of waste pollution.	- Waste generated during the exploitation phase will be collected and disposed of by specialised companies authorised to conduct this type of activity; - No pollution of the marine environment with waste will occur This impact will not cause a deterioration of water status in the context of waste pollution.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
			disposal, but also by proper education and raising public awareness.		
		Criterion D10C2 (primary):	Achievement of decreasing trends in micro-waste, i.e. particles less than 5 mm in size classified in two categories: 'artificial polymeric materials' and 'other', found on the shoreline, in surface water and in marine sediments, by taking appropriate action including appropriate legislation on the use of microparticles in industry and their disposal at the waste water treatment stage, the disposal of marine wastes that are a source of secondary microparticles, but also by actions including appropriate education and raising public awareness.	Not applicable.	Not applicable.
		Criterion D10C3 (secondary):	Achieving trends of decreasing numbers of waste and micro-waste classified in two categories: "artificial polymeric materials" and "other", ingested by marine animals representing resident species belonging to the groups: birds, mammals, reptiles, fish or invertebrates, by meeting the targets indicated for criteria D10C1 and D10C2.	Not applicable.	Not applicable.
		Criterion D10C4 (secondary):	Minimisation of the number of individuals belonging to selected species of birds, mammals, reptiles, fish or invertebrates that have suffered adverse effects in the form of health changes or death, resulting from the presence of waste, including micro-waste, in the marine environment (e.g. as a result of ingestion of waste or entanglement in nets) by meeting	Not applicable.	Not applicable.

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
			the objectives indicated for criteria D10C1 and D10C2.		
11.	Feature 11 – Maintain energy inputs, including undersea noise, at levels that do not adversely affect the marine environment.	Environmental objectives have been identified at an overall level for each of the criteria and their related indicators used for assessment in the update of the preliminary assessment of the environmental status of marine waters.			
		Criterion D11C1 (baseline):	Reduce the pressures associated with the temporal and spatial occurrence of impulse sounds in the sea associated with human activities, above levels that adversely affect marine animal populations.	- Impulsive noise will be generated during construction works associated with piling; - The sound exposure level (SEL) during piling is dependent on the diameter of the pile being driven and can range from approx. 230 dB re 1 $\mu\text{Pa}^2\text{s}$ to nearly 260 dB re 1 $\mu\text{Pa}^2\text{s}$ in the immediate vicinity of the source of the noise; - The noise impact will be negative, direct, short-term and regional, extending beyond the area of the BC-Wind OWF; - The soft start method and noise reduction systems will be applied during the works, which will reduce the level of impact from significant to moderate (for ichthyofauna and harbour porpoise) and to minor/moderate (for seals); - The impact will cease as soon as construction works are completed. This impact will not cause the deterioration of water status in the context of impulsive noise pollution.	Not applicable.
		Criterion D11C2 (baseline):	Reduce the pressures associated with the temporal and spatial occurrence of continuous low-frequency sounds in the sea associated with human activities,	- Sources of continuous noise emissions during the construction phase will include the movement of vessels and the works associated with the burial of cables connecting	- The continuous noise level generated during the operation of the OWF is approx. 137 dB re 1 Pa at a distance of 40 m; - It is much lower than the level

No.	Feature	Criterion	Environmental objective	Construction phase	Exploitation phase
			above levels that adversely affect marine animal populations.	the wind turbines and the connection infrastructure cables; - Noise generated by vessels reaches values of 160 to 190 re $\mu\text{Pa}^2\text{s}$ (depending on the size and speed of the vessel), while noise levels during dredging works associated with cable burial can reach 187 dB re 1 $\mu\text{Pa}^2\text{s}$ at a distance of 1 metre from the sound source; - It is assumed that the noise level will not increase significantly as a result of the increase in shipping caused by the construction of the BC-Wind OWF; - It will be a short-term and insignificant impact despite its direct nature; - The impact will cease immediately after the completion of the construction works. This impact will not cause a deterioration of water status in the context of permanent noise pollution.	registered during piling and lower or comparable to the one generated by vessels; - The emission of noise and vibration generated during the operation of the OWF may directly affect ichthyofauna and mammals – these will be negative, direct, local, long-term and permanent impacts; - Taking into account the sensitivity of the species present in the area of the planned OWF and the level of generated noise, the significance of this impact was assessed as minor, or negligible. This impact will not cause a deterioration of water status in the context of permanent noise pollution.

Source: own compilation based on the Regulation of the Minister of Infrastructure of 25 February 2021 on the adoption of an updated set of environmental objectives for marine waters (Journal of Laws of 2021, item 569)

The assessment of the waters was based on the update of the properties typical of good environmental status of marine waters contained in the study by Tamara Zalewska (ed.) entitled 'Second update of the set of properties typical of good environmental status of marine waters' of 2024, which was prepared using studies funded by the National Fund for Environmental Protection and Water Management and commissioned by the Chief Inspectorate for Environmental Protection.

The impacts of the planned project on the current water status defined by individual marine ecosystem features (D1-D11), both during the construction phase and the exploitation phase, will be minor, insignificant or negligible.

If moderate impacts related to impulsive noise generation (see feature D1, D4 and D11) occur during the construction of the planned project, they will be regional and reversible as they will cease immediately after the construction is completed. The application of the soft start method and appropriate noise reduction systems will significantly reduce the level of impact from significant to moderate (for ichthyofauna and harbour porpoise) and to minor/moderate (for seals), which, on the scale of the entirety of sub-area 27, will not result in any deterioration of water status in terms of noise pollution.

In the event that impacts of a significant nature occur during the exploitation phase of the planned project, related to the presence of wind turbines and the risk of collision (see feature D1), mainly concerning changes in the structure and spatial distribution of birds (mainly ducks), they will be at a local level, related to the area of the BC-Wind OWF and the buffer zone. At the scale of the entirety of sub-area 27, they will not cause any deterioration in the maintenance of habitat biodiversity.

In the case of the closure and decommissioning of the project, the impacts will be similar to those that will occur during the construction phase, but their intensity will be lower, especially in terms of noise (no impulsive noise emissions). On the scale of the entirety of sub-area 27, they will not cause any deterioration of water status.

In view of the above, it should be concluded that there will be no deterioration of the current water status of the Eastern Gotland Basin sub-area 27 during both the construction and exploitation and decommissioning phases of the planned project. Therefore, these impacts are to be considered insignificant.

9.4. IMPACT ON ANIMATE NATURE

9.4.1. Phytobenthos

Construction phase

No impacts shall occur due to the absence of phytobenthos in the area of the OWF before the commencement of the implementation of the project.

Exploitation phase

During the exploitation phase, support structures of wind turbines and the accompanying infrastructure located under the water surface in the euphotic zone may be overgrown by macroalgae.

Despite the lack of underwater vegetation in the area of the planned OWF, various natural and anthropogenic factors may cause the emergence of macroalgae in this area. The first group of factors should include the transport of spores, which are carried by sea currents from the areas of occurrence of macroalgae.^{201, 202, 203, 204} The spores may also be released by macroalgae thalli brought by sea currents from their original habitats, after breaking off from the seabed during storms.

²⁰¹ Norton T.A., *Dispersal by macroalgae. British Phycological Journal* 1992, 27 (3): 293-301

²⁰² Gaylord B., Reed D., Raimondi P., Washburn L. *Macroalgal spore dispersal in coastal environments. Mechanistic insights revealed by theory and experiment. Ecological Monographs* 2006, 76 (4): 481-502

²⁰³ Brennan G., Kregting L., Beatty G.E., Cole C., Elsässer B., Savidge G., Provan J., *Understanding macroalgal dispersal in a complex hydrodynamic environment. A combined population genetic and physical modelling approach. J. R. Soc. Interface* 2014, 11 (95): 20140197

²⁰⁴ van den Hoek C., *The possible significance of long-range dispersal for the biogeography of seaweeds. Helgoländer Meeresuntersuchungen* 1987, 41 (3): 261-272

The anthropogenic factors should include the transport of spores in ballast waters of vessels²⁰⁵, e.g. vessels involved in the construction and maintenance of the OWF infrastructure. They can also originate from the macroalgae growing on the hull of vessels.^{207, 208}

It should be presumed that the macroalgae spores are present in the area of the OWF and once a hard substrate appears in the euphotic zone, they will find favourable conditions for the development, and will begin the colonisation process. This process may already begin in the first vegetation season after the OWF structure is erected. Data from applicable literature indicates that in the initial phase of colonisation, macroalgae with filamentous thalli appear first, to be displaced by species with compact thalli.²⁰⁹

It is currently impossible to determine which macroalgae species will grow on the OWF structures. However, certain indications can be found in the research carried out for the Utgrunden 1 OWF located in the southern part of the Kalmar Strait.²¹⁰ In 2007, i.e. 7 years after the commencement of its operation, the presence of filamentous green algae (*Cladophora* sp.) and red algae (*Ceramium tenuicorne*, *Polysiphonia fucoides* and *Rhodocorton purpureum*) was found on the support structures of wind turbines. The example of *C. tenuicorne* indicates that among the macroalgae growing on structures, there may also be species subject to strict protection pursuant to the Regulation of the Minister of the Environment of 9 October 2014 on the protection of plant species (Journal of Laws of 2014, item 1409).

Macroalgae and animal organisms (e.g. mussels and barnacles) overgrowing the OWF components create an 'artificial reef', an element causing a local increase in the biodiversity of plant and animal species *per se* and indirectly affecting the increase in the richness of species and quantitative resources of the marine fauna – mainly fish and nekton crustaceans, which will search for food and places suitable for a refuge and reproduction within the reef.^{211, 212, 213, 214, 215, 216} Therefore, the effect of the overgrowth of macroalgae on the underwater OWF structures should be considered positive, however it should also be noted that the natural character of the maritime area will be disturbed. The functioning of the marine ecosystem will be changed locally and in the long-term, for which the anthropogenic factor will be responsible.

²⁰⁵ Lindeboom H.J., Kouwenhoven H.J., Bergman M.J.N., Bouma S., Brasseur S.M., Daan R., Fijn R.C., de Haan D., Dirksen S., van Hal R., Hille Ris Lambers R., ter Hofstede R., Krijgsveld K.L., Leopold M.F., Scheidat M., Short-term ecological effects of an offshore wind farm in the Dutch coastal zone. A compilation. *Bron Environmental Research Letters* 2011, 6: 035101

²⁰⁶ Fowler A.M., Jørgensen A., Svendsen J., Macreadie P., Jones D., Boon A., Booth D., Brabant R., Callahan E., Claisse J., Dahlgren T., Degraer S., Dokken Q., Gill A., Johns D., Leewis R., Lindeboom H., Linden O., May R., Murk A., Ottersen G., Schroeder D., Shastri S., Teilmann J., Todd V., Van Hoey G., Vanaverbeke J., Coolen J., Environmental benefits of leaving offshore infrastructure in the ocean. *Front. Ecol. Environ.* 2018, 16 (10): 571-578

²⁰⁷ Lembi C.A., Waaland J.R., *Algae and Human Affairs*. Cambridge University Press, Cambridge 1988

²⁰⁸ Norton T.A., Dispersal by macroalgae. *British Phycological Journal* 1992, 27 (3): 293-301

²⁰⁹ Lantz E., Roberts O., Nunemaker J., DeMeo E., Dykes K., Scott G., Increasing Wind Turbine Tower Heights: Opportunities and Challenges National Renewable Energy Laboratory, Golden, CO, National Renewable Energy Laboratory. NREL/TP-5000-73629; dostępne na: <https://www.nrel.gov/docs/fy19osti/73629.pdf>

²¹⁰ Brodin Y., Andersson M.H., The marine splash midge *Telmatogon japonicas* (Diptera: Chironomidae) – extreme and alien? *Biol Invasions*, 2009, 11: 1311-1317

²¹¹ Ambrose R.F., Anderson T.W., Influence of an artificial reef on the surrounding infaunal community. *Marine Biology* 1990, 107 (1): 41-52

²¹² Andersson M.H., Berggren M., Wilhelmsson D., Öhman M.C., Epibenthic colonization of concrete and steel pilings in a cold-temperate embayment: a field experiment. *Helgoland Mar. Res.* 2009, 63 (3): 249-260

²¹³ Lindeboom H.J., Kouwenhoven H.J., Bergman M.J.N., Bouma S., Brasseur S.M., Daan R., Fijn R.C., de Haan D., Dirksen S., van Hal R., Hille Ris Lambers R., ter Hofstede R., Krijgsveld K.L., Leopold M.F., Scheidat M., Short-term ecological effects of an offshore wind farm in the Dutch coastal zone. A compilation. *Bron Environmental Research Letters* 2011, 6: 035101

²¹⁴ Wilhelmsson D., Malm T., Thompson R., Tchou J., Sarantakos G., McCormick N., Luitjens S., Gullström M., Patterson Edwards J.K., Amir O., Dubi A. (red.), Greening blue energy. Identifying and managing the biodiversity risks and opportunities of offshore renewable energy. International Union for Conservation of Nature (IUCN), Gland 2010

²¹⁵ Wilson J.C., Elliott M., Cutts N.D., Mander L., Mendão V., Perez-Dominguez R., Phelps A., Coastal and offshore wind energy generation. Is it environmentally benign? *Energies* 2010, 3: 1383-1422

²¹⁶ Wilson J.C., Elliott M., The habitat creation potential of offshore windfarms. *Wind Energy* 2009, 12 (2): 203-212

In conclusion, the significance of the impact was considered positive and negligible.

Decommissioning phase

The decommissioning phase will involve the removal of the wind turbine supporting structures and its associated infrastructure from the offshore area. The decommissioning method will be decided several years before the end of the exploitation phase, which is estimated to last approx. 35 years. The decommissioning of the farm will be preceded by benthic surveys to determine the ecological quality of the ecosystem that will have been created during its operation.

With the removal of the OWF installations, the macroalgae growing on the structures in the euphotic zone will also be removed. Thus, a reinstatement of the original conditions from before the works associated with the project were commenced will occur. Restoration of natural conditions is theoretically a positive phenomenon; however, it should be remembered that structural elements overgrown with organisms of flora and fauna will constitute the so-called artificial reef, which locally increases biodiversity and attracts numerous species of nekton fauna. The dismantling of structural elements of the OWF will thus result in the loss of this habitat – of anthropogenic origin, but significantly shaping the functioning of the local marine ecosystem. Taking into account the fact that the artificial factor will cause a local and relatively long (the exploitation phase of the project may amount to several dozen years) increase in biotic qualitative (taxonomic composition) and quantitative (abundance and biomass) resources of phytobenthos, it should be considered that its removal, despite its unnatural origin, will have a negative impact on the environment of the marine area in the region of the planned OWF.

In conclusion, the significance of the impact was considered negative and negligible.

9.4.2. Macrozoobenthos

Construction phase

The works carried out on the seabed during the construction phase of the BC-Wind OWF will cause the following impacts affecting the condition of the macrozoobenthos inhabiting the area:

- a disturbance of the seabed sediment structure;
- an increased concentration of suspended solids in the water;
- a sedimentation of suspended solids on the seabed;
- a redistribution of pollutants from sediments into water.

The most important technical parameters of the OWF, which are important from the point of view of the assessment of the project's impact on macrozoobenthos during the construction phase, are:

- the development area of the OWF;
- the foundations of wind turbines – type and number of foundations with the largest area covering the seabed;
- power cables – their length and the area of the seabed disturbed during their placement.

This data is presented in the table below (Tab. 9.7).

Tab. 9.7. *Compilation of key parameters of the BC-Wind OWF in the variant selected for implementation (WWR 2024) in order to assess the impact on macrozoobenthos during the construction phase*

Parameter	Unit	WWR 2024
OWF area designated by the PSZW permit for the BC-Wind	km ²	90.94
Area of development of the BC-Wind OWF	km ²	78.71
Maximum number of wind turbines	-	39
Maximum number of OSS	-	1
Maximum diameter of a monopile-type foundation	m	11.5

Parameter	Unit	WWR 2024
Maximum area of the seabed occupied by a single monopile-type foundation with a protective layer	m ²	approx. 2600
Maximum length of inner cable routes within the OWF	km	100
Cable trench width	m	approx. 7.5

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 194

The assessment of the impact of wind turbines in the area of the OWF (1 NM) during the construction phase was carried out separately for:

- soft-bottom macrozoobenthos;
- hard-bottom macrozoobenthos.

A separate assessment of the impact of the project on macrozoobenthos is the result of these two benthic fauna communities (soft- and hard-bottom) differing in the taxonomic composition, abundance and biomass of their taxa. Consequently, they differ in significance and sensitivity regarding the various types of impact. The significance and sensitivity of the group of assessed organisms (soft- and hard-bottom macrozoobenthos), together with the evaluation of the scale of the impact scale (nature of interactions, type of interactions, spatial extent, time scope), influence the assessment of a given impact significance.

The significance of macrozoobenthos is primarily its ecological (functional) significance, such as the food supply or habitat-forming role, and the impact of these organisms on the condition of marine environment elements such as sediments and the near-seabed water layer.^{217, 218, 219, 220, 221} Moreover, the condition of macrozoobenthos as an environmental resource determines the ecological quality of marine areas, which can be assessed using appropriate indices.²²²

The results of the inventory studies carried out in the area of BC-Wind OWF showed that the macrozoobenthos does not present a high value of the quality status of the two communities assessed here, nor is it unique in terms of its qualitative and quantitative composition compared to the macrozoobenthos inhabiting a similar depth range in the open waters of the Southern Baltic within the PMA.

The soft-bottom macrozoobenthos complex inhabits the sandy and gravelly seabed with the greatest area within the planned project area (>95% of the surface), and is characterised by a moderate ecological quality status. The complex is made up of species common and characteristic of this type of seabed in the open waters of the southern Baltic, while their biomass is dominated by organisms such as the mussel *Limecola balthica* and the *Marenzelleria* sp. polychaetes, tolerant to environmental degradation and changes in organic matter content in the sediment. The significance of the soft-bottom macrozoobenthos complex in the area of the planned project for the functioning of the ecosystem was considered to be low.

²¹⁷ Żmudziński L., Świat zwierzęcy Bałtyku. Atlas makrofauny. Wydawnictwa Szkolne i Pedagogiczne, Warszawa 1990

²¹⁸ Węśławski J.M., Waloryzacja dna morskiego, [w:] Gabriela G., Kryla-Straszewska L., Urbański J., Warzocha J., Węśławski J., Atlas siedlisk dna polskich obszarów morskich. Waloryzacja przyrodnicza siedlisk morskich. Broker-Innowacji Gabriela Gic-Grusza, Gdynia 2009: 14-15, 86-87, 92-93

²¹⁹ Urban-Maliga B., Warzocha J., Zalewski M., Effects of the invasive polychaete *Marenzelleria* spp. on benthic processes and meiobenthos of a species-poor brackish system. *Journal of Sea Research* 2013, 80: 25-34

²²⁰ Michaud E., Desrosiers G., Mermillod-Blondin F., Sundby B., Stora G., The functional group approach to bioturbation. II. The effects of the *Macoma balthica* community on fluxes of nutrients and dissolved organic carbon across the sediment-water interface. *Journal of Experimental Marine Biology and Ecology* 2006, 337: 178-189

²²¹ Kruk-Dowgiało L., Kramarska R., Gajewski J. (red.), Siedliska przyrodnicze polskiej strefy Bałtyku. Głazowisko Ławicy Słupskiej. Instytut Morski w Gdańsku, Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Gdańsk–Warszawa 2011

²²² Oppel S., Powell A.N., Dickson D.L., Timing and distance of king eider migration and winter movements. *The Condor* 2008, 110: 296-305

The hard-bottom macrozoobenthos complex inhabiting the surface of boulders and stones, found in the western and southern parts of the planned OWF (1 NM), occupies up to 5% of its area. The valorisation of this type of habitat, which had a good ecological status, demonstrated its higher nature value. This group of organisms includes mainly the habitat-forming bay mussels *Mytilus trossulus*, which play an important role as a food source, and the accompanying fauna, such as crustaceans, bryozoans, hydrozoans and polychaetes. On the other hand, the range of the occurrence of this complex is limited to the small area of the boulder area occupied, located at the depth range of 28.3 m to 39.5 m. The significance of the hard-bottom complex in the area of the BC-Wind OWF was assessed as high.

The sensitivity of macrozoobenthos depends on the type of impact and preferences resulting from the very biology of the given species. On the one hand, it is the ability of its population to adapt to various changes occurring in the environment as a result of the implementation of the project that is key, and on the other hand, it is the ability of a complex of organisms to reconstruct the quantitative structure after the impact factor ceases to exist. The sensitivity of macrozoobenthos will differ in the subsequent stages of the project. The table below (Tab. 9.8) presents the definitions of the sensitivity of macrozoobenthos on a five-point scale.

Tab. 9.8. Macrozoobenthos sensitivity to the OWF impact

Sensitivity	Description
Negligible	The influence of the stressor has very little impact on the changes in the structure and functioning of the organism complex.
Low	The survival of some benthic species may be limited; the ability to restore the benthic complex and return it to its original state after the impact factor has ceased to exist will happen within a year.
Moderate	Some species in the benthic complex will be destroyed and the survival of the remainder may be limited; after the impact factor ceases to exist, the ability to restore the quantitative structure of the longest-living species in this complex may take up to several years.
High	Most species in the benthic complex will be destroyed and the survival of the remainder may be limited; the ability to restore the benthos complex may be possible many years after the impact factor has ceased to exist, however the complex may have a different qualitative structure than before the period in which the environment changed as a result of the implementation of the project.
Very high	The benthic complex will be destroyed under the impact of the stressor and it will not be possible to return it to its original state.

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 196

The disturbance of the seabed sediment structure is the most negative type of impact on macrozoobenthos of all those occurring during the OWF construction phase. Levelling the seabed, the burial of power cables in the seabed, dumping dredged material in the storage area, as well as the operation of jack-up type construction vessels are the factors with the greatest impact on macrozoobenthos species inhabiting the surface of sandy and gravelly sediments, as well as the stony seabed, because of their inability to move inside the sediment; but also on the organisms living in the sediment, mainly in its upper layer.^{223, 224} These activities lead primarily to the physical destruction of natural macrozoobenthos communities, and, to a lesser extent, to an increased macrozoobenthos mortality when invertebrates are brought to the surface of the sediment, as a result of which they will

²²³ Brakelmann H., Kabelverbindung der Offshore-Windfarmen Kriegers Flak und Baltic I zum Netzanschlusspunkt. Report commissioned by the Offshore Ostsee WindAG, 2005

²²⁴ Bohnsack J.A., Sutherland D.L., Artificial reef research. A review with recommendations for future priorities. *Bulletin of Marine Science* 1985, 37: 11-39

undergo physical elimination or pressure from predators, mainly fish.^{225, 226} Only mobile macrozoobenthos species, i.e. crustaceans present in low numbers both in the soft- and hard-bottom macrozoobenthos complexes in the area of the BC-Wind OWF, will avoid adverse environmental conditions by the means of escape.²²⁷ The destruction of macrozoobenthos organisms in the area of the BC-Wind OWF until their population is restored will contribute, i.a., to the loss of food sources, mainly for benthivorous fish. On the other hand, due to the spatial scale of this impact and the ability of fish to actively forage for food, it can be assumed that the reduction in food resources will not be significant for benthivorous fish (Appendix 1 to the EIA Report, Volume III). Then, the benthos species that play an important role in bioturbation and bioirrigation, and thus the transport of oxygen and organic matter into the sediment, important in terms of microbiological decomposition and mineralisation processes, will be destroyed.²²⁸ On the other hand, the planned area of the BC-Wind OWF is not a region of numerous occurrence of diving benthivorous birds (such as long-tailed ducks and velvet scoters) that feed on macrozoobenthos, mainly mussels, because there are great depths in this area that make it difficult for sea ducks to access food. Therefore, the abundance of the long-tailed duck and velvet scoter in the BC-Wind OWF area was low. With a considerable depth of the sea area, and for the BC-Wind OWF area it ranges between 28 m to 65 m, it is more difficult for benthivorous birds to reach their food because they incur high energy costs when diving. For sea ducks, the most energy-efficient method is feeding in shallower (up to 20 m to 25 m) water bodies (Appendix 1 to the EIA Report, Volume III). For this reason, the depletion of the food supply by the destruction of macrozoobenthic organisms in the investment area is not very significant for diving benthivorous birds, for which this area is not an important feeding ground.

The total area of the OWF designated in the PSZW is 90.94 km², of which the development area will not exceed 78.71 km². The physical destruction of macrozoobenthos will take place on the seabed surface disturbed by the installation of 39 wind turbine foundations of the monopile type across approx. 0.10 km². A much greater disturbance of macrozoobenthos will occur along the route of internal power cables, i.e. it will cover a seabed area of approx. 2.5 km², assuming the length of cable routes inside the OWF of approx. 100 km and a preparatory strip width of up to 25 m for the cable lines (with deeper seabed intervention works involving a strip width of approx. 7.5 m, i.e. an area of approx. 0.75 km²). Preparatory works include clearing the seabed of rocks, boulders and other physical obstructions, and levelling and dredging the seabed before the cable is laid. Three possible technologies are considered for the burial of the power cable: jetting, mechanical cutting and ploughing, depending on the type of seabed. In the case of a hard seabed, the cable will be laid on the surface and covered with a stone cover or concrete mattress (Chapter 3.2). The APV variant from the 2021 EIA (now the RAV 2024) assumed that the area of direct bottom intervention associated with the installation of cables inside the OWF was 2.065 km², assuming cable route lengths of 188 km and a trench width of 11 m, and was therefore smaller than in the case of WWR 2024. However, it should be noted that the APV 2021 (now the RAV 2024) variant did not take into account preparatory works within the cable routes, but only the width of the trench itself, so that a comparison of the spatial extent of the impacts of these variants may be misinterpreted. Due to the fact that the construction methods of the individual components of the BC-Wind OWF were specified, a value of 2.5 km² was assumed for the purposes of further assessment of WWR 2024 for the area that, together with the macrozoobenthic communities inhabiting it, will be directly exposed to seabed intervention works. On this basis, it was calculated that the cumulative damage to

²²⁵ Köller J., Koppel J., Peters W. (ed.), *Offshore wind energy. Research on environmental impacts*. Springer-Verlag, Berlin-Heidelberg 2006

²²⁶ Zalewska T., *Radionuklidy pochodzenia antropogenicznego*, [w:] Zalewska T., Jakusik E., Łysiak-Pastuszek E., Krzysiński W. (red.), *Bałtyk Południowy w 2011 roku. Charakterystyka wybranych elementów środowiska*. Instytut Meteorologii i Gospodarki Wodnej, Państwowy Instytut Badawczy, Warszawa 2012

²²⁷ Macnaughton M., Nielsen B., Nejrup L.B., Pedersen J., *Horns Rev 3 Offshore Wind Farm. Technical report no. 4. Benthic habitats and communities*. Orbicon A/S, 2014

²²⁸ Bohnsack J.A., Sutherland D.L., *Artificial reef research. A review with recommendations for future priorities*. *Bulletin of Marine Science* 1985, 37: 11-39

macrozoobenthic communities, and thus potential feeding grounds for benthivorous fish and birds in the BC-Wind OWF area, will cover an area of 2.6 km², which is approx. 3.3% of the development area.

Due to the reduction in the number of power plants, and thus the reduction of the area of the seabed that will be destroyed from 0.12 km² to 0.10 km², and the shortening of the length of the cable routes by almost a half, the impact of the WWR 2024 on macrozoobenthic communities is less than that of the RAV 2024. The apparent increase in impact is related to the specification of the parameters of route preparation methods and the installation of power cables in the area of the BC-Wind OWF.

The sensitivity of the soft-bottom macrozoobenthos complex in the area of the BC-Wind OWF to this impact is moderate. Despite the fact that the abundance structure of the population of this organism complex is dominated by *Pygospio elegans* polychaetes, the ability to restore the entire complex and return to its original state after the impact factor ceases to exist will last from one year up to several years. This is due to the length of time it will take to restore the quantitative structure of the longest living species in this group, such as the mussels *Mya arenaria*, *Macoma balthica* and *Mytilus trossulus*.^{229, 230, 231} It only applies to areas where no permanent mechanical destruction of the benthos underneath the foundations or supporting structures of wind turbines will occur.

Similarly, the sensitivity of the hard-bottom macrozoobenthos complex, in which the *Mytilus trossulus* mussels constitute a group of absolutely constant taxa dominant in abundance and biomass, the sensitivity to the disturbance of seabed sediments will be moderate.

Impact assessment will be identical for the soft-bottom and the hard-bottom macrozoobenthos complex. In both cases, with a moderate sensitivity of individual complexes and a moderate scale of the impact, and taking into account the medium-term scope of the seabed sediment structure disturbance of a local nature, the significance of the impact for the BC-Wind OWF Area was assessed to be low.

The increase in the concentration of suspended solids in the water is another type of impact on the macrozoobenthos present in the area of the BC-Wind OWF during the construction phase. During dredging works and the laying and burial of power cables in the seabed, due to the disturbance of the seabed sediment structure, the sediment from the seabed is lifted and dissipates in the water as suspended solids.^{232, 233} The concentration values of these suspended solids depend on the chosen method of cable burial, the velocity of sea currents, their direction, turbulence processes, as well as the size of the seabed sediment fraction. A higher concentration of suspended solids and a longer exposure time of mineral and organic particles in the water cause adverse effects on the condition of benthic fauna.^{234, 235} When there is an excessive concentration of suspended solids in the water, organisms that filter or feed on suspended solids and organic matter deposited in sediments may feed less effectively. At a suspension concentration above 250 mg·l⁻¹, the growth of macrozoobenthic organisms is limited,²³⁶

²²⁹ Westin D.T., Olney C.E., Rogers B.A., *Effects of Parental and Dietary Organochlorines on Survival and Body Burdens of Striped Bass Larvae*. Transactions of the American Fisheries Society 1985, 114 (1): 137-145

²³⁰ Żmudziński L., *Świat zwierzęcy Bałtyku. Atlas makrofauny*. Wydawnictwa Szkolne i Pedagogiczne, Warszawa 1990

²³¹ Piechocki A., Wawrzyniak-Wydrowska B., *Guide to freshwater and marine mollusca of Poland*. Bogucki Wydawnictwo Naukowe, Poznań 2016

²³² Leonhard S., *EIA Report. Benthic communities. Horns Rev 2 Offshore Wind Farm*. No. 2706-03-003 Rev. 4, 2006

²³³ Zalewska T., *Radionuklidy pochodzenia antropogenicznego*, [w:] Zalewska T., Jakusik E., Łysiak-Pastuszek E., Krzysiński W. (red.), *Bałtyk Południowy w 2011 roku. Charakterystyka wybranych elementów środowiska*. Instytut Meteorologii i Gospodarki Wodnej, Państwowy Instytut Badawczy, Warszawa 2012

²³⁴ Newcombe C.P., MacDonald D.D., *Effects of suspended sediments on aquatic ecosystems*. North American Journal of Fisheries Management 1991, 11: 72-82

²³⁵ Hiscock K., Tyler-Walter H., Jones H., *High Level Environmental Screening Study for Offshore Wind Farm Developments – Marine Habitats and Species Project. Report from the Marine Biological Association to the Department of Trade and Industry New & Renewable Energy Programme (AEA Technology, Environment Contract: W/35/00632/00/00)*, 2002

²³⁶ Essink K., *Ecological effects of dumping of dredged sediments; options for management*. Journal of Coastal Conservation 1999, 5: 69-80

and it may even increase the mortality of mussels, which is a result of the clogging effect.^{237, 238} Despite the fact that macroinvertebrates are naturally adapted to high concentrations of suspended solids, such as the ones occurring during storms (they can survive a month in conditions of very high suspended solids concentration, up to $100 \text{ mg}\cdot\text{l}^{-1}$)^{239, 240}, the Baltic Sea mussels are physiologically less adapted to filtering suspended solids in high concentrations, because they are not prepared to living in conditions of strong currents or tides.^{241, 242}

In order to carry out a more detailed assessment of the environmental impact on macrozoobenthos, new modelling was performed for the spread of suspended solids resulting from cable burial using the jetting method. The details of this remodelling are further described in Chapter 8.1, while the entire analysis, i.e. the report on the performed modelling, is included in Appendix 2 to this Report (Volume III). These results are new in comparison to the report performed in 2021, on the basis of which the Investor obtained the DEC. At that time, the modelling was done for a gravity-based foundation, the execution of which involves a very large amount of dredging works. At this stage, gravity foundation technology was excluded, and the execution of a monopile-type foundation does not require soil replacement and dredging works. Therefore, for the purpose of this EIA Report, the suspended solids dispersion modelling was carried out for the jetting method of cable-laying.

The conducted analyses show that the highest values of suspended solids concentration will occur in the immediate vicinity of the excavation and that the area of increased water turbidity will move along the excavation route with the progress of the works. In the case of cohesive sediments with a high content of silty and clay fractions, the extent of water turbidity, as well as the concentration of suspended solids, are greater than in the case of a sandy seabed. The extent of water turbidity in the faster cable-laying variant, i.e. $350 \text{ m}\cdot\text{h}^{-1}$, is greater than in the $125 \text{ m}\cdot\text{h}^{-1}$ variant due to a larger amount of disturbed suspended solids per unit of time. It was also found that the angle between the direction of the wind and the direction of the excavation has an effect on the size of the area occupied by the suspended solids, i.e., if the works are carried out 'upwind', the suspended solids will occupy a larger area than if the works are carried out in a direction transverse to the action of the wind.

Depending on the adopted modelling variant, the maximum extent of water turbidity during the construction phase of the BC-Wind OWF will range from 300 m to 2100 m from the axis of the excavation, with turbidity mostly not exceeding $30 \text{ mg}\cdot\text{l}^{-1}$, which is the permissible suspended solids concentration level in areas constituting breeding grounds. The range of turbidity with concentrations exceeding $30 \text{ mg}\cdot\text{l}^{-1}$ will not exceed 220 m from the axis of the excavation in the case of a sandy bottom and 1100 m from the axis of the excavation in the case of a clay bottom in the $350 \text{ m}\cdot\text{h}^{-1}$ cable-laying speed variant, and 120 m from the axis of the excavation in the case of a sandy bottom and 650 m from the axis of the excavation in the case of a clay bottom in the $125 \text{ m}\cdot\text{h}^{-1}$ cable-laying speed option. Suspended solids concentrations exceeding the level of visible water turbidity, i.e. above $100 \text{ mg}\cdot\text{l}^{-1}$, may occur only in the immediate vicinity of the excavation in the case of sandy sediments in the $350 \text{ m}\cdot\text{h}^{-1}$ variant, and up to 200 m from the axis of the excavation at a working speed of $125 \text{ m}\cdot\text{h}^{-1}$ and up to 500 m from the axis of the excavation at a working speed of $350 \text{ m}\cdot\text{h}^{-1}$ in the case of clay sediments.

²³⁷ Moore P.G., *Inorganic particulate suspensions in the sea and their effects on marine animals. Oceanography and Marine Biology: An Annual Review* 1977, 15: 225-363

²³⁸ Miller D.C., Muir C.L., Hauser O.A., *Detrimental effects of sedimentation on marine benthos. What can be learned from natural processes and rates? Ecological Engineering* 2002, 19: 211-232

²³⁹ Miller D.C., Muir C.L., Hauser O.A., *Detrimental effects of sedimentation on marine benthos. What can be learned from natural processes and rates? Ecological Engineering* 2002, 19: 211-232

²⁴⁰ Birklund J., *Anholt Offshore Wind Farm. Benthic Fauna. Baseline Surveys and Impact Assessment. Final Report. DHI Group*, 2009

²⁴¹ Essink K., *Ecological effects of dumping of dredged sediments; options for management. Journal of Coastal Conservation* 1999, 5: 69-80

²⁴² Coates D., van Hoey G., Colson L., Vincx M., Vanaverbeke J., *Rapid macrobenthic recovery after dredging activities in an offshore wind farm in the Belgian part of the North Sea. Hydrobiologia* 2014, 756: 3-18

It is estimated that the maximum concentrations of suspended solids during dredging operations in the BC-Wind OWF area may locally exceed $200 \text{ mg} \cdot \text{l}^{-1}$ in the close vicinity for sandy sediments, and $500 \text{ mg} \cdot \text{l}^{-1}$ in the case of a clay seabed. For both types of the seabed, such concentrations of suspended solids are expected mainly if the cables are laid in the direction opposite to the direction of the wind – ‘upwind’. It is important to note that the elevated concentrations of suspended solids in the water column will persist for a relatively short period of time. Suspended matter concentrations exceeding the background limit of $5 \text{ mg} \cdot \text{l}^{-1}$ may persist for up to 6 hours in the case of sandy sediments and up to 14 hours in the case of a clay seabed, depending on the speed of the excavation work and the orientation of the direction of the excavation relative to the direction of the wind.

The sensitivity of the macrozoobenthos complex inhabiting the soft bottom of the BC-Wind OWF Area to this impact is negligible. Since the organisms inhabiting the interior of the sediment, such as polychaetes and oligochaetes, are predominant in the abundance structure of this complex of organisms, the influence of the stressor that is the increase in the concentration of suspended solids in the water does not forecast significant changes in the structure and functioning of this complex of organisms.

On the other hand, the hard-bottom macrozoobenthos complex consisting primarily of filtering organisms, i.e. the *Mytilus trossulus* bivalve, will be characterised by low sensitivity, since it cannot be excluded that with the increase in the concentration of suspended solids in water, the functioning of the filtering system and, therefore, the survival of some of the most exposed individuals, will be reduced. However, it should be noted that the impact will be of a short-term character and, in terms of reaching the maximum values of suspended solids concentration in water, it will be comparable to those that may occur naturally during storms ($100 \text{ mg} \cdot \text{l}^{-1}$).

Taking into account the sensitivity of individual macrozoobenthos complexes, i.e. negligible for the soft-bottom macrozoobenthos and low for the hard-bottom macrozoobenthos, and the scale of the impact described, estimated to be negligible for the soft-bottom macrozoobenthos and low for the hard-bottom macrozoobenthos, the significance of the increased concentration of suspended solids in the area of the BC-Wind OWF was evaluated to be negligible for macrozoobenthos (Tab. 9.9, Tab. 9.10).

Sedimentation of suspended solids on the seabed causes the benthic habitat to be covered with an additional layer of sediment. Furthermore, suspended solids particles that fall onto the seabed may be subject to erosion by being transported in the resuspension process resulting from the hydrodynamic conditions in the marine area.²⁴³ Numerous macrozoobenthos organisms are naturally adapted to living in sediment disturbance and precipitation conditions (as a result of storms or tide cycles) that cause them to be covered. The response to such an adverse impact is the mechanical capability of some of the macroinvertebrates to move in the sediment towards the oxygenated above-seabed layer or the physiological resistance to hypoxic, or even anoxic, conditions.^{244, 245, 246} Vagile infauna species (e.g. polychaetes and oligochaetes) are more tolerant to being covered with an additional sediment layer, since they are able to move through a layer of up to 10 cm, although that depends on the sediment grain fraction and the duration of the negative impact. On the other hand, the species more sensitive to this impact are those of the sedentary epifauna and macrozoobenthos larvae, since, when covered by an additional layer of sediment, these organisms will have a limited capacity to move and reach the

²⁴³ Zalewska T., Radionuklidy pochodzenia antropogenicznego, [w:] Zalewska T., Jakusik E., Łysiak-Pastuszek E., Krzemiński W. (red.), Bałtyk Południowy w 2011 roku. Charakterystyka wybranych elementów środowiska. Instytut Meteorologii i Gospodarki Wodnej, Państwowy Instytut Badawczy, Warszawa 2012

²⁴⁴ Miller D.C., Muir C.L., Hauser O.A., Detrimental effects of sedimentation on marine benthos. What can be learned from natural processes and rates? Ecological Engineering 2002, 19: 211-232

²⁴⁵ Hinchey E.K., Schaffner L., Hoar C., Vogt B., Batte L., Response of estuarine benthic invertebrates to sediment burial. The importance of mobility and adaptation. Hydrobiologia 2006, 556 (1): 85-98

²⁴⁶ Birklund J., Anholt Offshore Wind Farm. Benthic Fauna. Baseline Surveys and Impact Assessment. Final Report. DHI Group, 2009

sediment surface, which is an essential condition for respiration and feeding. Thus, mussels will try to move their siphons above the sediment layer.^{247, 248, 249, 250} The Baltic clam (*Macoma balthica*) is one of the macrozoobenthos species that are the most resistant to this impact, since the species may survive for a month with a sediment layer increase of 7 cm to 20 cm.^{251, 252} On the other hand, the maximum tolerance of the sand gaper *Mya arenaria* to sand sedimentation is 5 cm/month.²⁵³ The most important factor influencing the survival of benthic fauna in these conditions is access to oxygen dissolved in water, which can diffuse into the sediment (from 1 mm to 2 mm).²⁵⁴ Typically, macrozoobenthos is quite tolerant to being covered by an additional layer, even up to 0.2 m to 0.3 m thick, of suspended solids undergoing sedimentation, especially if this layer is composed of a fine sand fraction.^{255, 256, 257} However, the long duration of the negative impact in the form of an additional sediment layer covering all benthic species contributes to their increased mortality.²⁵⁸

The modelling results in terms of determining the thickness and spatial distributions of sediments on the seabed resulting from the sedimentation of disturbed suspended solids as a result of the works in the WWR 2024 variant indicate a smaller impact extent on macrozoobenthos complexes compared to the one indicated by the analysis carried out for the APV 2021 (referred to in this Report as the RAV 2024). This is related to the specification of the methodology to be used for the works and thus the selection of appropriate parameters for the operation of the model. In the current model, the modelling of the spread of suspended solids for the installation of foundations for wind turbine towers and an offshore substation was abandoned due to the choice of a trenchless method for the placement of monopile-type foundations and the lack of soil replacement, and therefore a negligibly small and environmentally insignificant inflow of suspended solids. The results of the modelling of the impact of the WWR 2024 variant relate to the spread of suspended solids during jetting associated with the installation of internal cables in the area of the BC-Wind OWF. For a cohesive bottom, the thickness of the newly formed sediment layer is estimated to be up to a maximum of 1.4 mm in the immediate vicinity of the excavation; at distances above 150 m from the excavation, it will not exceed 1 mm, and at distances above 350 m from the excavation, it will not exceed 0.5 mm. In the case of a non-cohesive bottom, the range of the spread is even smaller, and the thickness of the newly formed sediment layer should not exceed 0.3 mm. The increase in the concentration of suspended solids and the process of

²⁴⁷ Maurer D., Keck R.T., Tinsman J.C., Leatham W.A., Wethe C., Lord C., Church T.M., Vertical Migration and Mortality of Marine Benthos in Dredged Material. A Synthesis. *Internationale Revue der gesamten Hydrobiologie und Hydrographie* 1986, 71: 49-63

²⁴⁸ Hiscock K., Tyler-Walter H., Jones H., High Level Environmental Screening Study for Offshore Wind Farm Developments – Marine Habitats and Species Project. Report from the Marine Biological Association to the Department of Trade and Industry New & Renewable Energy Programme (AEA Technology, Environment Contract: W/35/00632/00/00), 2002

²⁴⁹ Miller D.C., Muir C.L., Hauser O.A., Detrimental effects of sedimentation on marine benthos. What can be learned from natural processes and rates? *Ecological Engineering* 2002, 19: 211-232

²⁵⁰ Gibbs M., Hewitt J., Effects of sedimentation on macrofaunal communities. A synthesis of research studies for ARC. Technical Publication No. 264. National Institute of Water & Atmospheric Research Ltd, Hamilton 2004

²⁵¹ Turk T.R., Risk M.J., Effect of sedimentation on infaunal invertebrate populations of Cobequid Bay, Bay of Fundy. *Can. J. Fish. Aquat. Sci.* 1981, 38: 642-648

²⁵² Essink K., Ecological effects of dumping of dredged sediments; options for management. *Journal of Coastal Conservation* 1999, 5: 69-80

²⁵³ Essink K., Ecological effects of dumping of dredged sediments; options for management. *Journal of Coastal Conservation* 1999, 5: 69-80

²⁵⁴ Hinchey E.K., Schaffner L., Hoar C., Vogt B., Batte L., Response of estuarine benthic invertebrates to sediment burial. The importance of mobility and adaptation. *Hydrobiologia* 2006, 556 (1): 85-98

²⁵⁵ Essink K., Ecological effects of dumping of dredged sediments; options for management. *Journal of Coastal Conservation* 1999, 5: 69-80

²⁵⁶ Miller D.C., Muir C.L., Hauser O.A., Detrimental effects of sedimentation on marine benthos. What can be learned from natural processes and rates? *Ecological Engineering* 2002, 19: 211-232

²⁵⁷ Gibbs M., Hewitt J., Effects of sedimentation on macrofaunal communities. A synthesis of research studies for ARC. Technical Publication No. 264. National Institute of Water & Atmospheric Research Ltd, Hamilton 2004

²⁵⁸ Hiscock K., Tyler-Walter H., Jones H., High Level Environmental Screening Study for Offshore Wind Farm Developments – Marine Habitats and Species Project. Report from the Marine Biological Association to the Department of Trade and Industry New & Renewable Energy Programme (AEA Technology, Environment Contract: W/35/00632/00/00), 2002

its sedimentation during the construction phase will therefore have little impact on benthic organisms compared to similar natural processes.²⁵⁹ Furthermore, it was found that the speed of the works has little effect on the spatial extent of sediment deposition. It should also be emphasised that the assessment of water quality in the area of the BC-Wind OWF on the basis of oxygen concentration in the bottom layer during summer (July, August) indicates a good condition (no oxygen deficit) (Appendix 1 to the EIA Report, Volume III).

It was determined that the sensitivity of the soft-bottom macrozoobenthos complex in the BC-Wind OWF area to the sedimentation of suspended solids on the seabed is low. This complex includes the representatives of the epibenthos, i.e. bivalves, primarily *Macoma balthica* but also *Mya arenaria* and *Mytilus trossulus*. These are organisms which, when covered by an additional layer of sediment, may have an obstructed access to the oxygen dissolved in the water, causing their filtration process to be reduced. Also, the infauna may be, in short-term, affected by the arising anoxic conditions.

On the other hand, in the case of the hard-bottom macrozoobenthos complex, the *Mytilus trossulus* bivalve may be negatively affected due to the inhibition of the filtration process. The sensitivity of this complex was also assessed to be low.

It is estimated that during the construction phase of the BC-Wind OWF in the WWR 2024 variant, a layer with a maximum thickness of 1.4 mm for the cohesive bottom and 0.3 mm for the non-cohesive bottom will form in the area due to sedimentation of the disturbed suspended solids. Given that these are relatively low values for both bottom types, as well as the beneficial oxygen conditions in the above-seabed layer, the scale of the negative impact on the macrozoobenthos will be low. Despite the fact that the sedimentation of suspended solids on the seabed may temporarily reduce benthos resources and, therefore, reduce food sources for the fish and seabirds in the affected area, the maximum thickness of the sediment layer, apart from the areas closest to the foundations or cables being laid, will not exceed the lethal values specified in applicable literature for all macrozoobenthos taxa identified within the project area and, therefore, this impact will be short-term and reversible.

Taking into account the low sensitivity of both evaluated macrozoobenthos complexes and the scale of the impact described being assessed as low, the significance of the suspended solids sedimentation on the seabed of the area of the BC-Wind OWF was assessed to be negligible for both the soft- and hard-bottom macrozoobenthos complexes (Tab. 9.9, Tab. 9.10).

Redistribution of pollutants from sediment into water is the last of the factors that adversely impact the macrozoobenthos. As a result of disturbing seabed sediments during the installation works, cable burial or the anchoring of vessels, benthic fauna will be exposed to increased concentrations of pollutants, e.g. heavy metals and toxic organic compounds: polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and tributyltin (TBT) transferred from the sediments into water as a result of chemical and biochemical processes.^{260, 261, 262} Accumulation of toxic substances leads to reproductive function disorders, diseases and increased mortality of macrozoobenthos, resulting in the reduction of population numbers and biodiversity of the benthic fauna that will be dominated by

²⁵⁹ Miller D.C., Muir C.L., Hauser O.A., *Detrimental effects of sedimentation on marine benthos. What can be learned from natural processes and rates?* *Ecological Engineering* 2002, 19: 211-232

²⁶⁰ Bourg A., Loch J., *Mobilization of Heavy Metals as Affected by pH and Redox Conditions*, [w:] *Biogeodynamics of Pollutants in Soils and Sediments*. Springer-Verlag, Berlin-Heidelberg 1995: 87-102

²⁶¹ Dembska G., *Metale śladowe w osadach Portu Gdańskiego. Praca doktorska. Wydział Biologii, Geografii i Oceanologii, Uniwersytet Gdański, Gdańsk 2003*

²⁶² Uścińowicz S. (red.), *Geochemia osadów powierzchniowych Morza Bałtyckiego. Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy, Warszawa 2011*

opportunistic species. Especially filtering organisms such as mussels are susceptible to this impact as they develop cancer due to the accumulation of toxic substances in soft tissues.^{263, 264, 265, 266, 267}

The impact on the macrozoobenthos was indirectly determined using surveys of the physical and chemical condition of seabed sediments in the area of the BC-Wind OWF with regard to their contamination. As a result of the conducted surveys, it was concluded that the analysed seabed surface sediments belong to inorganic deposits with the organic matter content (expressed as loss on ignition [LOI]) below 4%. They were characterised by a low nutrient content. The concentrations of persistent organic pollutants (i.e. PAHs, PCBs and TBTs) and toxic substances such as metals or mineral oils in the survey area were low and did not deviate substantially from the data from literature regarding sandy seabed sediments of the southern Baltic. The sediments tested were also characterised by low concentrations of the radioactive element ¹³⁷Cs, which is typical for sandy sediments. The concentration values obtained for labile metal forms responsible, i.e., for their toxicity, bioavailability or accumulation in seabed sediments of the OWF area, as well as the PAH and PCB values, compared to normative values specified in the Regulation of the Minister of the Environment of 11 May 2015 on the recovery of waste outside the installations and facilities (Journal of Laws of 2015, item 796) were low in the tested seabed sediments, and the sediments were not contaminated with compounds of those groups. What is more, the concentrations of TBT and the products of its decay (DBT and MBT) obtained for the seabed sediments from the area of the BC-Wind OWF were typical for the sandy sediments of the southern Baltic (Appendix 1 to the EIA Report).

Due to the possibility of redistribution of pollutants from sediment into water, the sensitivity of both the soft- and hard-bottom macrozoobenthos complex representatives to this impact will be negligible. It is expected that this phenomenon has very little impact on the changes in the structure and functioning of both macrozoobenthos complexes, taking into account the results according to which the concentrations of substances that are toxic and harmful to the benthic fauna in the survey area were low, and the processes related to the release of labile metal forms, nutrients (nitrogen and phosphorus compounds) and PAHs and PCBs will occur with low intensity in the entire area of the BC-Wind OWF.

Given the negligible sensitivity of both macrozoobenthos complexes assessed for this impact and the scale of the described impact being assessed as negligible, the importance of redistribution of pollutants from sediment into water in the area of the BC-Wind OWF will be a negligible impact, for both the soft- and hard-bottom macrozoobenthos complexes (Tab. 9.9, Tab. 9.10). The analysis of the impact of the WWR 2024 variant on macrozoobenthos during the construction phase does not change the results of the analysis conducted for the APV in 2021. For the OSS backup location located adjacent to the primary location, the impacts on macrozoobenthos during the construction phase will be analogous.

²⁶³ Szaniawska A., *Gospodarka energetyczna bezkręgowców bentosowych występujących w Zatoce Gdańskiej. Praca habilitacyjna*. Wydawnictwo UG, Gdańsk 1991

²⁶⁴ Galer K., Makuch B., Wolska L., Namieśnik J., *Toksyczne związki organiczne w osadach dennych: problemy związane z przygotowaniem próbek i analizą*. Chem. Inż. Ekol. 1997, 4 (3): 285

²⁶⁵ Grant A., Briggs A.D., *Toxicity of sediments from around a North Sea oil platform: are metals or hydrocarbons responsible for ecological impacts?* Marine Environmental Research 2002, 53: 95-116

²⁶⁶ Hummel H., Sokołowski A., Bogaards R., Wołowicz M., *Ecophysiological and genetic traits of the Baltic clam Macoma balthica in the Baltic: Differences between populations in the Gdańsk Bay due to acclimatisation or genetic adaptation?* Intern. Rev. Hydrobiol. 2000, 85: 621-637

²⁶⁷ Gosz E., Horbowy J., Ruczyńska W., *Testes specific accumulation of tributyltin in turbot Scophthalmus maximus from the southern Baltic Sea*. Marine Pollution Bulletin 2011, 62: 2563-2567

Tab. 9.9. Assessment of the impact of wind turbines on the soft-bottom macrozoobenthos in the area of the BC-Wind OWF (1 NM) during the construction phase in the WWR 2024 variant

Impact	Soft-bottom macrozoobenthos complex characteristics		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Disturbance of the seabed sediment structure	Low	Moderate	Negative	Direct	Local	Medium-term	Moderate	Low
Increase in the content of suspended solids in the water	Low	Negligible	Negative	Direct	Local	Short-term Temporary	Negligible	Negligible
Sedimentation of suspended solids on the seabed	Low	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Redistribution of pollutants from the sediment into the water	Low	Negligible	Negative	Direct	Local	Short-term	Negligible	Negligible

Source: own elaboration based on the EIA Report for the BC-Wind, MEWO S.A., 2021

Tab. 9.10. Assessment of the impact of wind turbines on the hard-bottom macrozoobenthos in the area of the BC-Wind OWF (1 NM) during the construction phase in the WWR 2024 variant

Impact	Hard-bottom macrozoobenthos complex characteristics		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Disturbance of the seabed sediment structure	High	Moderate	Negative	Direct	Local	Medium-term	Moderate	Low
Increase in the content of suspended solids in the water	High	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Sedimentation of suspended solids on the seabed	High	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Redistribution of pollutants from the sediment into the water	High	Negligible	Negative	Direct	Local	Short-term	Negligible	Negligible

Source: own elaboration based on the EIA Report for the BC-Wind, MEWO S.A., 2021

Exploitation phase

The exploitation phase of the BC-Wind OWF will result in the following impacts on the macrozoobenthos inhabiting the area:

- partial loss of a macrozoobenthos habitat;
- an 'artificial reef' effect.

The most important technical parameters of the OWF which are important from the point of view of the assessment of the impact of the project on macrozoobenthos during the exploitation phase are:

- the area of permanent development of the OWF;
- wind turbine foundations – the type, number and shape of foundations covering the seabed.

The assessment of the impact of wind turbines in the area of the BC-Wind OWF (1 NM) during the exploitation phase was carried out separately for:

- soft-bottom macrozoobenthos;
- hard-bottom macrozoobenthos.

A separate assessment of the impact of the project on macrozoobenthos is the result of these two benthic fauna communities (soft- and hard-bottom) differing in taxonomic composition, as well as the abundance and biomass of their taxa. Consequently, they differ in significance and sensitivity regarding the various types of impact. The significance and sensitivity of the group of organisms assessed (soft- and hard-bottom macrozoobenthos), together with the evaluation of the scale of the impact (nature of interactions, type of interactions, spatial extent, time scope) influence the assessment of a given impact significance.

The significance of the soft-bottom macrozoobenthos complex is low, while the significance of the hard-bottom macrozoobenthos complex is high. The sensitivity of macrozoobenthos is defined in Tab. 9.8.

The partial loss of habitat for the macrozoobenthos is the main impact during this phase of the project.^{268, 269, 270} The development on the seabed will eliminate life from the sediment surface area occupied by the monopile-type offshore wind turbine foundations. The foundations will occupy the seabed during the entire phase of the exploitation of the OWF. At the same time, the wind turbine foundations, together with the layer protecting them from scouring, will modify the velocity distribution of the surrounding sea currents. As a result of changes in hydrodynamic conditions, the grain distribution of seabed sediments may change in the direct vicinity of the foundations. This will, in turn, entail the shift in the quantitative and qualitative structure of the zoobenthos complexes where the benthos has not been completely destroyed.²⁷¹

Estimated calculations indicating the amount of macrozoobenthos resources to be lost in the development area of the BC-Wind OWF are presented below.

In the case of the WWR 2024, a permanent loss of habitats with macrozoobenthos complexes under 39 wind turbines will occur on a very small surface area of 0.10 km², which constitutes only 0.13% of the development area, which is 78.71 km². In this study, it has been assumed that the hard bottom covers maximally 5% of the BC-Wind OWF area, thus taking into account also the assumption that the foundations and/or support structures of the wind turbines will be evenly distributed (37 foundations and/or support structures on the soft bottom and 2 on the hard bottom), the loss of the soft-bottom

²⁶⁸ Köller J., Koppel J., Peters W. (ed.), *Offshore wind energy. Research on environmental impacts*. Springer-Verlag, Berlin-Heidelberg 2006

²⁶⁹ Petersen J.K., Malm T., *Offshore windmill farms. Threats to or possibilities for the marine environment*. Ambio 2006, 35: 75-80

²⁷⁰ Zalewska T., *Radionuklidy pochodzenia antropogenicznego*, [w:] Zalewska T., Jakusik E., Łysiak-Pastuszek E., Krzemiński W. (red.), *Bałtyk Południowy w 2011 roku. Charakterystyka wybranych elementów środowiska*. Instytut Meteorologii i Gospodarki Wodnej, Państwowy Instytut Badawczy, Warszawa 2012

²⁷¹ Degraer S., Brabant R., Rumes B. (ed.), *Offshore wind farms in the Belgian part of the North Sea. Heading for an understanding of environmental impacts*. Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models, Marine ecosystem management unit, 2012

macrozoobenthos habitat will cover 0.095 km², so 0.12% of the development area, and the loss of the hard-bottom macrozoobenthos habitat – only 0.005 km², so 0.01% of the development area. Given this information, the area of macrozoobenthos habitat loss for the WWR 2024 is slightly smaller than that calculated for the variant for which the Investor was granted the DEC (now the RAV 2024).

The sensitivity of both the soft- and hard-bottom macrozoobenthos complexes to this impact is high, as a part of the benthos complex will be permanently destroyed due to the impact of a stress factor occurring throughout the entire exploitation phase.

Additionally, when assessing a high significance impact on the hard-bottom macrozoobenthos complex, it should be taken into account that an important component of the fish food supply will be eliminated from the environment. In the case of the area of the BC-Wind OWF, no significant changes will take place in the food chain regarding the links between birds and benthos. Due to this marine area being of large depth (27.7 m to 65.2 m), sea ducks have limited access to food such as the *Mytilus trossulus* mussels; hence, the long-tailed duck or the velvet scoter are present there in limited numbers, and the dominant bird species are the European herring gull, the razorbill or the common guillemot, all of which prey on pelagic fish (Appendix 1 to the EIA Report). Permanent destruction of the bay mussel *Mytilus trossulus* aggregation may occur only on the surface of 0.005 km² which corresponds to a biomass of approx. 10400 kg, with an average biomass of the hard-bottom macrozoobenthos of approximately 2080 g·m⁻², with the bay mussel (*Mytilus sp.*) share in this complex being more than 99%. The mussel biomass calculated for the WWR 2024 is twice as small as the biomass calculated for the variant for which the Investor was granted the DEC (now the RAV 2024).

Partial loss of habitat is a negative impact occurring during the exploitation phase, however, due to the local range limited to just 0.13% of the development area of the BC-Wind OWF, which is a small value, the scale of this impact will be low. The significance of this impact on the soft-bottom macrozoobenthos was assessed to be low, while for the hard-bottom macrozoobenthos it was assessed to be negligible (Tab. 9.11, Tab. 9.12). What is more, in the case of the complex comprising the bay mussel *Mytilus trossulus* aggregations, despite their loss due to the placement of wind turbine foundations, these mussels typically are the first and quick to recolonise the underwater parts of the wind turbines and their surrounding seabed environment during the OWF exploitation phase.

Tab. 9.11. Assessment of the impact of wind turbines on the soft-bottom macrozoobenthos in the area of the BC-Wind OWF (1 NM) during the exploitation phase in the WWR 2024 variant

Impact	Soft-bottom macrozoobenthos complex characteristics		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Partial loss of habitat	Low	High	Negative	Direct	Local	Long-term Permanent	Low	Low

Source: own elaboration based on the EIA Report for the BC-Wind, MEWO S.A., 2021

Tab. 9.12. Assessment of the impact of wind turbines on the hard-bottom macrozoobenthos in the area of the BC-Wind OWF (1 NM) during the exploitation phase in the WWR 2024 variant

Impact	Hard-bottom macrozoobenthos complex characteristics		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Partial loss of habitat	High	High	Negative	Direct	Local	Long-term Permanent	Low	Negligible

Source: own elaboration based on the EIA Report for the BC-Wind, MEWO S.A., 2021

The 'artificial reef' effect is the colonisation of hard artificial substrates of supporting structures introduced to the environment by animal and plant periphyton complexes and by mobile epifauna. Despite the fact that this impact is widely documented in literature (e.g.^{272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282}), so far, no OWF was built in the PMA of the southern Baltic and there was no possibility to monitor the 'artificial reef' phenomenon^{283, 284, 285, 286}. Only experimental research was conducted on an artificial structure installed in the environment.²⁸⁷

Based on literature, it is known that in the location where the hard substrate had not been previously present, the quantitative and qualitative structure of the zoobenthos complex will change within the entire microhabitat, i.e. on the surface of underwater structures and on the surrounding seabed. The process of overgrowing support structures with periphyton organisms (invertebrates and macroalgae) begins after the reproduction of periphyton species and the settlement of larvae on the hard surface of the structure, most often in late spring. Periphyton communities have a significant impact on the marine environment at the ecosystem level, although it is difficult to clearly determine the nature of this impact. This depends on the local environmental conditions, reproductive potential of zoobenthos organisms and ecosystem management plans in the area of the BC-Wind OWF.^{288, 289, 290}

²⁷² Birklund J., Petersen A., *Development of the fouling community on turbine foundations and scour protections in Nysted Offshore Wind Farm*, 2003. Report. DHI, June 2004

²⁷³ Lantz E., Roberts O., Nunemaker J., DeMeo E., Dykes K., Scott G., *Increasing Wind Turbine Tower Heights: Opportunities and Challenges* National Renewable Energy Laboratory, Golden, CO, National Renewable Energy Laboratory. NREL/TP-5000-73629; dostępne na: <https://www.nrel.gov/docs/fy19osti/73629.pdf>

²⁷⁴ Birklund J., Anholt Offshore Wind Farm. Benthic Fauna. Baseline Surveys and Impact Assessment. Final Report. DHI Group, 2009

²⁷⁵ Wilhelmsson D., Malm T., *Fouling assemblages on offshore wind power plants and adjacent substrata*. *Estuar. Coast. Shelf Sci.* 2008, 79: 459-66

²⁷⁶ Kerckhof F., Jacques T., Degraer S., Norro A., *Early development of the subtidal marine biofouling on a concrete offshore windmill foundation on the Thornton Bank (southern North Sea). First monitoring results*. *International Journal of the Society for Underwater Technology* 2010, 29 (3): 137-149

²⁷⁷ Bouma S., Lengkeek W., *Benthic communities on hard substrates of the offshore wind farm Egmond aan Zee (OWEZ). Including results of samples collected in scour holes. Final report*. Bureau Waardenburg bv, Culemborg 2012

²⁷⁸ Rostin L., Martin G., Herkul K., *Environmental concerns related to the construction of offshore wind parks. Baltic Sea case. Coastal Processes III*. WIT Transactions on Ecology and the Environment, 2013

²⁷⁹ Janßen H., Augustin C.B., Hinrichsen H.H., Kube S., *Impact of secondary hard substrate on the distribution and abundance of Aurelia aurita in the western Baltic Sea*. *Mar. Pollut. Bull.* 2013, 75: 224-234

²⁸⁰ Meissner W., *Przybrzeżne wody Bałtyku*, [w:] Wilk T., Jujka M., Krogulec J., Chylarecki P. (red.), *Ostoje ptaków o znaczeniu międzynarodowym w Polsce*. Ogólnopolskie Towarzystwo Ochrony Ptaków, Marki 2010: 531-532

²⁸¹ Lüdeke J., *Offshore Wind Energy. Good Practice in Impact Assessment, Mitigation and Compensation*. *Journal of Environmental Assessment Policy and Management* 2017, 19 (1): 1750005

²⁸² Wilding T., Gill A., Boon A., Sheehan E., Dauvin J., Pezy J., O'Beirn F., Janas U., Rostin L., De Mesel I., *Turning off the DRIP ('Data-rich, information-poor') – rationalizing monitoring with a focus on marine renewable energy developments and the benthos*. *Renewable and Sustainable Energy Reviews* 2017, 74: 848-859

²⁸³ Bergström L., Kautsky L., Malm T., Ohlsson H., Wahlberg M., Rosenberg R., Capetillo N.A., *The effects of wind power on marine life. A synthesis*. Report 6512. Swedish Environmental Protection Agency, Stockholm 2012

²⁸⁴ Topham E., Gonzalez E., McMillan D., João E., *Challenges of decommissioning offshore wind farms. Overview of the European experience*. *Journal of Physics: Conference Series* 2019, 1222: 012035

²⁸⁵ Topham E., McMillan D., Bradley S., Hart E., *Recycling offshore wind farms at decommissioning stage*. *Energy Policy* 2019, 129: 698-709

²⁸⁶ Polish Wind Energy Association, *The future of offshore wind in Poland*. PWEA Report, May 2019

²⁸⁷ Dziubińska A., Szaniawska A., *Short-term study on the early succession stages of fouling communities in the coastal zone of Puck Bay (southern Baltic Sea)*. *Oceanological and Hydrobiological Studies* 2010, 39 (4): 3-16

²⁸⁸ Bergström L., Kautsky L., Malm T., Rosenberg R., Wahlberg M., Capetillo N.A., Wilhelmsson D., *Effects of offshore wind farms on marine wildlife – a generalized impact assessment*, *Environmental Research Letters* 2014, 9 (3): 034012

²⁸⁹ Meissner W., *Przybrzeżne wody Bałtyku*, [w:] Wilk T., Jujka M., Krogulec J., Chylarecki P. (red.), *Ostoje ptaków o znaczeniu międzynarodowym w Polsce*. Ogólnopolskie Towarzystwo Ochrony Ptaków, Marki 2010: 531-532

²⁹⁰ Ojaveer H., Olenin S., Narščius A., Florin A.-B., Ezhova E., Gollasch S., Jensen K.R., Lehtiniemi M., Minchin D., Normant-Saremba M., Stråke S., *Dynamics of biological invasions and pathways over time: a case study of a temperate coastal sea*. *Biological Invasions* 2016, 19: 799-813

On the one hand, this is a positive phenomenon, since there will be an increase in local biodiversity in terms of species and habitat diversity, an increase in biological production, and a change in natural values of this microhabitat. A new place of refuge for the fry and attractive feeding grounds and spawning grounds for many fish species will appear, while the bay mussel (*Mytilus trossulus*) aggregations, a dominant species in the open waters of the Baltic Sea, quickly colonising the hard substrate and usually dominating on support structures, will constitute a new food supply for fish and seabirds, and also act as biofilters, especially in polluted and eutrophic waters.^{291, 292, 293, 294, 295}

On the other hand, the 'artificial reef' effect can be considered a negative impact, as the original character of that seabed habitat part will be lost. Furthermore, the presence of underwater, hard structures will constitute a new microhabitat contributing to the increase in biomass of the gelatinous zooplankton (medusae) whose polyps (settled form) attach to hard structure surfaces.²⁹⁶ However, primarily it is an artificial environment which was created in the place of the natural sandy and gravelly seabed that is conducive to propagation of invasive non-native species that are not native to the PMA.^{297, 298} On the basis of the surveys carried out as part of the update of the preliminary assessment of the environmental status of marine waters in 2011-2016, 5 new, introduced non-native species were identified, and all of them were the representatives of macrozoobenthos (molluscs, crustaceans). The information on new non-native species is collected on an ongoing basis in various databases, e.g. the AquaNIS Editorial Board 2015 (<http://www.corpi.ku.lt/databases/index.php/aquanis>) or the Ballast Water Exemption Decision Support Tool (http://jointbwmexemptions.org/ballast_water_RA/apex). The invasive non-native species quickly displace indigenous species, leading to changes in the existing balance in the trophic network.^{299, 300, 301} Currently it is a very serious problem in the southern Baltic that poses a risk to biodiversity and, consequently, changes in the structure and functioning of the inhabited ecosystems. This negative impact may also indirectly affect the economy, i.e. cause losses in the fishing and aquaculture industries.^{302, 303} However, the areas particularly at risk of introduction of non-native

²⁹¹ Vuorinen I., Antsulevich A., Maximovich N., Spatial distribution and growth of the common *Mytilus trossulus* L. in the archipelago of SW-Finland, northern Baltic Sea. *Boreal Environment Research* 2002, 7: 41-52

²⁹² Wilhelmsson D., Malm T., Fouling assemblages on offshore wind power plants and adjacent substrata. *Estuar. Coast. Shelf Sci.* 2008, 79: 459-466

²⁹³ Kyhn L.A., Tougaard J., Sveegaard S., Underwater noise from the drillship Stena Forth in Disko West, Baffin Bay, Greenland. NERI Technical Report No. 838. National Environmental Research Institute, Aarhus University, Denmark, 2011; available at: <http://www.dmu.dk/Pub/FR838.pdf>

²⁹⁴ Bergström L., Kautsky L., Malm T., Rosenberg R., Wahlberg M., Capetillo N.A., Wilhelmsson D., Effects of offshore wind farms on marine wildlife – a generalized impact assessment, *Environmental Research Letters* 2014, 9 (3): 034012

²⁹⁵ Meissner W., Przybrzeżne wody Bałtyku, [w:] Wilk T., Jujka M., Krogulec J., Chylarecki P. (red.), *Ostoje ptaków o znaczeniu międzynarodowym w Polsce. Ogólnopolskie Towarzystwo Ochrony Ptaków*, Marki 2010: 531-532

²⁹⁶ Janßen H., Augustin C.B., Hinrichsen H.H., Kube S., Impact of secondary hard substrate on the distribution and abundance of *Aurelia aurita* in the western Baltic Sea. *Mar. Pollut. Bull.* 2013, 75: 224-234

²⁹⁷ Bulleri F., Aioldi L., Artificial marine structures facilitate the spread of a nonindigenous green alga, *Codium fragile* ssp. *tomentosoides*, in the north Adriatic Sea. *J. Appl. Ecol.* 2005, 42: 1063-1072

²⁹⁸ Brodin Y., Andersson M.H., The marine splash midge *Telmatogon japonicas* (Diptera; Chironomidae) – extreme and alien? *Biol Invasions*, 2009, 11: 1311-1317

²⁹⁹ Janas U., Kendzierska H., Benthic non-indigenous species among indigenous species and their habitat preferences in Puck Bay (southern Baltic Sea). *Oceanologia* 2014, 56 (3): 603-628

³⁰⁰ Normant-Saremba M., Marszewska L., Kerckhof F., First record of the North-American amphipod *Melita nitida* Smith, 1873 in Polish coastal waters. *Oceanological and Hydrobiological Studies* 2017, 46 (1): 108-115

³⁰¹ Krzymiński W., Update of the preliminary assessment of the state of the environment of marine waters. Chief Inspectorate for Environmental Protection, Warsaw 2018; available at: http://rds.m.gios.gov.pl/images/aktualizacja_wstepnej_oceny_stanu_srodowiska_wod_morskich.pdf

³⁰² Tykarska M.B., Janas U., Gatunki obce – w Morzu Bałtyckim i w systemie prawnym. *Tutoring Gedanensis* 2017, 2 (1): 31-36

³⁰³ Krzymiński W., Update of the preliminary assessment of the state of the environment of marine waters. Chief Inspectorate for Environmental Protection, Warsaw 2018; available at: http://rds.m.gios.gov.pl/images/aktualizacja_wstepnej_oceny_stanu_srodowiska_wod_morskich.pdf

species are sea ports, which are the destinations of ships with ballast tanks and hulls carrying various kinds of plant and animal species, as well as pathogens brought from all over the world.³⁰⁴

An unambiguous scenario of colonisation of artificial substrates during the exploitation phase in the area of the BC-Wind OWF is difficult to predict. Based on experimental research³⁰⁵, it is assumed that underwater structures will be firstly colonised by barnacles (*Amphibalanus improvisus*) and bay mussels (*Mytilus* sp.), followed by mobile crustaceans (such as *Gammarus* spp., *Corophium volutator* and *Monoporeia affinis*) as well as macroalgae. The 'artificial reef' will partially compensate for the destroyed macrozoobenthos complex present there before human interference in the environment.

Nevertheless, monitoring during the exploitation phase will be necessary to further investigate the 'artificial reef' effect. This will also verify whether non-native species found mainly in the ports visited by transatlantic ships spread by plankton larvae and settle on the hard, artificial substrate in the open water zone of the Baltic Sea. It is assumed that this effect is unlikely, since the BC-Wind OWF will be located approx. 25 km away from the land and will comprise 39 wind turbines in the WWR 2024 variant. On the other hand, other offshore wind farms will also be located near this one, thus expanding the surface area of the new 'artificial reef' in the PMA.

It should be noted that for this impact, it is not the original complex of benthic communities of the BC-Wind OWF which is evaluated. Rather, the evaluation pertains to the impact of the 'artificial reef' on the natural environment. It is possible to evaluate only the scale of this phenomenon. The 'artificial reef' effect will be a long-term and permanent phenomenon, but, due to its local range, the impact was considered moderate (Tab. 9.13).

The analysed impact of the WWR variant on macrozoobenthos during the exploitation phase is smaller than the impact of the variant for which the Investor was granted the DEC (now the RAV 2024). The change relates to the significance of the impact of the BC-Wind OWF on the partial loss of hard-bottom macrozoobenthos habitat – from minor to negligible. In addition, for the OSS backup location located adjacent to the primary location, the impacts on macrozoobenthos during the exploitation phase will be analogous.

³⁰⁴ Krzywiński W., *Update of the preliminary assessment of the state of the environment of marine waters*. Chief Inspectorate for Environmental Protection, Warsaw 2018; available at: http://rdsm.gios.gov.pl/images/aktualizacja_wstepnej_oceny_stanu_srodowiska_wod_morskich.pdf

³⁰⁵ Dziubińska A., Szaniawska A., *Short-term study on the early succession stages of fouling communities in the coastal zone of Puck Bay (southern Baltic Sea)*. *Oceanological and Hydrobiological Studies* 2010, 39 (4): 3-16

Tab. 9.13. Assessment of the impact of an 'artificial reef' on the ecosystem in the area of the BC-Wind OWF (1 NM) during the exploitation phase in the WWR 2024 variant

Impact	Scale (size) of impact					Impact significance
	Character	Type	Spatial range	Time span	Size	
'Artificial reef' effect	Positive May also be negative	Direct	Local	Long-term Permanent	Large	Moderate

Source: own elaboration based on the EIA Report for the BC-Wind, MEWO S.A., 2021

Decommissioning phase

The decommissioning method will be decided several years before the end of the exploitation phase, which is estimated to last approx. 35 years. The decommissioning of the farm will be preceded by benthic surveys to determine the ecological quality of the ecosystem that will have been created during its operation.

During the phase of closure and decommissioning of the BC-Wind OWF, the following impacts on macrozoobenthos are expected to occur:

- disturbance of the seabed sediment structure;
- increased concentration of suspended solids in the water;
- sedimentation of suspended solids on the seabed;
- redistribution of pollutants from sediment into water;
- removal of artificial substrates of underwater wind turbine systems from the marine environment – decommissioning of the ‘artificial reef’.

The most important technical parameters of the OWF which are important from the point of view of the assessment of the impact of the project on macrozoobenthos during the closure and decommissioning phase are:

- the BC-Wind OWF Development Area;
- wind turbine foundations – the type and number of decommissioned foundations.

The assessment of the impact of wind turbines in the area of the BC-Wind OWF (1 NM) during the closure and decommissioning phase was carried out separately for:

- soft-bottom macrozoobenthos;
- hard-bottom macrozoobenthos.

A separate assessment of the impact of the project on macrozoobenthos is the result of these two benthic fauna communities (soft- and hard-bottom) differing in the taxonomic composition, abundance and biomass of their taxa. Consequently, they differ in significance and sensitivity regarding the various types of impact. The significance and sensitivity of the group of assessed organisms (the soft- and hard-bottom macrozoobenthos), together with the evaluation of the impact scale (nature of interactions, type of interactions, spatial extent, time scope), influence the assessment of a given impact significance.

The significance of the soft-bottom macrozoobenthos complex is low, while the significance of the hard-bottom macrozoobenthos complex is high. The sensitivity of macrozoobenthos is defined in Tab. 9.8.

After an average period of 20 to 25 years of the operation of the OWF, it will undergo the closure and decommissioning process. Because the decommissioning process of offshore wind farms built in Europe has begun only recently, the experience in carrying out this process from the technical, legal, logistic, economic, and also environmental impact perspective is very limited. So far, between 2015 and 2019, only seven minor offshore wind farms: three in the Baltic Sea (two in Sweden and one in Denmark) and four in the North Sea (two in the United Kingdom, one in the Netherlands and one in Germany) were disassembled. In Europe, there are no legal regulations and guidelines that would be adjusted to local environmental conditions and based on the experience gained from the decommissioning of oil and gas

platforms and expert knowledge.^{306, 307, 308, 309, 310, 311, 312} The manner of decommissioning of underwater OWF structures (full or partial removal of foundations, removal of cables or leaving the cables buried in the seabed) is of crucial importance for the impact on environment and its biotic elements, i.a. benthic fauna.

During the closure and decommissioning of the BC-Wind OWF, it is expected that the occurring impacts on the macrozoobenthos will be similar to those from the construction phase. This assessment assumes that most OWF facilities will be removed from the seabed in their entirety. However, the scale of impact of individual components will very much depend on the technical concept of this project and the type of foundations applied which is, currently, difficult to predict. Therefore, the impact evaluation at this stage stipulates the worst-case scenario for the macrozoobenthos.

The structure of seabed sediments may be disturbed as a result of the removal of foundations and/or support structures, as well as cables connecting the wind turbines from the seabed and during the operation of jack-up type vessels. The removal methods depend not only on the local environmental conditions, but also on the types of foundations and the available ships and tools³¹³, which will have a decisive influence on the scale of the discussed impact. This will result in physical destruction (e.g. crushing, scraping off, elimination from the natural environment) and increased mortality of the benthic fauna, which will have inhabited the seabed around the foundations and/or supporting structures and along the cable routes during the exploitation phase of the OWF.^{314, 315, 316}

Due to the moderate sensitivity of both the soft- and hard-bottom macrozoobenthos complexes to this impact, it is assumed that full regeneration of habitats in the place of the removed facilities may take up to several years from the moment of the impact factor cessation. This process is faster for polychaetes and slower for bivalves. At present, the technical concept for removing the underwater OWF structures is unknown; therefore, the scale of this impact may be smaller than the similar impact from the construction phase. With such an assumption, both for the moderate and low scale of impact, the significance of the disturbance of the seabed sediment structure in the OWF decommissioning phase will be low (Tab. 9.14, Tab. 9.15).

³⁰⁶ Bergström L., Kautsky L., Malm T., Ohlsson H., Wahlberg M., Rosenberg R., Capetillo N.A., *The effects of wind power on marine life. A synthesis. Report 6512. Swedish Environmental Protection Agency, Stockholm 2012*

³⁰⁷ Smith G., Lamont G., *Decommissioning of Offshore Wind Installations – What we can Learn. Presented at Offshore Wind Energy, 6–8 June 2017, London, 2017*

³⁰⁸ Fowler A.M., Jørgensen A., Svendsen J., Macreadie P., Jones D., Boon A., Booth D., Brabant R., Callahan E., Claisse J., Dahlgren T., Degraer S., Dokken Q., Gill A., Johns D., Leewis R., Lindeboom H., Linden O., May R., Murk A., Ottersen G., Schroeder D., Shastri S., Teilmann J., Todd V., Van Hoey G., Vanaverbeke J., Coolen J., *Environmental benefits of leaving offshore infrastructure in the ocean. Front. Ecol. Environ. 2018, 16 (10): 571-578*

³⁰⁹ Kruse M., Lindaas J., Olivares A., Korporaal H., de Keijzer D., Ring H., Kotzur S., Bentin M., Askari H., Rasmussen M., Skyt P., Larsen J., Kromann Bie J., Stubbe W., Motmans S., de Pauw B., Sünner I., Kallio N., Maheri A., Ivanovich A., Klinge I., Stensgaard S., Carstensen H., *Eco-innovative concepts for the end of offshore wind energy farms lifecycle. Interreg North Sea Region. Market analysis. DecomTools. Interreg North Sea Region – Project Number: 20180305091606, 2019*

³¹⁰ Topham E., Gonzalez E., McMillan D., João E., *Challenges of decommissioning offshore wind farms. Overview of the European experience. Journal of Physics: Conference Series 2019, 1222: 012035*

³¹¹ Topham E., McMillan D., Bradley S., Hart E., *Recycling offshore wind farms at decommissioning stage. Energy Policy 2019, 129: 698-709*

³¹² Raveling J., *How do you decommission an offshore wind turbine? WFB Wirtschaftsförderung Bremen GmbH, 2020; available at: <https://www.wfb-bremen.de/en/page/stories/internationales/how-decommission-offshore-wind-turbine>*

³¹³ Nedwell J., Langworthy J., Howell D., *Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms, and comparison with background noise. Report No. 544 R 04. Report commissioned by COWRIE. Subacoustech Ltd, Southampton 2003*

³¹⁴ Köller J., Koppel J., Peters W. (ed.), *Offshore wind energy. Research on environmental impacts. Springer-Verlag, Berlin-Heidelberg 2006*

³¹⁵ Zalewska T., *Radionuklidy pochodzenia antropogenicznego, [w:] Zalewska T., Jakusik E., Łysiak-Pastuszek E., Krzywiński W. (red.), Bałtyk Południowy w 2011 roku. Charakterystyka wybranych elementów środowiska. Instytut Meteorologii i Gospodarki Wodnej, Państwowy Instytut Badawczy, Warszawa 2012*

³¹⁶ Birklund J., *Sensitivity of benthic fauna and flora, [w:] Benthic Communities and Environmental Impact Assessment of the planned Rødsand 2 Offshore Wind Farm. Dong Energy, 2007*

Increased concentration of suspended solids in water will occur as a result of the disturbance of the seabed sediment structure during works related to the disassembly of foundations and/or supporting structures and cables. These works will cause sediment to rise from the seabed and disperse in the water.^{317, 318} It should be expected that the disassembly works are carried out in stages and may be of lesser intensity and range than similar works during the construction phase. The dominant negative effect of this impact is possible clogging of the filtering systems of macrozoobenthos representatives that feed in that way.^{319, 320}

The sensitivity of the soft-bottom macrozoobenthos inhabiting the area of the BC-Wind OWF to this impact is negligible and low for the hard-bottom macrozoobenthos complex comprising the aggregations of the *Mytilus trossulus* mussel.

It follows from the conducted model analyses of suspended solid dispersion within the area of the BC-Wind OWF that the higher suspended solids concentrations (from 30 mg to more than 100 mg·l⁻¹) have a local range in relation to the location of the conducted dredging works, and their impact range does not exceed 1100 m for cohesive sediments and 220 m for non-cohesive sediments (Appendix 2 to the EIA Report, Volume III).

Taking into account the sensitivity of individual macrozoobenthos complexes, i.e. negligible for the soft-bottom macrozoobenthos and low for the hard-bottom macrozoobenthos, and the scale of the described impact estimated as negligible for the soft-bottom macrozoobenthos and low for the hard-bottom macrozoobenthos, the significance of the increased suspended solids concentration in the area of the BC-Wind OWF was evaluated as negligible for macrozoobenthos (Tab. 9.14, Tab. 9.15).

Sedimentation of suspended solids on the seabed is an impact of negative character, as it leads to covering macroinvertebrates with an additional layer of sediment that restricts the access of benthic organisms to oxygen.^{321, 322} Especially sensitive to this impact is epifauna, i.e. the fraction of macrozoobenthos living on the sediment surface, as compared to infauna, i.e. animals living within the sediments that have better movement abilities.^{323, 324}

The results of the model calculations of the dispersion of suspended solids in the area of the BC-Wind OWF included in Appendix 2 to the EIA Report indicate that the average thickness of sediments in the entire area of the BC-Wind OWF deposited as a result of the conducted works will not exceed 1.4 mm for a cohesive seabed and 0.3 mm for a non-cohesive seabed. Due to the local nature of this impact, the entire benthic complex will be subject only to a short-term exposure to unfavourable conditions.

It was determined that the sensitivity of both macrozoobenthos complexes in the area of the BC-Wind OWF to the sedimentation of suspended solids on the seabed is low. Given the small scale of this impact, it was concluded that the significance of the impact of this factor on the benthic fauna will be negligible (Tab. 9.14, Tab. 9.15).

³¹⁷ Leonhard S., EIA Report. Benthic communities. Horns Rev 2 Offshore Wind Farm. No. 2706-03-003 Rev. 4, 2006

³¹⁸ Zalewska T., Radionuklidy pochodzenia antropogenicznego, [w:] Zalewska T., Jakusik E., Łysiak-Pastuszek E., Krzysiński W. (red.), Bałtyk Południowy w 2011 roku. Charakterystyka wybranych elementów środowiska. Instytut Meteorologii i Gospodarki Wodnej, Państwowy Instytut Badawczy, Warszawa 2012

³¹⁹ Moore P.G., Inorganic particulate suspensions in the sea and their effects on marine animals. *Oceanography and Marine Biology: An Annual Review* 1977, 15: 225-363

³²⁰ Miller D.C., Muir C.L., Hauser O.A., Detrimental effects of sedimentation on marine benthos. What can be learned from natural processes and rates? *Ecological Engineering* 2002, 19: 211-232

³²¹ Hinchey E.K., Schaffner L., Hoar C., Vogt B., Batte L., Response of estuarine benthic invertebrates to sediment burial. The importance of mobility and adaptation. *Hydrobiologia* 2006, 556 (1): 85-98

³²² Birklund J., Anholt Offshore Wind Farm. Benthic Fauna. Baseline Surveys and Impact Assessment. Final Report. DHI Group, 2009

³²³ Miller D.C., Muir C.L., Hauser O.A., Detrimental effects of sedimentation on marine benthos. What can be learned from natural processes and rates? *Ecological Engineering* 2002, 19: 211-232

³²⁴ Hinchey E.K., Schaffner L., Hoar C., Vogt B., Batte L., Response of estuarine benthic invertebrates to sediment burial. The importance of mobility and adaptation. *Hydrobiologia* 2006, 556 (1): 85-98

The redistribution of pollutants from sediments into water that will occur during the OWF decommissioning phase and its negative impact on macrozoobenthos will depend on the concentration of heavy metals and persistent organic pollutants identified in the seabed sediments of the BC-Wind OWF Area (1 NM). Toxic compounds, when transferred from sediments to the water, may accumulate in benthic fauna tissues, causing its mortality.^{325, 326, 327}

Taking into account the irrelevant sensitivity of both of the assessed macrozoobenthos complexes and the scale of the impact determined to be negligible in accordance with the results of geochemical surveys provided in Appendix 1 to the EIA Report (low concentrations of substances that are toxic and harmful to benthic fauna in the survey area), this impact of negligible significance will not cause any significant changes in the physiology of the soft- and hard-bottom macrozoobenthos inhabiting the area of the OWF (1 NM) (Tab. 9.14, Tab. 9.15).

³²⁵ Szaniawska A., *Gospodarka energetyczna bezkręgowców bentosowych występujących w Zatoce Gdańskiej. Praca habilitacyjna.* Wydawnictwo UG, Gdańsk 1991

³²⁶ Dembska G., *Metale śladowe w osadach Portu Gdańskiego. Praca doktorska. Wydział Biologii, Geografii i Oceanologii, Uniwersytet Gdański, Gdańsk 2003*

³²⁷ Hummel H., Sokółowski A., Bogaards R., Wołowicz M., *Ecophysiological and genetic traits of the baltic clam Macoma balthica in the Baltic: Differences between populations in the Gdańsk Bay due to acclimatization or genetic adaptation? Intern. Rev. Hydrobiol. 2000, 85: 621-637*

Tab. 9.14. Assessment of the impact of wind turbines on the soft-bottom macrozoobenthos in the area of the BC-Wind OWF (1 NM) during the closure and decommissioning phase in the WWR 2024 variant

Impact	Soft-bottom macrozoobenthos complex characteristics		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Disturbance of the seabed sediment structure	Low	Moderate	Negative	Direct	Local	Medium-term Permanent	Low/Moderate	Low
Increase in the content of suspended solids in the water	Low	Negligible	Negative	Direct	Local	Short-term Temporary	Negligible	Negligible
Sedimentation of suspended solids on the seabed	Low	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Redistribution of pollutants from the sediment into the water	Low	Negligible	Negative	Direct	Local	Short-term	Negligible	Negligible

Source: own elaboration based on the EIA Report for the BC-Wind, MEWO S.A., 2021

Tab. 9.15. Assessment of the impact of wind turbines on the hard-bottom macrozoobenthos in the area of the BC-Wind OWF (1 NM) during the closure and decommissioning phase in the WWR 2024 variant

Impact	Hard-bottom macrozoobenthos complex characteristics		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Disturbance of the seabed sediment structure	High	Moderate	Negative	Direct	Local	Medium-term Permanent	Low/Moderate	Low
Increase in the content of suspended solids in the water	High	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Sedimentation of suspended solids on the seabed	High	Low	Negative	Direct	Local	Short-term Temporary	Low	Negligible
Redistribution of pollutants from the sediment into the water	High	Negligible	Negative	Direct	Local	Short-term	Negligible	Negligible

Source: own elaboration based on the EIA Report for the BC-Wind, MEWO S.A., 2021

Removal of artificial substrates of the underwater structures of wind turbines will result in irreversible, permanent elimination of the periphyton complexes of the 'artificial reef', and destruction of benthos around each foundation, as well as yet another restructuring of the qualitative and quantitative structure of the macrozoobenthos complex that inhabited the seabed at this location during the several dozen years of the operation of the OWF. To the best of the currently available knowledge, it is difficult to clearly predict how quickly the environment will return to the state from before the impact of the factor and what nature of this impact (negative or positive) will prevail. However, based on the experience gained during the decommissioning of the OWF foundations commenced in the several recent years and, predominantly, during the decommissioning of oil and gas platforms, most researchers clearly state that leaving underwater structures together with the 'artificial reef' will benefit the environment more, provided that it had positively affected the local ecosystem. They recommend maintaining the biodiversity in these locations and not eliminating new resources with a certain ecological value (positive significance of the benthos in the trophic network) or even economic value (fish). However, it should be taken into account that these scenarios refer to a situation in, i.a., sea areas with higher salinity than the Baltic Sea, and they refer to the 'artificial reef' forming on truss-type foundations.^{328, 329, 330} The monitoring during the exploitation phase of the BC-Wind OWF will provide information on whether the 'artificial reef' that will be created in the BC-Wind OWF area will be a phenomenon with a positive impact that will allow for a recommendation of only a partial removal of the OWF foundations. Currently, it is known that in connection with the removal of artificial substrates, biodiversity will be reduced and that there will be a local reduction in the resources of zoobenthos, which is an additional food supply for fish and seabirds, which is a negative impact. However, the scale of this phenomenon is moderate at most, as it will pertain to only 39 foundations stipulated in the WWR 2024. On the other hand, the original natural state of the seabed habitats in the OWF area will be restored, which is a positive impact. The assessment of the effect of the decommissioning of the 'artificial reef' in the BC-Wind OWF Area (1 NM) is presented in the table below (Tab. 9.16). Even taking into account the very high sensitivity of periphytic fauna and flora, this impact was considered moderate.

The conducted analysis of the impact of the WWR variant on macrozoobenthos during the decommissioning phase does not change the results of the analysis conducted for the purposes of the variant for which the Investor was granted the DEC (now the RAV 2024). In addition, for the OSS backup location located adjacent to the primary location, the impacts on macrozoobenthos during the decommissioning phase will be analogous.

³²⁸ Sommer B., Fowler A.M., Macreadie P.I., Palandro D.A., Aziz A.C., Booth D.J., Decommissioning of offshore oil and gas structures. *Environmental opportunities and challenges. Science of the Total Environment* 2019, 658: 973-981

³²⁹ Fowler A.M., Jørgensen A., Svendsen J., Macreadie P., Jones D., Boon A., Booth D., Brabant R., Callahan E., Claisse J., Dahlgren T., Degraer S., Dokken Q., Gill A., Johns D., Leewis R., Lindeboom H., Linden O., May R., Murk A., Ottersen G., Schroeder D., Shastri S., Teilmann J., Todd V., Van Hoey G., Vanaverbeke J., Coolen J., *Environmental benefits of leaving offshore infrastructure in the ocean. Front. Ecol. Environ.* 2018, 16 (10): 571-578

³³⁰ Topham E., McMillan D., Bradley S., Hart E., Recycling offshore wind farms at decommissioning stage. *Energy Policy* 2019, 129: 698-709

Tab. 9.16. Assessment of the impact of decommissioning the 'artificial reef' in the area of the BC-Wind OWF (1 NM) in the WWR 2024 variant

Impact	Periphytic fauna and flora characteristics in terms of impact		Scale (size) of impact					Impact significance
	Significance	Sensitivity	Character	Type	Spatial range	Time span	Size	
Decommissioning of the 'artificial reef' (removal of the artificial substrate of underwater wind turbine installations from the marine environment)	High	Very high	Negative May also be positive	Direct	Local	Long-term	Moderate	Moderate

Source: own elaboration based on the EIA Report for the BC-Wind, MEWO S.A., 2021

9.4.3. Ichthyofauna

Construction phase

The main impacts on ichthyofauna will be as follows:

- emission of noise and vibration;
- increased suspended solids concentration;
- release of pollutants and nutrients from sediments into water;
- habitat change;
- barrier creation.

Emission of noise and vibration

The main source of acoustic interference in the construction phase is the driving of foundation components of the wind turbines into the seabed (piling). The noise related to this process may negatively affect marine organisms.³³¹ According to Popper and Hastings³³², piling is the only noise source, apart from underwater explosions, that can result in fish deaths.

The sound generated during piling is of pulsating nature, characterised by a short duration (<1 s) and a bandwidth between 100 Hz and 1000 Hz, however most of its energy falls within the range of up to 500 Hz³³³. The level of noise emitted during piling depends mainly on the technical parameters of the process (pile diameter, technology of pile driving, force and frequency of pile driver strikes). Some of the technological requirements are, in turn, dependent on the environmental conditions (depth, type of sediment). The values of sound level related to piling are usually expressed in two categories of units.

The first category refers to the sound pressure level and represents the maximum/minimum value of pressure recorded for a single pulse [SPL_{peak}], or the value corresponding to the range between the maximum values of the over- and underpressure [$SPL_{peak-peak}$]. The sound intensity expressed in such units is correlated with the behavioural reactions.

The second category of units refers to the exposure to sound and represents the cumulated sound energy for a single pulse (SEL_{ss}) or for several pulses ($SEL_{cum.}$). This parameter is correlated with physical damage: tissue damage, PTS – permanent shift of the hearing threshold, TTS – temporary shift of the hearing threshold and, for fish with a swim bladder – reversible hearing damage.³³⁴

Sound exposure level (SEL) during piling depends on the pile diameter and can reach from approx. 230 dB re: 1 μPa^2s (pile diameter of 1.5 m)³³⁵ to nearly 260 dB re: 1 μPa^2s (pile diameter of 4.5 m)³³⁶ in the immediate vicinity of the source. The values measured at a distance of 750 m from the sound source, available in literature, in the case of SEL_{ss} range from 157 dB re: 1 μPa (pile diameter of 0.9 m) up to 180 dB re: 1 μPa (pile diameter of 5 m); whereas, for SPL_{peak} , they fall between 183 dB re: 1 μPa^2s (pile diameter of 0.9 m) and 200 dB re: 1 μPa^2s (pile diameter of 4 m).³³⁷

Many authors dealing with the issues of the impact of acoustic stimuli on fish underline the great difficulties in determining the noise levels at which particular effects occur and which could be used as

³³¹ OSPAR Commission, *Overview of the impacts of anthropogenic underwater sound in the marine environment*. Publication Number: 441/2009, 2009

³³² Popper A.N., Hastings M.C., *The effects of human-generated sound on fish*. Integrative Zoology 2009, 4: 43-52

³³³ Dahl P.H., de Jong C., Popper A.N., *The underwater sound field from impact pile driving and its potential effects on marine life*. Acoustics Today 2015, 11, 18-25

³³⁴ Popper A.N., Hawkins A.D., *An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes*. J. Fish Biol. 2019, 94: 692-713

³³⁵ Thomsen F., Lüdemann K., Kafemann R., Piper W., *Effects of offshore wind farm noise on marine mammals and fish*. biola, Hamburg, Germany on behalf of COWRIE Ltd. 2006

³³⁶ OSPAR Commission, *Overview of the impacts of anthropogenic underwater sound in the marine environment*. Publication Number: 441/2009, 2009

³³⁷ Andersson M.H., Andersson S., Ahlsén J., Andersson B.L., Hammar J., Persson L.K.G., Pihl J., Sigray P., Wikström A., *A framework for regulating underwater noise during pile driving. A technical Vindval report. Report 6775*. Swedish Environmental Protection Agency, Stockholm 2016

universal values for ichthyofauna. This stems, first of all, from the differences in the anatomical structure of the auditory system, mainly the morphology of the swim bladder.^{338, 339} An additional handicap is the fact that the majority of experiments are carried out in enclosed tanks, and translating their results to natural environment conditions may be vitiated by a major error.

The latest available recommendation for sound limits that cause physical injury to fish was provided by Andersson et al.³⁴⁰ on the basis of experimental data. The minimum sound values at which physical injury to internal organs or death occurs are presented in the table below (Tab. 9.17).

Tab. 9.17. Recommendations for establishing thresholds for the noise generated during piling that can cause physical injury to fish

Unit	Adult fish and juvenile stages	Roe and larvae
SPL _{peak}	207 dB re 1 μ Pa	217 dB re 1 μ Pa
SEL _{ss}	174 dB re 1 μ Pa ² s	187 dB re 1 μ Pa ² s
SEL _{cum.*}	204 dB re 1 μ Pa ² s	207 dB re 1 μ Pa ² s

* Cumulative exposure value corresponding to 960 pulses or 24 minutes of exposure

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 204

It should be underlined that the SEL_{cum.} value of 204 dB re: 1 μ Pa²s is a conservative value. The occurrence of irreversible body injuries was observed at higher values of this parameter (207 dB re: 1 μ Pa²s), whereas the SEL_{cum.} value of 204 dB caused reversible injuries that may subside in favourable conditions (no pressure from predators, good availability of food and favourable environmental parameters).³⁴¹ At the same time, Andersson et al.³⁴² underline that the provided value is the effect of the sound exposure lasting 24 minutes. During this time, a fish may migrate away from the area of increased exposure: for both cod and herring, this may be a distance exceeding 1000 m.

Approximate sound levels at which individual impacts occur are provided by Popper et al.³⁴³ In their deliberations, these authors also consider the dependence of the impact effect on the structure of the fish auditory system and provide values at which a temporary threshold shift of hearing may occur (TTS) (Tab. 9.18). Fish without a swim bladder (e.g. adult flatfish, common seasnail, round goby) or fish in which the swim bladder is far away from the ear (e.g. salmon) are only able to perceive the movement of water particles, but not pressure changes. This is due to the narrow range of frequencies they hear (usually up to approx. 500 Hz) and the higher hearing threshold. In the case of fish with a swim bladder located close to or directly connected to the ear (e.g. cod and clupeids, sand goby), the hearing threshold is lower and the range of frequencies perceived can reach 3000 Hz to 4000 Hz (Tab. 9.18).

³³⁸ Andersson et al. 2016...

³³⁹ Popper and Hawkins 2019...

³⁴⁰ Andersson et al. 2016...

³⁴¹ Popper and Hawkins 2019...

³⁴² Andersson et al. 2016...

³⁴³ Popper A.N., Hawkins A.D., Fay R.R., Mann D., Bartol S., Carlson T., Coombs S., Ellison W.T., Gentry R.L., Halvorsen M.B., Løkkeborg S., Rogers P.H., Southall B., Zeddis D.G., Tavalga W.N., Sound Exposure Guidelines for Fishes and Sea Turtles. A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014. Springer Cham, Heidelberg–New York–Dordrecht–London 2014

Tab. 9.18. Impact of a pile driver sound on ichthyofauna, taking into account morphology and developmental stage. For impact effects for which it was impossible to determine the sound level, the relative risk (low, moderate, high) was determined depending on the distance from the source of the sound: (C) close – several dozen meters, (M) moderately far – several hundred meters, (F) far – several thousand meters. Units for peak values: dB re 1 μ Pa and for the cumulative SEL value: dB re 1 μ Pa²s

Type of organism	Mortality and potential lethal damage	Renewable damage	Temporary Threshold Shift (TTS)	Masking	Behavioural changes
Fish without a swim bladder (detection of molecule movement), e.g. flatfish	>219 dB SEL _{cum} >213 dB _{peak}	>216 dB SEL _{cum} >213 dB _{peak}	>186 dB SEL _{cum}	(C) moderate (M) low (F) low	(C) high (M) moderate (F) low
Fish with a swim bladder unconnected to the inner ear (detection of molecule movement), e.g. Atlantic salmon	210 dB SEL _{cum} >207 dB _{peak}	203 dB SEL _{cum} >207 dB _{peak}	>186 dB SEL _{cum}	(C) moderate (M) low (F) low	(C) high (M) moderate (F) low
Fish with a swim bladder connected to the inner ear (sound pressure detection), e.g. Atlantic cod, herring	207 dB SEL _{cum} >207 dB _{peak}	203 dB SEL _{cum} >207 dB _{peak}	186 dB SEL _{cum}	(C) high (M) high (F) moderate	(C) high (M) high (F) moderate
Roe and larvae	>210 dB SEL _{cum} >207 dB _{peak}	(C) moderate (M) low (F) low	(C) moderate (M) low (F) low	(C) moderate (M) low (F) low	(C) moderate (M) low (F) low

Source: EIA Report for BC-Wind, MEWO S.A., 2021

Data on cod indicates that a behavioural response can be expected from the level of 140-160 dB re: 1 μ Pa SPL_{peak}. In the case of sprat (sound recording range similar to herring), changes in behaviour were observed at SPL (peak-peak) levels of 163 dB re: 1 μ Pa and SEL_{ss} 135 dB re 1 μ Pa²s³⁴⁴. It may be assumed that the basic reaction of fish will involve abandoning the area in which the increased level of noise is present. According to Hammar et al.³⁴⁵, the spawning of cod may be significantly disrupted during the construction phase of the project in the vicinity of the spawning grounds. The authors recommend the piling and submarine cable-laying to be suspended in the spawning period of this species. However, some studies indicate that fish may remain in the area subject to such impact, if this conditions their survival or success of their reproduction processes.^{346, 347} A similar effect was observed during the feeding migrations of herring, during which the response to sound was observed at higher noise levels than in other circumstances. The US National Marine Fisheries Service assumes 150 dB re: 1 μ Pa (rms) (unit based on the root mean square of energy per pulse) as the limit from which the behavioural changes in fish can occur. However, the adoption of a criterion based on a single value, which does not take into consideration the varied sensitivity to sound of different fish species and is not based on survey results, is highly questionable.^{348, 349}

³⁴⁴ Hawkins A.D., Pembroke A., Popper A., Information gaps in understanding the effects of noise on fishes and invertebrates. *Reviews in Fish Biology and Fisheries* 2015, 25: 39-64

³⁴⁵ Hammar L., Wikström A., Molander S., Assessing ecological risks of offshore wind power on Kattegat cod. *Renewable Energy* 2014, 66: 414-424

³⁴⁶ Wardle C.S., Carter T.J., Urquhart G.G., Johnstone A.D.F., Ziolkowski A.M., Hampson G., Mackie D. Effects of seismic air guns on marine fish. *Cont. Shelf Res.* 2001, 21: 1005-1027

³⁴⁷ Pena H., Handegard N.O., Ona E., Feeding herring schools do not react to seismic air gun surveys. *ICES Journal of Marine Science* 2013, 70: 1174-1180

³⁴⁸ Andersson et al. 2016...

³⁴⁹ Popper and Hawkins 2019...

Andersson et al.³⁵⁰ believe that the available data does not support the determination of noise levels that are universal across ichthyofauna, at which temporary threshold shifts in hearing (TTS), as well as masking effects and behavioural changes occur. This stems from the interspecies differences in response to sound frequency and intensity.

In the current DEC for the BC-Wind OWF, an obligation was introduced under point (I.3.8) to achieve $SEL_{cum.} = 186 \text{ dB re } 1 \mu\text{Pa} \cdot \text{s}^{-1}$ for fish with a swim bladder in the context of the potential impact on TTS in these fish at a distance of 11 km.

However, this threshold is not reliable in the context of the current knowledge on the subject and aforementioned analyses, as:

- The threshold is based on studies conducted on pike (*Esox lucius*), broad whitefish (*Coregonus nasus*) and lake chub (*Couesius plumbeus*) – freshwater fish – exposed to airgun noise ($SEL_{cum.}$ of 186 dB $1 \mu\text{Pa}^2\text{s}$ at different frequencies, from 100 to 1600 Hz) (Popper et al., 2005). Air gun noise is the impulsive noise that is most similar to pile driving, with highest energy between 20-50 Hz and decreasing energy at frequencies higher than 200 Hz;
- There are too few species-specific studies that can be used to determine saltwater species-specific noise levels. The levels proposed in literature on the subjects are based on studies of specific species, so cannot be applied to all fish species. They are also not weighted by the frequencies of the hearing ranges of fish;
- Fish show great variation in auditory sensitivity depending not only on the species, but on the anatomy of the auditory system, the weight of the fish, and other aspects of their biology, such as preferred depths. It is not possible to indicate a universal threshold value for impulse noise representing the limit of risk for fish. What is more, behavioural response (including escaping and/or remaining exposed to the noise and its accumulation) is also strongly dependent on both sound pressure and frequency, and may vary according to sex, age, condition, functional stage, and the importance of the area for the survival and/or reproduction of the fish.

In addition, the study area does not play a major role in the overall spawning success of most fish species, therefore the 11 km limitation does not result in the protection of important or large spawning grounds (such spawning grounds do not occur within 11 km of the BC Wind OWF).

For fish without a swim bladder, a quantitative assessment was not feasible. The results of recent studies on the effects of noise on fish without a swim bladder have shown that for this group of fish, the important auditory stimulus is particle movement rather than pressure. As shown by Popper and Hawkins³⁵¹, only a subset of fish species is sensitive to sound pressure, while all fish are sensitive to particle movement. There is very little data on particle movement caused by anthropogenic activities at sea and the aforementioned authors clearly recommended the development of guidelines for the assessment of sound effects on fish that would take particle movement into account. Therefore, there are no criteria that would form the basis for performing an impact assessment on fish without a swim bladder as a result of particle movement at the present. A qualitative assessment was thus carried out for this group of fish based on a review of the available literature. Relatively recently, Sigray et al.³⁵² first documented measurements of particle movement during the construction of an offshore wind farm in the German Bight (6 MW turbines with a nominal hammer energy of 1600 kJ). They showed that mitigation techniques based on the same assumptions as those used in the present study significantly reduced particle motion levels (i.e. to 23 dB re $1 \mu\text{m/s}^2$ s^2 - particle acceleration)), as well as lowered the power content of higher frequencies. These results suggest that the planned mitigation measure has an effect reducing the ranges of impact on marine species, including fish without a swim bladder.

³⁵⁰ Andersson et al. 2016...

³⁵¹ Popper, A. N., and Hawkins, A. D. (2018). The importance of particle motion to fishes and invertebrates, *The Journal of the Acoustical Society of America* 143, 470-488

³⁵² Sigray, P., Linné, M., Andersson, M. H., Nöjd, A., Persson, L. K. G., Gill, A. B., and Thomsen, F. (2022). Particle motion observed during offshore wind turbine piling operation, *Marine Pollution Bulletin* 180, 113734

Other sources of noise emissions in the construction phase will be the burial of cables connecting the wind turbines and the cables connecting the connection infrastructure. Very little information is available in literature on the noise emitted during this type of work. According to Nedwell and Howell³⁵³, the noise level during dredging works for cables was 178 dB re: 1 $\mu\text{Pa}^2\text{s}$ at a distance of 1 meter from the sound source. A higher value of 187 dB re: 1 $\mu\text{Pa}^2\text{s}$ is given by Taormina et al.³⁵⁴

In the majority of studies^{355, 356, 357, 358}, it is assumed that the impact of this factor on marine organisms will be relatively small. However, at the same time, most authors emphasise that a final assessment of the significance of this factor requires the acquisition of more data on noise levels generated during cable-laying.

Increased vessel traffic can be expected during the construction phase of the project. The noise generated by vessels reaches, depending on the size and speed of the vessel, from 160 to 190 $\mu\text{Pa}^2\text{s}$ ³⁵⁹, and appears to pose less of a threat than the sound sources associated directly with construction works.

For the purpose of this Report, the propagation of underwater noise during piling was remodelled, also taking into account fish with swim bladders. The results of this remodelling were achieved for the most conservative approach, i.e. for a $\text{SEL}_{\text{cum.}}$ threshold of 186 dB re 1 $\mu\text{Pa} \cdot \text{s}^{-1}$ in the context of potential effects on TTS in fish at a distance of 11 km, and for the location of the power plant in the deepest part of the BC-Wind basin, in order to capture the largest possible range of noise propagation (most foundations will be sited at shallower depths, so noise propagation will be smaller).

In addition, the range of $\text{SEL}_{\text{cum.}} = 186 \text{ dB re } 1 \mu\text{Pa} \cdot \text{s}^{-1}$ using a single and Double Big Bubble Curtain for single piling (Tab. 9.19) was additionally analysed with reference to $\text{PTS}_{\text{cum.}}$, which is defined as reversible hearing damage in fish. The reference to $\text{PTS}_{\text{cum.}}$ was used e.g., by the authors of the noise modelling for the Baltica-1 OWF³⁶⁰, indicating that fish have the ability to restore the cells responsible for perceiving sounds. Therefore '*...the impact defined as permanent hearing damage (PTS) defined for marine mammals is not accurate in the case of fish, and should be considered as reversible*'³⁶¹. Furthermore, the extent of noise mitigation for seals and porpoises was also cited for comparison.

Tab. 9.19. Maximum range for cumulative TTS and PTS for seals, harbour porpoises and fish with a swim bladder (in kilometres)

Receptor	Maximum impact range [km]					
	Big Bubble Curtain (BBC)		Double Big Bubble Curtain (DBBC)		Hydro Sound Damper (HSD)	
	TTS _{cum.}	PTS _{cum.}	TTS _{cum.}	PTS _{cum.}	TTS _{cum.}	PTS _{cum.}
	[km]	[km]	[km]	[km]	[km]	[km]
Fish with a swim bladder	46.8	4.9	31.4	2.9	9.2	0.4
Seals	7.2	0.1	3.7	0.1	0.1	0.1
Harbour porpoises	0.2	0.1	0.1	0.1	0.1	0.1

Source: working material developed as part of noise propagation modelling

³⁵³ Nedwell J., Howell D., A review of offshore windfarm related underwater noise sources Report No. 544 R 0308. Report commissioned by COWRIE. Subacoustech Ltd, Southampton 2004

³⁵⁴ Taormina B., Bald J., Want A., Thouzeau G., Lejart M., Desroy N., Carlier A., A review of potential impacts of submarine power cables on the marine environment. Knowledge gaps, recommendations and future directions. Renewable and Sustainable Energy Reviews 2018, 96: 380-391

³⁵⁵ Meissner K., Schabelon H., Bellebaum J., Sordyl H., Impacts of Submarine Cables on the Marine Environment. A Literature Review. Institute of Applied Ecology (IfAO), Neu Broderstorf 2006

³⁵⁶ OSPAR Commission, Background Document on potential problems associated with power cables other than those for oil and gas activities. Biodiversity Series. Publication Number: 370/2008, 2008

³⁵⁷ OSPAR Commission, Guidelines on Best Environmental Practice (BEP) in Cable Laying and Operation. Agreement 2012-2. OSPAR 12/22/1, Annex 14, 2012

³⁵⁸ Taormina et al. 2018...

³⁵⁹ OSPAR 2008...

³⁶⁰ Environmental Impact Report for the Baltica-1 OWF. Appendix 3. Numerical modelling of noise propagation generated by piling in the area of the Baltica-1 OWF, MEWO Subsea Solutions, August 2024

³⁶¹ Environmental Impact Report for the Baltica-1 OWF. Appendix 3. Numerical modelling of noise propagation generated by piling in the area of the Baltica-1 OWF, MEWO Subsea Solutions, August 2024 (p. 46)

These results indicate that the use of a single Big Bubble Curtain makes it possible to achieve the threshold for seals and harbour porpoises established in the DEC for the BC-Wind OWF, and enables the PTS for fish to be reached at a distance of 4.9 km.

Using the cited modelling results of the maximum noise range (i.e. up to a threshold of 186 db re 1 $\mu\text{Pa} \cdot \text{s}^{-1}$), the figures below have been prepared showing these ranges in the context of areas that are potential spawning grounds and in relation to protected areas.

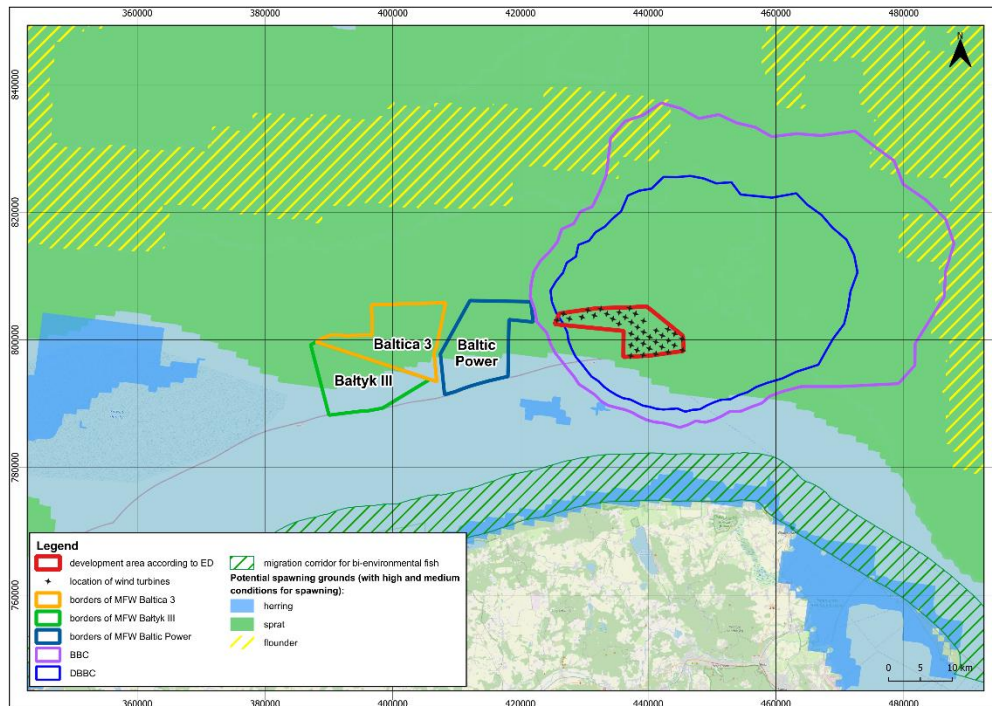


Fig. 9.14. Maximum $TTS_{cum.}$ range for fish (186 db re 1 $\mu\text{Pa} \cdot \text{s}^{-1}$) against potential spawning grounds
Source: own elaboration based on working data from noise propagation modelling

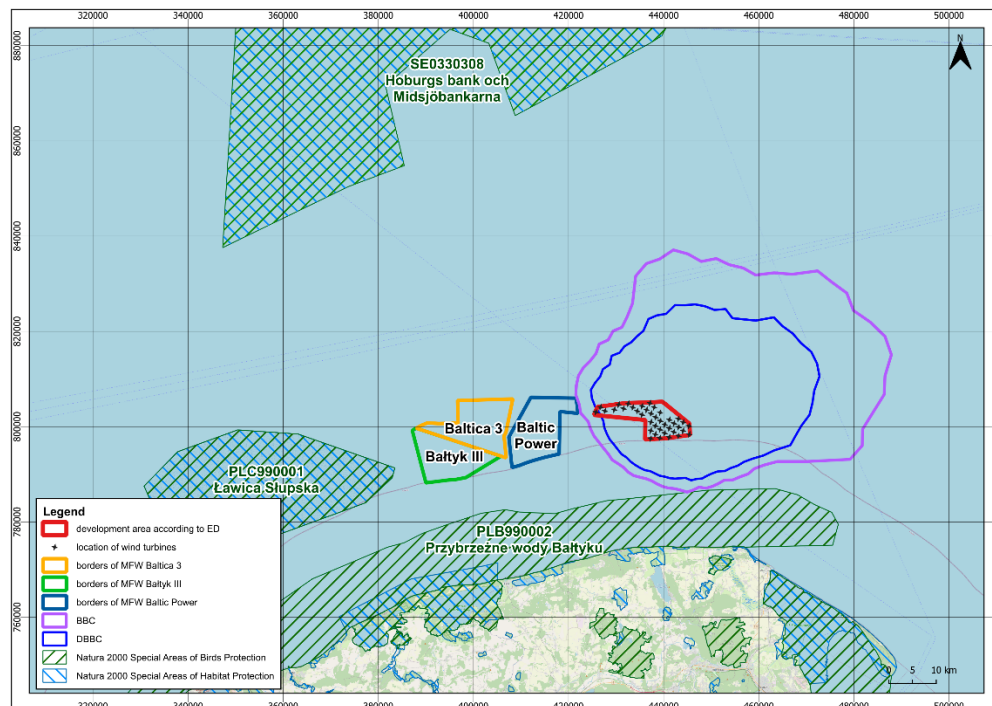


Fig. 9.15. Maximum $TTS_{cum.}$ range for fish (186 db re 1 $\mu\text{Pa} \cdot \text{s}^{-1}$) against marine protected areas
Source: own elaboration based on working data from noise propagation modelling

Tab. 9.20. Range of impact of TTS_{cum} noise in relation to spawning grounds and migration routes of diadromous fish with consideration of mitigation measures

Area affected by impact of noise at the level of TTS_{cum}	DBBC [km ²]	BBC [km ²]	Share in spawning grounds at the PMA scale
Migration corridor of diadromous fish (strip 4 NM from the shore)	0	0	-
Herring spawning grounds with a moderate probability of spawning	0	0.01	-
Herring spawning grounds with a high probability of spawning	0	0	-
Sprat spawning grounds with a moderate probability of spawning	839.58	972.72	from 2.8% (DBBC) to 3.3% (BBC)
Sprat spawning grounds with a high probability of spawning	373.09	1279.34	from 1.2% (DBBC) to 4.3% (BBC)
Turbot spawning grounds with a moderate probability of spawning	0	140.13	od 0% (DBBC) to 0.5% (BBC)

Source: own elaboration based on working data from noise propagation modelling

The largest area of projected impact would be sprat spawning grounds with a high probability of spawning – if a BBC is applied, the area constitutes 4.3% of the spawning grounds in the PMA.

In the context of the cod spawning grounds that historically existed in the Eastern Baltic Sea within the Gdańsk Deep, the Bornholm Deep, the Gotland Deep and the Słupsk Furrow, the modelling results indicate that with the application of mitigation measures such as a single or double air curtain, the TTS_{cum} level does not extend into these areas. Most importantly, the most vital cod spawning ground within the Bornholm Deep, which is located to the west of the BC-Wind OWF, is out of the impact range, with the direction of noise propagation indicated in the modelling being northeast due to the basin shape in this area.

Because of the hydrological conditions prevailing there, the area of the OWF does not constitute spawning grounds of cod or the deep-water spawning European flounder, which dominates in this area. During ichthyofauna surveys, sprat spawning grounds were found, but this marine area is small in comparison with the large areas of the spawning grounds of pelagic fish, and the spawning was of low intensity. Therefore, permanent fish damage and mortality within the spawning grounds is not expected.

The time required for the foundation of one pile is forecast to equal up to approx. 2 hours (this time will be extended by approx. 15 minutes due to the soft start procedure). This pile driver operating time is followed by a technical break to move the vessel and position the next pile. In view of the above, the impact of impulse noise will occur for a short period of time at a time, but will be repeated at intervals of several hours or more, regardless of the time of day (continuous operation). Interruptions due to adverse weather conditions are also possible. It is estimated that the whole offshore wind turbine foundation operation will take a maximum of approx. 3 months. Therefore, the impact of impulsive noise generated by pile driving will be a short-term impact (repeated series of short sounds of high intensity for up to 3 months).

In addition, the use of a soft start method (which was not taken into account in the modelling for fish), which aims to scare the ichthyofauna away from the area subject to impact before the works are commenced through a gradual increase in the impact energy of the piling (ramp-up), should additionally reduce the impact causing TTS. For this reason, the analysis does not include the possibility of increased mortality or tissue damage in ichthyofauna.

The sensitivity of cod, herring, sprat and sand goby to the impact was assessed to be very high, while in the case of European flounder and common seasnail, it was found to be high.

The impact of noise and vibration on adult fish and juvenile stages of sprat will be: negative, direct, short-term, and with a range beyond the area of OWF BC-Wind (regional). In the case of protected fish, only larval stages (carried by water currents from spawning grounds located outside the area of the planned OWF) occurred during the surveys, for which the impact will be local. The significance of

underwater noise impact was assessed as moderate, assuming the application of a noise reduction system (resulting from the need to protect the extremely endangered harbour porpoise), and the soft start procedure.

Increase in suspended solids content

The increase in suspended solids concentration in seawater occurs during the construction and decommissioning phases of the project. It occurs during the placement of foundations for wind turbines (mainly in the case of gravity-based structures, less so for truss- and monopile-type foundations) and dredging works for the purpose of power cable burial, as well as during the decommissioning and removal of the components of the OWF. The significance of this impact on fish will depend both on physical factors, such as sediment characteristics (grain size, mineral composition, adsorption and absorption capacity), salinity, temperature, and oxygen concentration of the seawater³⁶², as well as biotic factors related to the condition of fish, their developmental stage, method of reproduction and lifestyle. The intensity of the impact is also strictly related to the concentration of suspended solids, as well as the duration of exposure and the range of the increase of this factor over ichthyofauna.³⁶³ Both parameters are closely related to the sediment type, current directions, seabed morphology and hydrodynamic conditions in the area of the project. In the case of sandy sediments, especially those with coarser grain-size distribution, both the spatial range and the impact duration will be much lower than in the case of silty sediments, or silty and sandy sediments.

The impact of increased concentration of suspended solids on ichthyofauna may cause a series of negative effects, such as an avoidance response and the reduction of growth rate and reproductive efficiency. It may also cause an increase in susceptibility to disease, and even fish mortality.

The sensitivity to the impact of this factor depends on the developmental stage of the organism. In the case of early developmental stages (eggs and larvae), adverse effects may occur at concentrations of several milligrams per dm³, whereas the increased mortality of juvenile and adult fish is observed at higher concentrations (several grams per dm³)³⁶⁴, although some sources provide lower values that can cause such effects (above 100 mg·dm⁻³).³⁶⁵ Higher susceptibility of the earliest developmental stages to the impact results from their high rate of metabolism and the related high demand for oxygen.^{366, 367} Particles of suspended solids entering the gills of larvae may impede respiration and contribute to the increase in their mortality.^{368, 369}

Experimental surveys demonstrated the slowdown of herring larvae growth at suspended solids concentration exceeding 540 mg dm⁻³, whereas at a concentration of 19 g dm⁻³, mortality of 100% was

³⁶² Engell-Sørensen K., Skyt P.H. *Evaluation of the effect of sediment spill from offshore wind farm construction on marine fish.* Bio/consult A/S, 2001

³⁶³ Newcombe C.P., MacDonald D.D., *Effects of suspended sediments on aquatic ecosystems.* North American Journal of Fisheries Management 1991, 11: 72-82

³⁶⁴ Engell-Sørensen K., Skyt P.H. 2001...

³⁶⁵ Hansson S. (1995). *En litteraturomgång av effekter på fisk av muddring och tippning, samt erfarenheter från ett provfiske inför Stålverk 80.* Tema Nord, no. 513, 73-84

³⁶⁶ Auld A.H., Schubel J.R., *Effects of suspended sediment on fish eggs and larvae. A laboratory assessment.* Estuarine, Coastal and Shelf Science 1978, 6: 153-164

³⁶⁷ Partridge G.J., Michael R.J., *Direct and indirect effects of simulated calcareous dredge material on eggs and larvae of pink snapper Pagrus auratus.* Journal of Fish Biology 2010, 77 (1): 227-240

³⁶⁸ Groot de S.J., *The consequences of marine gravel dredging of spawning of herring, Clupea harengus Linné.* Journal of Fish Biology 1980, 16: 605-611

³⁶⁹ Hammar L., Wikström A., Molander S., *Assessing ecological risks of offshore wind power on Kattegat cod.* Renewable Energy 2014, 66: 414-424

recorded.³⁷⁰ In similar studies involving the Arctic grayling³⁷¹, Newcombe and MacDonald indicated a slight increase in mortality (6%) at concentrations of 25 mg·dm⁻³, while a 4-day exposure of larvae to suspended solids concentration exceeding 230 mg·dm⁻³ increased mortality up to 50%. Westerberg et al.³⁷² found a very high sensitivity of the early developmental stages of cod (larvae with a yolk sac), for which increased mortality was observed already at values of 10 mg·dm⁻³.

A high concentration of suspended solids may also limit visibility. Taking into consideration the minimal sight of larvae (in many cases limited to a distance equal to their body length)³⁷³, this may negatively affect the efficiency of noticing and obtaining food. According to Utne-Palm³⁷⁴, high turbidity (80 JTU) negatively affected the ability of herring larvae to obtain food. On the other hand, the limitation of visibility may indirectly positively affect the survival of larvae by reducing pressure from predators.³⁷⁵

The increased sensitivity of larvae in comparison to adult fish also results from a significantly lower mobility of these developmental stages, and consequently, a limited possibility to abandon the area subject to the impact.

A negative impact of increased suspended solids concentrations on fish roe was also observed. This involves mainly the limitation of gas and metabolite exchanges caused by the suspended solids particles adhering to the egg membrane.^{376, 377} According to Rönnbäck and Westerberg³⁷⁸, a significant increase in mortality of cod eggs at suspended solids concentrations exceeding 100 mg·dm⁻³ was observed. The deposition of suspended particles on the surface of pelagic roe may also result in the roe falling to lower water layers or to the seabed. This may be connected to the exposure to worse oxygen conditions, as well as the exposure to predation by benthic organisms, as well as mechanical and physiological stresses.

This is confirmed by the studies of Rönnbäck and Westerberg³⁷⁹, which demonstrate the correlation between the suspended solids concentration in the water depth and the exposure time of the cod roe, as well as the rate at which it falls to the seabed. These authors reported that this process can occur already at a suspension concentration of 5 mg·dm⁻³, maintained at this level for 4 days.

The impact of increased concentrations of suspended solids on demersal roe is probably less intensive than in the case of pelagic roe. Information on the harmful impact of this factor concerns mainly freshwater fish or fish spawning in freshwater, and a decrease in hatching success was observed only at relatively high concentrations (500-1000 mg·dm⁻³).³⁸⁰

³⁷⁰ Messieh S.N., Wildish S.N., Peterson R.H., *Possible Impact of Sediment from Dredging and Spill Disposal on the Miramichi Bay Herring Fishery*. Canadian Technical Report of Fisheries and Aquatic Science No 1008. Minister of Supply and Services Canada, St. Andrews 1981: 1-37

³⁷¹ Newcombe C.P., MacDonald D.D., *Effects of suspended sediments on aquatic ecosystems*. North American Journal of Fisheries Management 1991, 11: 72-82

³⁷² Westerberg H., Rönnebäck P., Frimansson H., *Effects of suspended sediments on cod egg and larvae and on the behaviour of adult herring and cod*. International Council for the Exploration of the Sea, CM 1996/E:26

³⁷³ Bone Q., Marshall N.B., Blaxter J.H.S., *Biology of fish*. Second edition. Springer Science+Business Media, B.V., Dordrecht 1987

³⁷⁴ Utne-Palm A.C., *Effects of larvae ontogeny, turbidity, and turbulence on prey attack rate and swimming activity of Atlantic herring larvae*. Journal of Experimental Marine Biology and Ecology 2004, 310: 147-161

³⁷⁵ Graham I.M., Merchant N.D., Farcas A., Barton T.R., Cheney B., Bono S., Thompson P.M., *Harbour porpoise responses to pile-driving diminish over time*. R. Soc. Open Sci. 2019, 6: 190335

³⁷⁶ Argent D.G., Flebbe P.A., *Fine sediment effects on brook trout eggs in laboratory streams*. Fish. Res. 1999, 39: 253-262

³⁷⁷ Chapman D.W., *Critical review of variables used to define effects of fines in redds of large salmonids*. Trans. Am. Fish. Soc. 1988, 117: 1-21

³⁷⁸ Rönnbäck P., Westerberg H., *Sedimenteffekter på pelagiska fiskägg och gulesäckslarver*. Fiskeriverket, Kustlaboratoriet, Frölunda 1996

³⁷⁹ Rönnbäck P., Westerberg H., *Sedimenteffekter på pelagiska fiskägg och gulesäckslarver*. Fiskeriverket, Kustlaboratoriet, Frölunda 1996

³⁸⁰ Auld et al. 1978...

On the other hand, no distinct impact of an increased, even up to $7000 \text{ mg} \cdot \text{dm}^{-3}$, suspended solids concentration in the water was observed in relation to the hatching of herring eggs.³⁸¹ Also, Kiørboe et al.³⁸² have not observed a negative impact of the increased suspended solids concentrations ($300\text{-}500 \text{ mg} \cdot \text{dm}^{-3}$) on the development of roe. However, these authors emphasise that the negative impact of this factor may be much greater in bad oxygen conditions. The increase in suspended solids quantity may also indirectly affect the reproductive success of herring. De Groot³⁸³ points to the possibility that individuals of this species may spawn in random places as a result of problems with finding traditional spawning grounds. Unless there is a clear negative impact of the increased suspended solids concentration on demersal roe, the harmfulness of covering the grains deposited on the sediment surface by a layer of particles undergoing sedimentation cannot be excluded.

Due to the possibility of active avoidance of areas with high suspended solids concentration by adult developmental stages of fish, sublethal rather than lethal impacts should be expected.³⁸⁴ The suspended solids concentration values at which the effect of contaminated areas avoidance is caused differ depending on the species and the development stage of fish. For juvenile herrings, it was observed at $12 \text{ mg} \cdot \text{dm}^{-3}$ ³⁸⁵, whereas for adult fish the reaction was observed at a slightly lower level – $10 \text{ mg} \cdot \text{dm}^{-3}$ ³⁸⁶. Lower values of $3 \text{ mg} \cdot \text{dm}^{-3}$, causing the same effect, were observed in experimental studies by Westerberg et al.³⁸⁷

On the other hand, the studies conducted by Hammar et al.³⁸⁸ during the construction of the Lillgrund OWF located in the Danish straits did not confirm a significant impact of the suspended solids concentrations reaching up to $10 \text{ mg} \cdot \text{dm}^{-3}$ on the distribution of fish in the project area.

A reverse reaction to avoidance is also possible for species preferring an increased level of turbidity, which limits the pressure from predators.³⁸⁹

According to the generalised assessment of the impact of the increased concentration of suspended solids on fish during the construction of the OWF that was conducted by Bergström et al.³⁹⁰, a moderate (proper Baltic and the Danish straits) or low (the Gulf of Bothnia) potential level of this impact on fish should be expected. In the analysis conducted using the Ecological Risk Assessment method³⁹¹, the significance of the impact of suspended solids on different developmental stages of cod were assessed in the area of the project implemented on the spawning grounds of this species in the Danish straits.³⁹² The analysis indicated that only for the early developmental stages (eggs, larvae and fry up to 3 months old), there is a risk of the impact of this factor. However, no risk related to this factor was found for fish at other developmental stages.

³⁸¹ Messieh et al. 1981...

³⁸² Kiørboe T., Frantsen E., Jensen C., Sørensen G. (1981). Effects of suspended sediment on development and hatching of herring (*Clupea harengus*) eggs. *Estuarine and Coastal Shelf Science* 13: 107-111

³⁸³ Groot de 1980...

³⁸⁴ Kjelland M.E., Woodley C.M., Swannack T.M., Smith D.L., A review of the potential effects of suspended sediment on fishes. Potential dredging-related physiological, behavioral, and transgenerational implications, *Environment Systems and Decisions* 2015, 35: 334-350

³⁸⁵ Messieh et al. 1981...

³⁸⁶ Iverson S.A., Esler D., Site fidelity and the demographic implication of winter movements by a migratory bird, the harlequin duck *Histrionicus histrionicus*. *Journal of Avian Biology* 2006, 37: 219-228

³⁸⁷ Westerberg et al. 1996...

³⁸⁸ Hammar L., Andersson S., Rosenberg R., Miljömassig optimering av fundament för havsbaserad vindkraft. Rapport 5828. Naturvårdsverket, 2008

³⁸⁹ Kjelland et al. 2015...

³⁹⁰ Bergström L., Kautsky L., Malm T., Rosenberg R., Wahlberg M., Capetillo N.A., Wilhelmsson D., Effects of offshore wind farms on marine wildlife – a generalized impact assessment, *Environmental Research Letters* 2014, 9 (3): 034012

³⁹¹ Suter G.W. II, Barnthouse L., Assessment concepts, [w:] Suter G.W. II (red.), *Ecological risk assessment*. Lewis Publishers, Boca Raton 1993

³⁹² Hammar et al. 2014...

The increase in suspended solids will be associated with the laying of cables on the seabed for the purpose of connecting the wind turbines, whereas the adopted foundation technology for the power plants themselves and the OSS (monopile or a truss structure) does not require dredging works on the seabed. The range of impact will therefore concern relatively small areas relative to the total area of spawning and feeding grounds of fish. At the same time, the results of the modelling of the dispersion of suspended solids in the area of the BC-Wind OWF indicate that the increase of suspended solids content in the water will be short-term and local. Detailed results of the modelling of the spread of suspended solids are presented in Appendix 2 to the EIA Report (Volume III).³⁹³

The obtained results indicate that the spatial extent of sediment deposition depends little on the excavation speed variant chosen for the dredging works for the purposes of cable burial, but is actually influenced by the amount of debris input. In areas where the bottom is made up of cohesive sediments, the extent of the deposition is significantly greater than in areas characterised by sandy bottoms. Furthermore, in the case of excavation works performed on a sandy seabed, the thickness of the newly formed sediment layer after total sedimentation of the suspended matter introduced into the basin will not exceed 0.2 mm, while in the case of excavation works performed on a clay seabed, the thickness of the new deposition in the close vicinity of the excavation may reach 1.4 mm, while at distances of more than 150 m from the excavation it does not exceed 1 mm, and at distances of more than 350 m from the excavation it does not exceed 0.5 mm.

The scope of works associated with seabed cable-laying will cover the total length of cable routes inside the BC-Wind OWF, estimated at 100 km, with the average width of the strip of possible seabed intervention as a result of scouring being approx. 25 m, which translates into an area of approximately 2.5 km², representing 3.18% of the development area of the BC-Wind OWF. On the other hand, when analysing the larger bottom interference associated with the cable trenching, the maximum width of the trench will be 7.5 m (assuming the use of ploughing), so the deeper bottom interference may cover an area of approx. 0.75 km², representing 0.95% of the BC-Wind OWF Development Area.

Because of the hydrological conditions prevailing there, the area of the OWF does not constitute spawning grounds of cod or the deep-water spawning European flounder, which dominates in this area. There are also no spawning grounds for protected species in the BC-Wind OWF Area. During ichthyofauna surveys, sprat spawning grounds were found, but this marine area is small in comparison with the large areas of the spawning grounds of pelagic fish. Sprat roe is pelagic (float in the water) and may therefore be adversely affected by increased concentrations of suspended solids in the water. However, it will not be covered by a layer of suspended matter deposited on the seabed.

The impact related to the increase of suspended solids content will be negative, direct, local, and short-term.

The sensitivity of cod, European flounder, common seasnail and sand goby to this impact was assessed to be moderate and for sprat and herring, it was assessed to be high. The significance of the impact is assessed to be **negligible** for all the analysed fish species.

Emission of toxic chemicals

During construction, harmful chemical substances may be released. The main sources of emission may be the leaks of oil derivative substances caused by failures or sinking of vessels as well as the release of harmful substances from the sediments during dredging works (excavations for foundations of wind turbines, trenches for transmission infrastructure cables). The total length of cable routes inside the BC-Wind OWF is estimated at 100 km, with the average width of the strip of possible seabed intervention as a result of scouring being approx. 25 m, which translates into an area of approx. 2.5 km², representing 3.18% of the development area. In contrast, deeper bottom intervention within

³⁹³ Cerkowniak G.R., Szmytkiewicz P., Cerkowniak M., *Modelling of Suspended Solids Dispersion during the Burial of Interconnection Cables in the Area of the BC-Wind OWF*, Gdańsk, June 2024

this strip, associated with trenching, may involve a surface of approx. 0.75 km², representing 0.95% of the BC-Wind OWF Development Area.

The sensitivity of fish to harmful substances depends on their developmental stage, sex and species. Maturing females, embryos and early larval stages are particularly sensitive. High concentrations of some harmful substances in the gonads of spawning fish may cause high mortality of their offspring.^{394, 395, 396}

The exposure of fish to toxic substances may cause morphological changes, such as abnormal development of reproductive organs, deformities of the lower jaw, eyes, spinal anomalies, and a reduced larval size at hatching. Such effects were observed during surveys in the North Sea area in such species as the common dab, flounder, cod³⁹⁷, as well as herring (*Clupea harengus membras*).³⁹⁸

Physiological changes such as a reduced heart rate and endocrine disruptions, including those that reduce spawning efficiency, may also take place. Some authors^{399, 400, 401} also provide information on the occurrence of behavioural disorders resulting in the reduced effectiveness of fish feeding.

As has already been mentioned, the main toxic substances released into water during vessel collision or failure will be oil derivatives. They include the especially hazardous polyunsaturated aromatic hydrocarbons (PAHs), which have been found to have negative effects on fish embryonic stages even at low concentrations.⁴⁰² However, according to the US National Oceans and Atmosphere Administration (NOAA), the impact of oil derivatives on fish is largely limited to coastal and closed sea areas, where active risk avoidance is hindered. What is more, the studies of Koehler⁴⁰³ and Vethaak and Wester⁴⁰⁴ have not shown a statistically significant link between the concentrations of PAHs and the occurrence of liver tumours in flounder in Danish and German waters of the North Sea, although the researchers did not exclude the possibility of tumours being triggered by these substances.

According to the Helsinki Commission (HELCOM Guidelines for the Disposal of Dredged Material at Sea)⁴⁰⁵, a series of substances may permeate from the sediment into the water, such as heavy metals (cadmium, chromium, copper, lead, mercury, nickel, zinc, arsenic), chlorinated biphenyls, organochlorine and organophosphorus pesticides, tributyltin (TBT) and its breakdown products, total hydrocarbons, polychlorinated dibenzodioxins, polychlorinated dibenzofurans, and PCBs. However, it could be assumed that the risk of high concentrations of these substances caused by their release from the sediment in the area of the PMA is low. The analyses of the content of polychlorinated biphenyl, organochlorine and organophosphorus pesticides, and heavy metals (copper, zinc, cadmium, lead,

³⁹⁴ Groot de S.J., 1980...

³⁹⁵ Westin et al. 1985...

³⁹⁶ Dethlefsen V., Cameron P., Berg A., Von Westernhagen H., Malformations of embryos of spring spawning fishes in the southern North Sea. *Int. Counc. Explor. Sea C.M.* 1986/E: 21

³⁹⁷ Dethlefsen et al. 1986...

³⁹⁸ Lindén O., The influence of crude oil/dispersants on the ontogenetic development of the Baltic herring, *Clupea harengus membras* L. *Ambio* 1976, 5: 136-140

³⁹⁹ Rosenthal H., McInerney-Northcoet M., Musial C.J., Uthe J.F., Castell J.D., Viable hatch and organochlorine contaminant levels on gonads of fall spawning Atlantic herring from Manan, Bay of Fundy, Canada. *Int. Counc. Explor. Sea C.M.* 1986/E:26

⁴⁰⁰ Struhsaker J.W., Effects of benzene (a toxic component of petroleum) on spawning Pacific herring, *Clupea harengus palasi*. *Fishery Bulletin* 1977, 75: 43-49

⁴⁰¹ Szlinder-Richert J., Usydus Z., Drgas A., Persistent organic pollutants in sediment from the southern Baltic. *Risk assessment. Journal of Environmental Monitoring* 2012, 14: 2100-2107

⁴⁰² Collier C.T., Anulacion B.F., Arkoosh M.R., Dietrich J.P., Incardona J.P., Johnson L.L., Ylitalo G.M., Myers M.S., Effects on Fish of Polycyclic Aromatic Hydrocarbons (PAHs) and Naphthenic Acid Exposures. *Fish Physiology* 2013, 33: 195-255

⁴⁰³ Koehler A., The gender-specific risk to liver toxicity and cancer of flounder (*Platichthys flesus* (L.)) at the German Wadden Sea coast. *Aquat. Toxicol.* 2004, 70 (4): 257-276

⁴⁰⁴ Vethaak A.D., Wester P.W., Diseases of flounder *Platichthys flesus* in Dutch coastal and estuarine waters, with particular reference to environmental stress factors. II. Liver histopathology. *Dis. Aquat. Org.* 1996, 26: 99-116

⁴⁰⁵ HELCOM, Guidelines for the Disposal of Dredged Material at Sea – Adopted in June 2007 – and Form for Reporting on Disposal of Dredged Material at Sea – Approved by HELCOM MONAS 9 in October 2006; available at: <http://archive.iwlearn.net/helcom.fi/stc/files/Guidelines/GuidelinesDredgedMaterial.pdf>

mercury) in the sediments from different locations in the PMA did not indicate the presence of the substances listed above in concentrations which could cause negative effects in organisms.⁴⁰⁶ The results of the measurements of heavy metal concentrations (copper, zinc, cadmium, lead, and mercury) in the sediments and tissues of flounders in 2011 indicate a low level of accumulation of harmful substances in fish tissue.⁴⁰⁷ Also, the concentrations of DDT, HCB and PCDD/F in the sandy sediments of this area remain at a level that does not cause a toxic effect in the marine organisms.⁴⁰⁸

The impact related to the release of pollutants and nutrients from the sediments into water will be negative, direct, temporary and local.

The sensitivity of cod, European flounder, common seasnail, sand goby, sprat and herring to this impact was assessed to be moderate.

The significance of the impact was assessed to be negligible for all the fish species analysed due to the low accumulation of harmful substances in the bottom sediments of the PMA.

Habitat change

During construction, situations may take place in which, due to the impact of a series of harmful factors (noise, increased suspended solids concentration, intensive vessel traffic), the construction area will be avoided by fish. The scale of this impact depends both on the biology of individual species and their developmental stage.⁴⁰⁹ The size of the area, as well as the duration and dates of the work, are also crucial factors. In the case when even a small area is an important spawning ground, the effect of its exclusion from the reproduction processes may be visible at a much larger sea area.⁴¹⁰

Construction works may lead to physical changes in the environment, such as the sediment character or the seabed morphology. As a result of such changes, the disruption of the reproductive processes of fish may take place.^{411, 412, 413, 414, 415} The disruption of the original sediment structure may result in periodical abandonment of spawning or result in unfavourable development conditions for eggs or fry.^{416, 417} Such a reaction may, e.g., concern herrings requiring a seabed covered with sediment allowing the attachment of eggs.^{418, 419}

What is more, the seabed surface is being occupied by the structural elements of the OWF (wind turbine foundations, scour protection structures). The scale of this loss depends on the number of wind turbines and the type of foundations. The foundation of 39 wind power plants is planned, with

⁴⁰⁶ Dąbrowska H., Kopko O., Turja R., Lehtonen K.K., Góra A., Polak-Juszczak L., Warzocha J., Kholodkevich S., Sediment contaminants and contaminant levels and biomarkers in caged mussels (*Mytilus trossulus*) in the southern Baltic Sea. *Marine Environmental Research* 2013, 84: 1-9

⁴⁰⁷ Polak-Juszczak L., Trace metals in flounder, *Platichthys flesus* (Linnaeus, 1758), and sediments from the Baltic Sea and the Portuguese Atlantic coast. *Environ. Sci. Pollut. Res.* 2013, 20: 7424-7432

⁴⁰⁸ Wedemeyer G.A., McLeay D.J., Goodyear C.P., Assessing the tolerance of fish and fish populations to environmental stress. The problems and methods of monitoring, [w:] Cairns V.W., Hodson P.V., Nriagu J.O. (ed.), *Contaminant Effects on Fisheries*. John Wiley & Sons, Inc., New York 1984

⁴⁰⁹ Wilson J.C., Elliott M., Cutts N.D., Mander L., Mendão V., Perez-Dominguez R., Phelps A., Coastal and offshore wind energy generation. Is it environmentally benign? *Energies* 2010, 3: 1383-1422

⁴¹⁰ Bergström L., Kautsky L., Malm T., Ohlsson H., Wahlberg M., Rosenberg R., Capetillo N.A., The effects of wind power on marine life. A synthesis. Report 6512. Swedish Environmental Protection Agency, Stockholm 2012

⁴¹¹ ICES, Effects of extraction of marine sediments on fisheries. ICES Coop. Res. Rep. No. 182, 1992

⁴¹² ICES, Effects of extraction of Marine Sediments on the Marine Ecosystem. Report of the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem. ICES Coop. Res. Rep. No. 247, 2001

⁴¹³ Phua C., van den Akker S., Baretta J., van Dalen M., Ecological Effects of Sand Extraction in the North Sea, 2004

⁴¹⁴ Posford Duvivier Environment, Hill M.I., Guidelines on the impact of aggregate extraction on European Marine Sites. Countryside Council for Wales (UK Marine SACs Project), 2001

⁴¹⁵ Birklund J., Wijsman J.W.M., Aggregate Extraction. A review on the effect on ecological functions. Report Z3297.10. SANDPIT Fifth Framework Project No. EVK3CT200100056. DHI Water & Environment; WL | Delft Hydraulics, 2005

⁴¹⁶ Groot de S.J., 1980...

⁴¹⁷ Phua et al. 2004...

⁴¹⁸ Kjørboe et al. 1981...

⁴¹⁹ Posford Duvivier Environment, Hill M.I., Guidelines, 2001...

monopile indicated as the foundation type (with truss-type foundation also being considered as an option in a few cases). The monopile, with a protective layer reinforcing the bottom (2600 m²), will occupy a greater area of the seabed, hence the assessment was carried out for this construction solution, as in the case of the use of a truss-type foundation, there would be less of an impact.

The area of the seabed to be permanently occupied by the foundation of one 11.5 m diameter monopile is 104 m², which translates into a total area of 0.004 km² of seabed to be permanently lost under 39 wind turbines and one OSS, which amounts to 0.005% of the development area of the BC-Wind OWF. The area of the seabed to be occupied under the 2 considered non-productive infrastructure facilities is negligible.

The permanent transformation of the seabed associated with the protective layer required around each pile will cover a total area of approx. 0.104 km², equivalent to 0.12% of the development area. Changes to the character of the seabed will therefore be spatially limited. They will be greater in the case of a sandy or clay bottom, where the introduction of additional stones as part of the reinforcement will create new structures with the character of an artificial reef. In contrast, the changes will be minor in the case of rocky seabed foundations. Permanent changes to the seabed structure created during the construction phase will therefore cover approx. 0.12% of the total development area. On the other hand, a larger area of the seabed will be subject to periodic disturbance of habitat conditions due to the laying of cables connecting the power plants in the BC-Wind OWF Area. The length of the cable routes within the BC-Wind OWF is estimated to be approx. 100 km, with the average width of the strip of possible seabed intervention as a result of scouring being approx. 25 m, which translates into an area of approximately 2.5 km², representing 3.18% of the development area. In contrast, deeper bottom intervention within this strip, associated with trenching, may involve a surface of approx. 0.75 km², representing 0.95% of the BC-Wind OWF Development Area. An additional disturbance to the bottom habitat will be the sedimentation of the suspended solids disturbed during the cable-laying works. According to the modelling of the dispersion of suspended solids, the layer of deposited sediment within 150 m of the excavation will range from approx. 0.2 mm in the case of a sandy bottom to 1.4 mm in the case of a cohesive bottom. The loss of the surface available for benthic organisms and the changes in environmental parameters may result in the reduction of benthic abundance and biomass. In connection to the physical destruction of fauna inhabiting the sediment during construction, this may lead to a reduction in food sources for benthivorous fish,^{420, 421, 422} and thus cause a reduction in their number. Taking into consideration the probable small spatial scale of this impact and the ability of fish to actively forage for food, it can be assumed that the reduction in food resources will not be significant for benthivorous fish.

The area of the BC-Wind OWF does not constitute spawning grounds of cod or the deep-water spawning European flounder, which dominates in this area. During ichthyofauna surveys, sprat spawning grounds were found, but this marine area is small in comparison with the large areas of the spawning grounds of pelagic fish. Herring spawning may occur in the BC-Wind OWF Area, but it can be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level. The BC-Wind Area therefore lacks valuable spawning grounds for bottom spawning species (apart from herring spawning grounds of minor importance to the species), so disturbance of the sediment structure will not degrade spawning conditions. The area constitutes spawning grounds for sprat (with moderate spawning probability according to HELCOM data). However, sprat are pelagic spawners, so their spawning is not related to the type of bottom substrate.

⁴²⁰ Daan N., Bromley P.J., Hislop J.R.H., Nielsen N.A., *Ecology of North Sea fish. Netherlands Journal of Sea Research* 1990, 26 (2–4): 343–386

⁴²¹ Cohen E., Grosslein M., Sissenwine M., Steimle F., *A comparison of energy flow on Georges Bank and in the North Sea. ICES CM* 1980/L: 64

⁴²² Sissenwine M.P., Cohen E.B., Grosslein M.D., *Structure of the Georges Bank ecosystem. Rapports et Procès-Verbaux des Réunions – Conseil International pour l'Exploration de la Mer* 1984, 183: 243–254

Impacts related to permanent habitat conversion will be negligible in relation to the area of development of the BC-Wind OWF and the total area of the spawning and feeding grounds of fish.

The impact associated with temporary habitat change due to the disturbance of the bottom structure and sedimentation of suspended solids will be a negative, direct, temporary and local impact.

The sensitivity of cod, flounder, common seasnail, sand goby, sprat and herring was assessed as high. Impact significance was assessed as **negligible** for all the surveyed fish species due to the limited spatial scale of the impact.

Barrier creation

The construction of underwater structures may constitute a barrier for fish the migration routes of which may run in this area. Intense maritime traffic during the construction period may also reinforce this effect. The observations carried out in the areas of Danish offshore wind farms indicate that due to the possibility of active movement of fish, these factors do not significantly disturb migration processes⁴²³. The scale of the impact will probably be local and short-term, causing only temporary avoidance of the area during the performance of works.

The density of the structures is so low that it will not affect the migration possibilities of ichthyofauna.

The impact related to the creation of the barrier will be negative, direct, local, and temporary for all species.

The sensitivity of cod, European flounder, common seasnail, sand goby, sprat and herring to this impact was assessed as moderate. There are no significant migration routes of diadromous ichthyofauna species running through the area of the BC-Wind OWF. The significance of this impact was assessed as **negligible** for all the analysed fish species.

Exploitation phase

During the exploitation phase of the BC-Wind OWF, the impacts on ichthyofauna will result from:

- emissions of noise and vibration;
- habitat changes;
- the creation of a barrier;
- EMF emissions.

Emission of noise and vibration

The sound generated by operating wind turbines is characterised by a low frequency, usually not exceeding 1 kHz. The level of noise depends mainly on the distance from the wind turbine. To a lesser degree, it depends also on the size of the structure and the strength of wind. Literature indicates that differences between noise levels generated by turbines operating at different wind speeds (from 3.5 to 17 m·s⁻²) do not exceed 30 dB. The maximum noise level generated by an operating wind turbine was measured to be 137 dB re 1 Pa at a distance of 40 m. Thus, it is much lower than the noise observed during piling and lower or comparable to the one generated by vessels. The cumulative noise for the entire OWF will also remain at a level lower than the one generated by the traffic of large vessels.⁴²⁴

The impact of the noise generated during the exploitation phase of the OWF should be much lower than the one observed during construction and decommissioning. Its possible effect can be

⁴²³ Stenberg C., Deurs M.V., Støttrup J., Mosegaard H., Grome T., Dinesen G.E., Christensen A., Jensen H., Kaspersen M., Berg C.W., Leonhard S.B., Skov H., Pedersen J., Hvidt C.B., Klastrup M., Leonhard S.B. (ed.), Stenberg C. (ed.), Støttrup J. (ed.), *Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities. Follow-up Seven Years after Construction. DTU Aqua Report No 246-2011, 2011*

⁴²⁴ Tougaard J., Hermannsen L., Madsen, P.T., *How loud is the underwater noise from operating offshore wind turbines? The Journal of the Acoustical Society of America 2020, 148: 2885-2893*

behavioural responses. According to Thomsen et al.⁴²⁵, the sound generated by operating wind turbines will be audible to salmon and the common dab at a distance of approx. 1 km, while for cod and herring – at a distance of up to 4 km to 5 km. The maximum range of the masking effect (interference with sound perception) should be close to the range of audibility. However, for herring, it is likely to be much smaller⁴²⁶. The effect of avoiding the areas located in the immediate vicinity of the wind turbine is probable, however, the extent of this impact should not exceed a few metres. According to Wahlberg and Westerberg⁴²⁷, the response involving the avoidance of increased pressure related to the generated sound occurs in the zone up to 4 m away from the wind turbine. Observations carried out in the area of one of the Swedish offshore wind farms showed no changes in behaviour of eels swimming at a distance of 500 m from the operating wind turbine. On the other hand, the experimental research conducted in aquaria⁴²⁸ demonstrated plaice and cod to have a reaction to noise generated by wind turbines. However, it was not strong enough to result in a permanent habitat abandonment.

A comparison of roach and cod catches in the vicinity of the non-operating wind turbines showed a significant accumulation of fish in the immediate vicinity of the structure (100 m), which can be attributed to the artificial reef effect. However, in the case of an operating wind turbine, the catch volume halved in the area. Such a result can be interpreted as the effect of the emitted noise, but other causes cannot be excluded.^{429, 430} The results of many studies documenting the aggregation of fish in the direct vicinity of wind turbines (discussed in the subchapter dedicated to the artificial reef effect) indicate that the level of noise generated by the operating wind turbines is not sufficient to play the role of a deterrent.⁴³¹ However, due to the lack of studies, the possible negative effect of the prolonged exposure of fish to sound cannot be excluded.

Another source of noise occurring in the exploitation phase may be the increased traffic of vessels servicing the OWF. Responses involving the avoidance of vessels sailing by was recorded in the case of surveys conducted on the Baltic populations of cod, herring and sprat, which indicate the best acoustic reception among the main species exploited by fishing.⁴³² In the case of herring, the avoidance of sound sources related to the traffic of vessels and fishing gear was usually observed outside the reproductive season^{433, 434}, whereas, in the spawning period, this stimulus was not significant enough to elicit such a response. According to Thomsen et al.⁴³⁵, there are no scientific grounds for determining the universal noise level of vessels above which it would be detrimental to fish.

The area of the BC-Wind OWF does not constitute spawning grounds of cod or the deep-water spawning European flounder, which dominates in this area. During ichthyofauna surveys, sprat spawning grounds were found, but this marine area is small in comparison with the large areas of the

⁴²⁵ Thomsen F., Lüdemann K., Kafemann R., Piper W., *Effects of offshore wind farm noise on marine mammals and fish*. biola, Hamburg, Germany on behalf of COWRIE Ltd. 2006

⁴²⁶ Thomsen et al. 2006...

⁴²⁷ Wahlberg M., Westerberg H., *Hearing in fish and their reactions to sounds from offshore wind farms*. Marine Ecology Progress Series 2005, 288: 295-309

⁴²⁸ Müller C., *Behavioral reactions of cod (Gadus morhua) and plaice (Pleuronectes platessa) to sound resembling offshore wind turbine noise*. Dissertation. Humboldt-Universität zu Berlin, Mathematisch-Naturwissenschaftliche Fakultät I, Berlin 2007

⁴²⁹ Węśławski J.M., *Waloryzacja dna morskiego*, [w:] Gabriela G., Kryla-Straszewska L., Urbański J., Warzocha J., Węśławski J., *Atlas siedlisk dna polskich obszarów morskich. Waloryzacja przyrodnicza siedlisk morskich. Broker-Innowacji Gabriela Gic-Grusza*, Gdynia 2009: 14-15, 86-87, 92-93

⁴³⁰ Thomsen et al. 2006...

⁴³¹ van Hal R., Griffioen A.B., van Keeken O.A., *Changes in fish communities on a small spatial scale, an effect of increased habitat complexity by an offshore wind farm*. Marine Environmental Research 2017, 126: 26-36

⁴³² ICES, *Underwater noise of research vessels. Review and recommendations*. ICES Cooperative Research Report No. 209, 1995

⁴³³ Olsen K., Angell J., Pettersen F., Løvik A., *Observed fish reactions to a surveying vessel with special reference to herring, cod, capelin and polar cod*. FAO Fisheries Report No. 300, 1983

⁴³⁴ Vabø R., Kjell Olsen K., Huse I., *The effect of vessel avoidance of wintering Norwegian spring spawning herring*. Fisheries Research 2002, 58 (1): 59-77

⁴³⁵ Thomsen et al. 2006...

spawning grounds of pelagic fish. Herring spawning may occur in the BC-Wind OWF Area, but it can be assumed that any disturbances in the reproductive process will not affect the recruitment of this species at the population level.

The emission of noise and vibrations generated during the exploitation of the OWF may directly and negatively affect the ichthyofauna. These impacts will be of a negative, direct, local, long-term and permanent nature.

The sensitivity of cod, sprat and herring to this impact was assessed as high, while for the European flounder, sand goby and the common seasnail it was determined as moderate.

The significance of this impact was assessed as **negligible** for all the analysed fish species.

Habitat change

The presence of structural elements of wind turbines involves the creation of additional hard substrates forming a new habitat. According to Petersen and Malm⁴³⁶, its occurrence in the environment is one of the most significant impacts of an OWF. Such structures constitute the so-called artificial reef – a new habitat that can be inhabited by organisms. The scale of this phenomenon depends both on the size of the area in which the underwater parts of wind turbine structures and other infrastructure elements are placed and the surface and complexity of its structures, as well as the environmental conditions in which it was constructed, and the composition of ichthyofauna in its area.⁴³⁷ It should be emphasised that this case is unique, since the hard habitable surfaces are located not only on the seabed (horizontal elements of foundations and scouring protections), but are also present in the water depth up to the water surface (wind turbine towers).⁴³⁸ At the stage of designing the project, it is possible to enhance the artificial reef effect by using materials and structural solutions expanding the structure surface available to organisms, i.e. scouring protection around foundations.⁴³⁹ This will be the role of the stone cover used to reinforce the bottom around the monopiles or truss structures of the wind turbines and the OSS, covering an area of approx. 0.104 km², corresponding to 0.13% of the development area.

At the first stage, the reef becomes inhabited by periphyton organisms, macrophytes and invertebrates.⁴⁴⁰ Already at the point of several months later, numerous populations of fish^{441, 442} appear in the reef area, both those returning after the disturbances related to the construction have ceased⁴⁴³ and those not present in this area so far (increase in biodiversity). According to Kerckhof et al.⁴⁴⁴, after 6 years, a fully developed complex of organisms inhabiting the artificial reef (a climax community) can be expected.

An artificial reef is an attractive habitat which can act as a rich food source and shelter, as well as create favourable conditions for reproduction for many fish species. Extensive hard structures (e.g.

⁴³⁶ Petersen J.K., Malm T., *Offshore windmill farms. Threats to or possibilities for the marine environment. Ambio* 2006, 35: 75-80

⁴³⁷ Hammar L., Perry D., Gullström M., *Offshore Wind Power for Marine Conservation. Open Journal of Marine Science* 2016, 6: 66-78

⁴³⁸ Degraer S., Carey D.A., Coolen J.W.P., Hutchison Z.L., Kerckhof F., Rumes B., Vanaverbeke J., *Offshore wind farm artificial reefs affect ecosystem structure and functioning a synthesis. Oceanography* 2020, 33 (4): 48-57

⁴³⁹ Glarou M., Zrust M., Svendsen J.C., *Using Artificial-Reef Knowledge to Enhance the Ecological Function of Offshore Wind Turbine Foundations: Implications for Fish Abundance and Diversity. J. Mar. Sci. Eng.* 2020, 8: 1-25

⁴⁴⁰ Eager E.W., *Pattern in the development of a marine community. Limnol. Oceanogr.* 1971, 16: 241-253

⁴⁴¹ Tougaard J., Carstensen J., Teilmann J., Skov H., Rasmussen P., *Pile driving zone of responsiveness extends beyond 20 km for harbour porpoises (Phocoena phocoena (L.)). The Journal of the Acoustical Society of America* 2009, 126: 11-14

⁴⁴² Stone R.B., Pratt H.L., Parker R.O., Davis G.E., *A comparison of fish populations on an artificial and natural reef in the Florida Keys. Mar. Fish. Rev.* 1979, 41 (9): 1-11

⁴⁴³ Rellini M., Torchia G., Rellini G., *Seasonal Variation of Fish Assemblages in the Loana Artificial Reef (Ligurian Sea Northwestern-Mediterranean). Bull. Mar. Sci.* 1994, 55 (2-3): 401-417

⁴⁴⁴ Kerckhof F., Rumes B., Degraer S., *About 'mytilisation' and 'slimeification'. A decade of succession of the fouling assemblages on wind turbines off the Belgian coast, [w:] Degraer S., Brabant R., Rumes B., Vigin L. (ed.), Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea: Marking a Decade of Monitoring, Research and Innovation. Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management Section, Brussels 2019: 73-84*

submerged structural elements of wind turbines) are attractive shelters for young (2 to 3 years old) cod (*Gadus morhua*).⁴⁴⁵ There, they are sheltered from sea currents, predators^{446, 447} and fishing. Studies by Reubens⁴⁴⁸, which compared the fish catch efficiency of cod and pouting (*Trisopterus luscus*) on a sandy seabed in the regions where an artificial hard substratum was present (wrecks, offshore wind farms), indicated a distinct grouping of these species in the project area, especially in the periods of intense feeding (summer, autumn). On the other hand, the studies conducted by van Hal⁴⁴⁹ in the area of a Danish OWF located in the North Sea showed a regularity of fish distribution at a microscale within the area of the OWF itself. Cod, pouting and shorthorn sculpin (*Myoxocephalus scorpius*) were found to form clusters in the immediate vicinity of wind turbines, while flatfish preferred sandy seabed areas between the turbines.

Artificial reefs may also provide favourable breeding conditions for many fish such as herring (*Clupea harengus*), hooknose (*Agonus cataphractus*), garfish (*Belone belone*), lumpfish (*Cyclopterus lumpus*) and rock gunnel (*Pholis gunnellus*)⁴⁵⁰. According to Jensen et al.⁴⁵¹, the artificial reef area also provides preferable spawning conditions for gobies, which include species protected in Poland.

The studies by Bergström et al.⁴⁵² in the area of the Lillgrund OWF located in the Sund strait showed visible aggregations in the area of the project of fish species such as cod, shorthorn sculpin, black goby, eelpout and eel. The results of the surveys on the long-term impact of the Horns Rev 1 OWF on the abundance and taxonomic composition of fish showed that the artificial reef effect was significant enough to cause an increase in the number of fish that prefer a hard substrate and, at the same time, too small to cause a decrease in the number of fish that prefer a sandy substrate.⁴⁵³

The assessment whether the artificial reef effect is limited only to attracting fish from the surrounding sea area, or whether there is an actual production of additional biomass, is a matter of an ongoing discussion that cannot be resolved without further extensive research.⁴⁵⁴ The results of studies conducted by Reubens et al.⁴⁵⁵ in the area of Belgian offshore wind farms located in the North Sea showed not only the aggregation of cod in these areas, but also an increase in the local production. However, it was limited to the area in the immediate vicinity of the OWF, and this result was not visible at a regional scale.

One of the conditions necessary for an actual increase in fish biomass caused by the artificial reef effect is the provision of a sufficient amount of food in the area. The fulfilment of this condition in the case of the OWF in the Belgian part of the North Sea is confirmed by the studies of De Troch et

⁴⁴⁵ Reubens J., Degraer S., Vincx M., Aggregation and feeding behaviour of pouting (*Trisopterus luscus*) at wind turbines in the Belgian part of the North Sea. *Fisheries Research* 2011, 108: 223-227

⁴⁴⁶ Bohnsack J.A., Sutherland D.L., Artificial reef research. A review with recommendations for future priorities. *Bulletin of Marine Science* 1985, 37: 11-39

⁴⁴⁷ Wilhelmsson D., Yahya S., Öhman M., Effects of high-relief structures on cold temperate fish assemblages. A field experiment. *Marine Biology Research* 2006, 2 (2): 136-147

⁴⁴⁸ Reubens J., Braeckman U., Vanaverbeke J., Van Colen C., Degraer S., Vincx M., Aggregation at windmill artificial reefs. CPUE of Atlantic cod (*Gadus morhua*) and pouting (*Trisopterus luscus*) at different habitats in the Belgian part of the North Sea. *Fisheries Research* 2013, 139: 28-34

⁴⁴⁹ van Hal et al. 2017...

⁴⁵⁰ Wilson M., Ireland P., Triton Knoll Environmental Impact Assessment Scoping Report. Report No. EN010005-000148. RWE Innogy, 2010

⁴⁵¹ Jensen B., Klausstrup M., Skov H., EIA Report – Fish. Horns Rev 2 Offshore Wind Farm. Doc. No. 2676-03-001-rev 4. Bio/consult as, 2006

⁴⁵² Bergström L., Sundqvist F., Bergström U., Effects of an offshore wind farm on temporal and spatial patterns in the demersal fish community. *Mar. Ecol. Prog. Ser.* 2013, 485: 199-210

⁴⁵³ Stenberg C., Støttrup J., van Deurs M., Berg C., Dinesen G., Mosegaard H., Grome T., Leonhard S., Long-term effects of an offshore wind farm in the North Sea on fish communities. *Marine Ecology Progress Series* 2015, 528: 257-265

⁴⁵⁴ Pickering H., Whitmarsh D., Artificial reefs and fisheries exploitation: a review of the 'attraction versus production' debate, the influence of design and its significance for policy. *Fisheries Research* 1997, 31: 39-59

⁴⁵⁵ Reubens et al. 2013...

al.⁴⁵⁶ These demonstrate that the OWF areas constituted good feeding grounds for both cod and pouting, and that the food resources were sufficient enough for the food competition not to occur. The observation of Reubens⁴⁵⁷ also confirm the good condition of both these species in the area of the artificial reef.

The results of ecological modelling confirm the increase in the environmental capacity in the area of the artificial reef located near the coast of Portugal. This resulted in a significant increase in the biomass of fish of the two-banded sea bream (*Diplodus vulgaris*) species in that area⁴⁵⁸. However, according to Bohnsack⁴⁵⁹, in many cases, the presence of an artificial reef involves only the aggregation of fish in its area, and not the increase in biomass.

In the case of limitations introduced for fishery and navigation in the areas occupied by the project (e.g. an OWF), the anthropogenic pressure shall decrease. As a result, the areas of artificial reefs may become a particular refuge for fish, both adult and in their early developmental stages (larvae and fry), becoming an equivalent of protected areas.⁴⁶⁰ Hammar et al.⁴⁶¹ even state that in some cases, the OWF areas may become a protection tool as effective as the Marine Protected Areas, provided that adequate fishing restrictions are introduced in them. In such a situation, even if the artificial reef does not increase the capacity of the environment, it may contribute to the increase of the production of certain fish species in its vicinity by reducing fishing mortality.⁴⁶²

If there are no restrictions on fishing in the area of the OWF, there may be a situation where large groups of fish attracted by favourable living conditions will become an easy fishing target. As a result, it may lead to a reduction of fish resources and biodiversity in the areas adjacent to the OWF.⁴⁶³

It is possible that artificial reefs offering environmental conditions significantly different from those that occurred in a given area before may constitute an environment facilitating invasion of non-native species.⁴⁶⁴ However, the information available in literature concerns mainly the appearance of periphyton organisms and crustaceans. However, it cannot be ruled out that artificial reefs may create an environment that also favours non-native fish species.

The new habitat created as a result of the construction of the OWF, with its hard substrate and relatively rich food supply for benthivorous fish, may, for example, constitute a favourable environment for colonisation by the invasive round goby (*Neogobius melanostomus*).

Since the first report in 1990 on the introduction of the round goby to the Gulf of Gdańsk with the ballast waters of vessels, the presence of this species has been recorded in the Polish area of the Baltic Sea, both in deeper waters (up to 40-60 m), and in the coastal shallow water zone, in the Pomeranian Bay and in the Vistula Lagoon and its tributaries.

⁴⁵⁶ De Troch M., Reubens J.T., Heirman E., Degraer S., Vincx M., Energy profiling of demersal fish: a case-study in wind farm artificial reefs. *Marine Environmental Research* 2013, 92: 224-233

⁴⁵⁷ Reubens J., Vandendriessche S., Zenner A.N., Degraer S., Vincx, M., Offshore wind farms as productive sites or ecological traps for gadoid fishes? Impact on growth, condition index and diet composition. *Marine Environmental Research* 2013, 90: 66-74

⁴⁵⁸ Roa-Ureta R.H., Santos M.N., Leitão F., Modelling long-term fisheries data to resolve the attraction versus production dilemma of artificial reefs. *Ecol. Model.* 2019, 407: 108727

⁴⁵⁹ Bohnsack J.A., Are high densities of fishes at artificial reefs the result of habitat limitation or behavioral preference? *Bulletin of Marine Science* 1989, 44 (2): 631-645

⁴⁶⁰ Degraer S., Brabant R. (ed.), Offshore wind farms in the Belgian part of the North Sea. State of the art after two years of environmental monitoring. Royal Belgian Institute for Natural Sciences, Management Unit of the North Sea Mathematical Models. Marine ecosystem management unit, 2009

⁴⁶¹ Hammar L., Perry D., Gullström M., Offshore Wind Power for Marine Conservation. *Open Journal of Marine Science* 2016, 6: 66-78

⁴⁶² Reubens et al. 2013...

⁴⁶³ Sanders N., Haynes T., Goriup P.D. (2017). *Marine Protected Areas and Offshore Wind Farms*, [w:] Goriup P.D. (red.), Management of Marine Protected Areas. A Network Perspective. John Wiley & Sons Ltd, 2017: 263-280

⁴⁶⁴ Langhamer O., Artificial Reef Effect in relation to Offshore Renewable Energy Conversion. State of the Art. *The Scientific World Journal* 2012; 386713: 1-8

The spawning of the round goby takes place many times in several portions during the season, at a depth ranging from 0.2 to 1.5 m, on various substrates.^{465, 466} Therefore, it can be assumed that OWF areas, which are usually located in deeper sea regions, will not be appropriate for the breeding of this species.

It is unlikely that the area of the planned project will be colonised by the round goby migrating from coastal areas due to the lack of plankton larval stages and a limited range of movements of adult fish. This species rarely migrates far. The range of migrations is small and usually does not exceed 100 m⁴⁶⁷.

The impact of the formation of a new habitat was assessed by Bergström et al.⁴⁶⁸ as positive, and its level as moderate.

The impact related to the change of habitat will be positive, direct, local, permanent and long-term.

The sensitivity of cod, European flounder and herring to this impact (understood as a scale of positive impact) was assessed as high and for sprat, common seasnail and sand goby, it was determined to be moderate. The significance of the impact was assessed to be **negligible** for all the analysed fish species due to the limited spatial scope.

Barrier creation

The construction of underwater structures may constitute a barrier for fish the migration routes of which may run in this area. The observations carried out in the areas of Danish offshore wind farms indicate that due to the possibility of active movement of fish, these factors do not significantly disturb migration processes.⁴⁶⁹

The impact related to the barrier creation will be negative, direct, local, long-term and permanent.

The sensitivity to this impact was assessed to be moderate for all the examined fish species. There are no significant migration routes of diadromous ichthyofauna species running through the area of the BC-Wind OWF. The significance of the impact was assessed to be **negligible** for all the analysed fish species due to the low density of wind turbines.

Electromagnetic field emission

Submarine cables through which electric current flows become a source of electromagnetic field. The current flowing through them generates a magnetic field, which, in turn, becomes a source of induced electric field. Depending on the cable type and the depth of its burial in the sediment, the range of magnetic impacts may vary from several to several hundred metres, whereas in the case of induced electric field it reaches several metres.⁴⁷⁰

The sensitivity of ichthyofauna to the impact of electromagnetic field depends on:

- the species-specific detection threshold;

⁴⁶⁵ Wandzel T., Babka okrągła *Neogobius melanostomus* (Pallas, 1811) – nowy komponent ichtiocenozy południowego Bałtyku. Rola w ekosystemie i rybołówstwie. Morski Instytut Rybacki, Gdynia 2003

⁴⁶⁶ Sapota M.R., Bałazy P., Mirny Z., Modification in the nest guarding strategy – one of the reasons of the round goby (*Neogobius melanostomus*) invasion success in the Gulf of Gdańsk? *Oceanological and Hydrobiological Studies* 2014, 43: 21-28.

⁴⁶⁷ Skóra K.E., Stolarski J., *Neogobius melanostomus* (PALLAS 1811) a new immigrant species in Baltic Sea. *Proceedings of the Second International Estuary Symposium held in Gdańsk 18–22.X.1993*, Crangon Iss. MBC Gdynia 1996: 101-108

⁴⁶⁸ Bergström L., Kautsky L., Malm T., Rosenberg R., Wahlberg M., Capetillo N.A., Wilhelmsson D., *Effects of offshore wind farms on marine wildlife – a generalized impact assessment*, *Environmental Research Letters* 2014, 9 (3): 034012

⁴⁶⁹ Stenberg C., Deurs M.V., Støttrup J., Mosegaard H., Grome T., Dinesen G.E., Christensen A., Jensen H., Kaspersen M., Berg C.W., Leonhard S.B., Skov H., Pedersen J., Hvidt C.B., Klastrup M., Leonhard S.B. (ed.), Stenberg C. (ed.), Støttrup J. (ed.), *Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities. Follow-up Seven Years after Construction*. DTU Aqua Report No 246-2011, 2011

⁴⁷⁰ Engell-Sørensen K., *Possible effects of the offshore windfarm at Vindeby on the outcome of fishing. The possible effects of electromagnetic fields*. Bio/consult A/S, 2002

- the type of sensor in the fish (magnetic, electrical);
- the lifestyle (demersal, pelagic – seabed dwellers are exposed to a higher force of the electromagnetic field).⁴⁷¹

The magnetic field detection threshold is, depending on the species, between 0.01 and 0.05 μT .

The natural Earth's magnetic field is used by fish during migrations and also provides a sense of direction for the purposes of identification and localisation of resources.⁴⁷² Interferences by anthropogenic electromagnetic fields can have important ecological consequences.

According to Taormina et al.⁴⁷³, the electromagnetic field generated by cables may affect navigation and orientation capabilities of marine organisms, cause avoidance or attraction effects, as well as cause physiological and developmental disturbances.

Disturbances in the natural field may cause problems with the orientation of migratory fish, such as the European eel. However, previous field surveys do not indicate a significant impact of this factor on the migration capabilities of this species. In the surveys conducted in the southern Baltic, no disturbances in the migration of eels swimming 500 m away from a wind turbine were observed.⁴⁷⁴ Westerberg and Begout-Anras⁴⁷⁵ did not find that a high-voltage DC cable constituted a barrier to the migration of this species, either. Only a decline in swimming speed was observed in the zone near the cable, however it was insignificant, causing an approx. 30-minute delay in the completion of the migration route.⁴⁷⁶ Studies on the impact of the magnetic field generated by the submarine cable in the San Francisco Bay area on the migration of Chinook salmon (*Oncorhynchus tshawytscha*) also did not indicate a significant impact of this potential source of interferences on the migration route, although the route was slightly changed.⁴⁷⁷

The studies conducted by Bochert and Zettler⁴⁷⁸ did not indicate a significant impact of the prolonged exposure to an increased permanent magnetic field on flounder. Also, during the experimental surveys on the halibut's response to an electromagnetic field, no significant changes in the behaviour of these fish were observed.⁴⁷⁹

The extensive surveys on the impact of cables running across the area of the Nysted OWF (the Danish straits) on ichthyofauna indicated that although they constitute no barrier for fish, they can be an obstacle to their movement, especially the migration of eel. The authors of the report conclude that although changes in the behaviour of fish along the cable route have been observed, their cause-and-effect relationship is unclear.⁴⁸⁰

Research on the impact of an electric field on salmonids and eels indicates the possibility of the occurrence of such reactions as accelerated pulse (field strength of 0.007-0.07 V/m), as well as gills and

⁴⁷¹ Engell-Sørensen 2002...

⁴⁷² Hutchison Z.L., Secor D.H., Gill A.B., *The interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms. Oceanography* 2020, 33 (4): 96–107

⁴⁷³ Taormina et al. 2018...

⁴⁷⁴ Öhman M.C., Sigra P., Westerberg H., *Offshore windmills and the effects of electromagnetic fields on fish. Ambio* 2007, 36: 630-633

⁴⁷⁵ Westerberg H., Begout-Anras M.L., *Orientation of silver eel (Anguilla anguilla) in a disturbed geomagnetic field*, [w:] Moore A., Russel I. (red.), *Advances in Fish Telemetry. Proceedings of the Third Conference on Fish Telemetry in Europe, held in Norwich, England, 20–25 June. Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Lowestoft* 1998

⁴⁷⁶ Öhman et al. 2007...

⁴⁷⁷ Gill A.B., Desender M., *Risk to Animals from Electromagnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices*, [w:] Copping A.E., Hemery L.G. (red.), OES-Environmental. 2020 State of the Science Report. Environmental Effects of Marine Renewable Energy Development Around the World. Report for Ocean Energy Systems (OES), 2020: 87-103

⁴⁷⁸ Bochert R., Zettler M.L., *Long-term exposure of several marine benthic animals to static magnetic fields. Bioelectromagnetics* 2004, 25: 498-502

⁴⁷⁹ Wilson J.C., Elliott M., *The habitat creation potential of offshore windfarms. Wind Energy* 2009, 12 (2): 203-212

⁴⁸⁰ Danish Offshore Wind – Key Environmental Issues. DONG Energy, Vattenfall; The Danish Energy Authority (DEA); The Danish Forest and Nature Agency (DFNA), 2006

fins vibration (field strength of 0.5-7.5 V/m).⁴⁸¹ Harmful effects such as paralysis and temporary loss of consciousness were observed in fish exposed to an electric field with a force above 15 V/m⁴⁸², thus at values significantly exceeding the ones generated by submarine cables.

The area of the BC-Wind OWF does not constitute spawning grounds of cod or the deep-water spawning European flounder, which dominates in this area. During ichthyofauna surveys, sprat spawning grounds were found, but this marine area is small in comparison with the large areas of the spawning grounds of pelagic fish. There are no significant migration routes of diadromous ichthyofauna species running through the area of the BC-Wind OWF, including Atlantic salmon, sea trout and eel.

The impact related to the emission of an electromagnetic field will be negative, direct, local, long-term and permanent.

The sensitivity to this impact was assessed as moderate for all the examined fish species. The significance of the impact was assessed as **negligible** for all the analysed fish species.

Decommissioning phase

The currently binding laws (the United Nations Convention on the Law of the Sea – UNCLOS; the guidelines of the International Maritime Organization – IMO) require the environment to be restored to state pre-construction of the project. This entails the total dismantling of the infrastructure elements in the waters, up to a depth of 75 m. However, more and more often, opinions emerge that it would be a more favourable solution to leave the submerged elements of the artificial reef behind.⁴⁸³

The assessment of the environmental impact of the works carried out during the decommissioning phase of the project is hindered due to a lack of experience in this area, as well as the lack of knowledge about the technologies that will become available in the future. The first decommissioning of an offshore wind farm, of the small Yttre Stengrund OWF located near the Swedish coast in the vicinity of Karlskrona, was carried out in 2016.⁴⁸⁴ In accordance with the current law regarding the restoration of the environment to the state it was in prior to the project, in this case the wind turbine masts were totally removed and the concrete foundations were cut off at the seabed level.

The recommendations issued by the British authorities for the OWF decommissioning process⁴⁸⁵ point to the necessity to update the Environmental Impact Assessment prepared before the start of the project with additional information available at a later stage before the dismantling of the infrastructure.

The decommissioning phase of the BC-Wind OWF will be preceded by surveys of benthos and ichthyofauna to assess the ecological quality of the ecosystem created after more than 30 years, and then to plan the decommissioning in such a way as to preserve, as much as it will be possible, an ecosystem of high ecological quality (if one is created).

The following types of impacts are forecast for the decommissioning phase:

- emission of noise and vibrations;
- an increase in suspended solids content;
- a release of pollutants and nutrients from sediments;
- habitat change.

⁴⁸¹ Marino A.A., Becker R.O., *Biological effects of extremely low frequency electric and magnetic fields. A review. Physiological Chemistry and Physics* 1977, 9 (2): 131-147

⁴⁸² Fisher C., Slater M., *Effects of electromagnetic field on marine species. A literature review. No. 0905-00-001, 2010; available at: https://tethys.pnnl.gov/sites/default/files/publications/Effects_of_Electromagnetic_Fields_on_Marine_Species.pdf*

⁴⁸³ Smyth K., Christie N., Burdon D., Atkins J.P., Barnes R., Elliott M., *Renewables-to-reefs? Decommissioning options for the offshore wind power industry. Marine Pollution Bulletin* 2015, 90: 247-258

⁴⁸⁴ Power, *Vattenfall Completes World's First Decommissioning of an Offshore Wind Farm, April 1, 2016; available at: <https://www.powermag.com/vattenfall-completes-worlds-first-decommissioning-offshore-wind-farm>*

⁴⁸⁵ Department of Energy and Climate Change, *Decommissioning of offshore renewable energy installations under the Energy Act 2004 Guidance notes for industry, 2011; available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/80786/orei_guide.pdf*

Emission of noise and vibrations

The effect of the impact shall depend on the size of the structure and the dismantling technology. The currently available technologies of cutting/fragmentation of structural elements are diamond wire cutting, waterjet cutting and underwater explosions.⁴⁸⁶ In the case of the two first technologies, the lack of information on the level of noise they will generate hinders the assessment of their possible impact. The level of noise generated as a result of a 45 kg explosion may cause minor hearing damage to fish at a distance of up to 2.2 km from the location of the explosion.⁴⁸⁷ The effect of fish avoiding the area of works is probable. It can be assumed that the level of noise impact will be similar to that during the construction phase. However, it seems probable that the time necessary for the decommissioning will be shorter than that required for the construction of the project.

The emission of noise and vibrations generated during the removal of the OWF foundation piles may directly affect the ichthyofauna. These will be negative, direct, short-term, and regional impacts.

The sensitivity to the impact was assessed as very high for cod, sprat, herring and sand goby, and as high for flounder and common seasnail. The significance of the impact was assessed to be **negligible** for all the examined fish species. In the case of the fish under protection, only larval stages were present during the survey, for which the impact will be local.

Increase in suspended solids content

During works related to the dismantling of the infrastructure components, sediments will be disturbed and an increase in water turbidity will occur. The intensity of this impact will depend, e.g., on the extent to which the infrastructure elements will be removed from the environment. In the case a decision is made to leave the connection cables buried in the sediment, the emission of suspended solids and the destruction of the fauna inhabiting the seabed will be significantly reduced. According to Topham and McMillan⁴⁸⁸, such a solution may be more beneficial than removing the cable, which involves major disturbances of the seabed morphology and an increase in the concentration of suspended solids.

The release of sediment particles to the water depth may also take place during the removal of the sediments from around the elements of metal foundations of wind turbines during their preparation for cutting.⁴⁸⁹

In the case solutions are applied that cause the emission of suspended solids, the level of this impact will be similar to the one assumed for the construction phase.

The impact related to the increase of suspended solids content will be negative, direct, local, and short-term.

The significance of this impact was assessed as **negligible** for all the analysed fish species.

Release of pollutants and nutrients from sediments

During the dismantling works, sediment will be disturbed and pollutants (i.a. heavy metals, chlorinated biphenyls, pesticides, oil derivatives) and nutrients will be released from sediments into water.

In case toxic chemicals are released, an increased mortality of fish, diseases (e.g. skin diseases, liver and gill damage) and spawning disturbances may occur.

The risk of environmental pollution with the substances emitted from the sediment seems relatively small due to their low concentrations found in the sediments of the southern Baltic.

⁴⁸⁶ Topham E., McMillan D., Sustainable decommissioning of an offshore wind farm. *Renewable Energy* 2017, 102: 470-480

⁴⁸⁷ Nedwell J., Howell D., A review of offshore windfarm related underwater noise sources Report No. 544 R 0308. Report commissioned by COWRIE. Subacoustech Ltd, Southampton 2004

⁴⁸⁸ Topham and McMillan 2017...

⁴⁸⁹ Topham and McMillan 2017...

According to Topham and McMillan⁴⁹⁰, the risk of a spill of operating fluids from the decommissioned wind turbines can be minimised by dismantling the structural elements on land. The risk associated with the emission of toxic substances during the decommissioning of the project will be similar to the one expected for the construction phase.

The impact related to the release of pollutants and nutrients from sediments into water will be negative, direct, local, and short-term.

The sensitivity to the impact was assessed as moderate for all the examined fish species. The significance of the impact was assessed to be **negligible** for all the analysed fish species.

Habitat change

During the decommissioning, a significant part of the artificial reef, which will provide living, feeding, shelter and reproduction grounds for many fish species, will be destroyed. This may result in a decrease in the abundance and diversity of ichthyofauna. The end of the operation of the OWF and the removal of elements constituting navigational obstacles will enable fishing in this area. This may offset the beneficial impact on ichthyofauna of the cessation of fishing activities, in particular on the reproduction processes of certain fish species (the common seasnail, gobies).

The concept of leaving at least some of the infrastructural elements is popular in the United States, where the 'rigs-to-reef' programme is implemented. It involves leaving the oil exploration infrastructure elements in the environment as a substratum enabling the formation of artificial reefs.⁴⁹¹ In the case of offshore wind farms, this role could be played primarily by the scouring protection elements.

The impact related to the change of habitat will be negative, direct, local, long-term and permanent.

The sensitivity to the impact was assessed as high for all the examined fish species. The significance of the impact was determined to be **negligible** for all the analysed fish species.

9.4.4. Marine mammals

Construction phase

During the construction phase of the BC-Wind OWF, marine mammals may be subject to impacts arising from:

- underwater noise from piling;
- noise resulting from ship traffic;
- an increased amount of suspended solids in water;
- habitat changes;
- spills of oil derivatives into the environment as a result of shipwrecks.

Noise from piling

In general, the effects of impulse noise on marine mammals can be divided into five broad categories, which largely depend on the distance of the animal from the sound source^{492,493, 494}:

- detection;
- masking;
- changes in behaviour (behavioural response);

⁴⁹⁰ Topham and McMillan 2017...

⁴⁹¹ Kaiser M.J., Pulsipher A.G., Rigs-to-reef programs in the Gulf of Mexico. *Ocean Dev. Int. Law* 2005, 36: 119-134

⁴⁹² Hawkins A.D., Popper A.N., A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates. *ICES Journal of Marine Science* 2017, 74 (3): 635-651

⁴⁹³ Popper A.N., Hawkins A.D., Thomsen F., Taking the Animals' Perspective Regarding Anthropogenic Underwater Sound. *Trends in Ecology & Evolution* 2020, 35: 787-794

⁴⁹⁴ Redmond L.J., Murphy M.T., Using complementary approaches to estimate survival of juvenile and adult Eastern Kingbirds. *J. Field Ornithol.* 2012, 83: 247-259

- hearing damage – temporary and permanent (TTS, PTS);
- physical and physiological effects.

These categories have corresponding impact zones. It should be noted that the boundaries of these noise impact zones are not exact and that there is a high degree of overlap between the different zones. It is generally accepted that the zone of sound **detection** of the OWF construction is quite large for marine mammals due to the high level of generated noise.⁴⁹⁵ However, this area is usually not included in impact assessments, as it is not associated with significant negative impact on marine mammals. Physical and physiological effects include tissue damage and physiological effects (e.g. stress). In extreme cases, tissue damage can lead to the death of the animal. In the case of pile driving, however, little is known about the effects of the noise on marine mammal physiology and the spatial extent of these impacts. Therefore, physiological effects are not directly investigated in environmental impact assessments for wind farms.

Masking occurs when noise interferes with the detection of biologically relevant signals used by marine animals for communication and navigation. It is a phenomenon natural in the environment and occurs if the frequencies of the signal of interest and noise overlap. The ranges of masking by anthropogenic noise depend on its level, as well as existing background noise levels and other factors, such as e.g. the structure of the sound.^{496, 497} For impulse sounds, such as those generated by piling, masking is essentially irrelevant and is therefore not considered in this assessment.^{498, 499}

Changes in behaviour of the harbour porpoise as a result of anthropogenic noise are in most cases reversible and short-term. The most common response to pile-driving noise is moving away from the pile-driving area, relocating to areas that are sometimes less favourable to the species, as well as having foraging disturbed and changing mating behaviour.^{500, 501} Reactions of a studied specimen kept in a small tank and exposed to pile-driving noise included an acceleration of respiratory rate and, at higher noise levels, more frequent jumping out of the water⁵⁰². During the construction of the Alpha Ventus OWF in the German part of the North Sea, porpoises were observed to have an avoidance response to the piling area (exceeding 21 km from the noise source).^{503, 504} Other studies in the North Sea have shown the animals move up to 26 km in response to piling.⁵⁰⁵ During the construction of the Horns Rev II OWF, the activity of porpoises in the analysed region was decreased up to a distance of 17.8 km, both during the piling and after it was finished. At the closest surveyed distance (up to 2.5 km),

⁴⁹⁵ Thomsen F., Lüdemann K., Kafemann R., Piper W., *Effects of offshore wind farm noise on marine mammals and fish*. biola, Hamburg, Germany on behalf of COWRIE Ltd. 2006

⁴⁹⁶ Erbe C., Reichmuth C., Cunningham K., Lucke K., Dooling R., *Communication masking in marine mammals. A review and research strategy*. Marine Pollution Bulletin 2016, 103: 15-38

⁴⁹⁷ Branstetter B.K., Finneran J.J., *Comodulation masking release in bottlenose dolphins (Tursiops truncatus)*. The Journal of the Acoustical Society of America 2008, 124 (1): 625-633

⁴⁹⁸ Madsen P.T., Wahlberg M., Tougaard J., Lucke K., Tyack P., *Wind turbine underwater noise and marine mammals. Implications of current knowledge and data needs*. Marine Ecology – Progress Series 2006, 309: 279-295

⁴⁹⁹ Thomsen F., Lüdemann K., Kafemann R., Piper W., *Effects of offshore wind farm noise on marine mammals and fish*. biola, Hamburg, Germany on behalf of COWRIE Ltd. 2006

⁵⁰⁰ Skjellerup P., Maxon C.M., Tarpgaard E., Thomsen F., Schack H.B., Tougaard J., Teilmann J., Madsen K.N., Mikaelson M.A., Heilskov N.F., *Marine mammals and underwater noise in relation to pile driving – Working Group 2014. Report to the Danish Energy Authority. Project: Effects of offshore renewables on marine mammals*, 2015

⁵⁰¹ Tougaard J., *Input to revision of guidelines regarding underwater noise from oil and gas activities – effects on marine mammals and mitigation measures*. Scientific Report from DCE – Danish Centre for Environment and Energy No. 202. Aarhus University, DCE - Danish Centre for Environment and Energy, 2016.

⁵⁰² Kastelein R.A., van Heerden D., Gransier R., Hoek L., *Behavioral responses of a harbour porpoise (Phocoena phocoena) to playbacks of broadband pile driving sounds*. Marine Environmental Research 2013, 92: 206-214

⁵⁰³ Dähne M., Gilles A., Lucke K., Peschko V., Adler S., Krügel K., Sundermeyer J., Siebert U., *Effects of pile-driving on harbour porpoises (Phocoena phocoena) at the first offshore wind farm in Germany*. Environmental Research Letters 2013, 8: 025002

⁵⁰⁴ Tougaard J., Carstensen J., Teilmann J., Skov H., Rasmussen P., *Pile driving zone of responsiveness extends beyond 20 km for harbour porpoises (Phocoena phocoena (L.))*. The Journal of the Acoustical Society of America 2009, 126: 11-14

⁵⁰⁵ Brandt M.J., Dragon A.C., Diederichs A., Bellmann M.A., Wahl V., Piper W., Nabe-Nielsen J., Nehls G., *Disturbance of harbour porpoises during construction of the first seven offshore wind farms in Germany*. Marine Ecology Progress Series 2018, 596: 213-232.

the decreased activity of the animals persisted for 24-70 hours after the piling. A similar response was observed during the construction of the Alpha Ventus OWF, with the effect of a pause in harbour porpoise activity up to 20-35 hours after the piling⁵⁰⁶. Additionally, Graham et al. showed that the response of the species to noise from piling diminishes over time⁵⁰⁷. The behavioural responses of harbour porpoises during a 10-month installation of OWF foundations in the North Sea were studied. During the first piling, the recorded probability of a behavioural response was 50% within a radius of up to 7.4 km. For the last piling, the range of behavioural response decreased to 1.3 km.

Studies on the changes in behaviour of harbour porpoises as a result of pile-driving noise have shown relatively low response thresholds, averaging a SEL level of approx. 140 dB re 1 $\mu\text{Pa}^2\text{s}$.^{508, 509} Based on the study results presented above and the criterion brought forward by Skjellerup et al.⁵¹⁰, this value was adopted as the acoustic threshold for the behavioural response of harbour porpoises in the EIA Report for the BC-Wind OWF.

Tab. 9.21. Field studies in which harbour porpoise responses to piling were investigated

Source	Sound level	Location	Comments
Tougaard et al.	130 dB re 1 μPa rms	Piling in the area of the Horns Reef I OWF	The threshold was not set
Brandt et al.	149 dB re 1 μPa rms	Piling in the area of the Horns Reef II OWF	Results were probably overestimated due to failure to take into account the dampening effect of the reef
Tougaard et al.	130 dB re 1 μPa rms	Experiments carried out at Fyns Hoved, Great Belt, Denmark	The piling was not real – the sounds of the piling were played from underwater speakers
Dähne et al.	140 dB re 1 $\mu\text{Pa}^2\text{s}$ SEL	Piling in the Alpha Ventus OWF area	Aerial observations were additionally made
Kastelein et al.	>136 dB re 1 μPa rms	Performed playback experiments	Porpoises in captivity

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 213

As is the case with harbour porpoises, data available in literature shows that changes in the behaviour of seals caused by pile driving tend to be reversible and short-term. Common seals and grey seals studied at their haul-out sites in Danish waters did not respond to piling noise.⁵¹¹ However, Russell et al.⁵¹², in a study of the effects of OWF construction on common seals in southeast England, observed that the number of animals decreased significantly in the construction area up to 25 km from the piling site. It was estimated that 440 individuals abandoned the impact area. Significant animal displacement began with SELs between 142 and 151 dB for 1 $\mu\text{Pa}^2\text{s}$ and was limited to 2 hours after the piling had

⁵⁰⁶ Brandt M.J., Diederichs A., Betke K., Nehls G., Effects of Offshore Pile Driving on Harbour Porpoises (*Phocoena phocoena*). *Advances in Experimental Medicine and Biology* 2012, 730: 281-284

⁵⁰⁷ Graham I.M., Merchant N.D., Farcas A., Barton T.R., Cheney B., Bono S., Thompson P.M., Harbour porpoise responses to pile-driving diminish over time. *R. Soc. Open Sci.* 2019, 6: 190335

⁵⁰⁸ Brandt M.J., Diederichs A., Betke K., Nehls G., Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. *Marine Ecology Progress Series* 2011, 421: 205-216

⁵⁰⁹ Dähne M., Gilles A., Lucke K., Peschko V., Adler S., Krügel K., Sundermeyer J., Siebert U., Effects of pile-driving on harbour porpoises (*Phocoena phocoena*) at the first offshore wind farm in Germany. *Environmental Research Letters* 2013, 8: 025002

⁵¹⁰ Skjellerup P., Maxon C.M., Tarpgaard E., Thomsen F., Schack H.B., Tougaard J., Teilmann J., Madsen K.N., Mikkelsen M.A. and Heilskov N.F. 2015. Marine mammals and underwater noise in relation to pile driving — Working Group 2014. Report to the Danish Energy Authority. Project: Effects of offshore renewables on marine mammals

⁵¹¹ Dethlefsen V., Cameron P., Berg A., Von Westernhagen H., Malformations of embryos of spring spawning fishes in the southern North Sea. *Int. Counc. Explor. Sea C.M.* 1986/E: 21

⁵¹² Russell D.J.F., Hastie G.D., Thompson D., Janik V.M., Hammond P.S., Scott-Hayward L.A.S., Matthiopoulos J., Esther L. Jones E.L., McConnell B.J., Avoidance of wind farms by harbour seals is limited to pile driving activities. *Journal of Applied Ecology* 2016, 53 (6): 1642-1652

ceased. Kastelein et al.⁵¹³, while studying the response of captive common seals to the sound of pile driving, noted that the animals spent more time at the water surface during the exposure to the noise. During the construction of two offshore wind farms in Dutch waters, Luchterduinen and Gemini, the behavioural response of the grey seal was studied⁵¹⁴. The animals responded in different ways: by changing their behaviour at the water surface or while diving, changing their swimming direction, including swimming away from the source of the noise, fleeing to the shore or swimming perpendicular to the incoming sound. In some cases, no changes in behaviour were observed. The most common reaction of seals was a decrease in swimming speed, which suggests a switch from foraging (diving towards the bottom) to swimming horizontally. These changes occurred significantly more often at shorter distances from the pile driving source, and were statistically significant up to at least 36 km.

The acoustic threshold for the behavioural response of seals in reaction to pile-driving noise adopted in the EIA Report for the BC-Wind OWF is based on the studies of Russel et al.⁵¹⁵ and equals the SEL of 158 dB re 1 $\mu\text{Pa}^2\text{s}$.

Noise-induced **shifts in hearing threshold** can lead to temporary (TTS) or permanent (PTS) changes. TTS means that the animal will regain its original hearing after a period of convalescence. In contrast, PTS leads to irreversible changes to the auditory system. There are a few studies that have documented TTS in harbour porpoises exposed to intense impulsive noise. Lucke et al.⁵¹⁶ measured TTS in an individual exposed to a single pulse from projectiles used for seismic surveys. Following exposure to sound of 164.3 dB re 1 $\mu\text{Pa}^2\text{s}$, the TTS was above 6 dB. Kastelein et al.⁵¹⁷ also induced TTS in harbour porpoise, but using a longer noise duration with a lower octave band, around 4 kHz. Exposure at 124 dB re 1 μPa for 120 minutes resulted in a TTS of 6 dB. Kastelein et al.⁵¹⁸ induced TTS in two individuals exposed to playback of pile-driving sounds at 4 and 8 kHz. Signals in the 8 kHz band caused a higher TTS than in the 4 kHz band. The animals were also exposed to a broadband sound at a level of 145 dB re 1 $\mu\text{Pa}^2\text{s}$ for 15-360 minutes (a cumulative SEL range of 173-187 dB re 1 $\mu\text{Pa}^2\text{s}$). The mean TTS (1-4 minutes after the sound exposure for the first porpoise and 12-16 minutes for the second animal) increased from 0 dB after 15 minutes of noise exposure to 5 dB after 360 minutes. The individuals recovered their original hearing within 60 minutes after the exposure to the sound had ceased. Popov et al.⁵¹⁹ studied TTS in a Yangtze finless porpoise (*Neophocaena phocaenoides asiaeorientalis*). After exposure to a continuous semi-octave band noise centred at 32, 45, 64 or 128 kHz for 30 minutes, TTS was elicited at 140 dB re 1 μPa . In general, temporary hearing damage can occur near the main frequency of continuous sounds⁵²⁰, low-frequency impulsive sounds⁵²¹, and also at

⁵¹³ Kastelein R.A., Helder-Hoek L., Kommeren A., Covi J., Gransier R., Effect of pile-driving sounds on harbor seal (*Phoca vitulina*) hearing. *J. Acoust. Soc. Am.* 2018, 143: 3583-3594

⁵¹⁴ Aarts G., Brasseur S., Kirkwood R., Behavioural response of grey seals to pile driving. Wageningen Marine Research report C006/18. Wageningen Marine Research, Den Helder 2018

⁵¹⁵ Russell D.J.F., Hastie G.D., Thompson D., Janik V.M., Hammond P.S., Scott-Hayward L.A.S., Matthiopoulos J., Esther L. Jones E.L., McConnell B.J., Avoidance of wind farms by harbour seals is limited to pile driving activities. *Journal of Applied Ecology* 2016, 53 (6): 1642-1652

⁵¹⁶ Lucke K., Siebert U., Lepper P.A., Blanchet M.A., Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli, *Journal of the Acoustical Society of America* 2009, 125: 4060-4070

⁵¹⁷ Kastelein R.A., Gransier R., Hoek L., Macleod A., Terhune J.M., Hearing threshold shifts and recovery in harbor seals (*phoca vitulina*) after octave-band noise exposure at 4 KHz, *Journal of the Acoustical Society of America* 2012, 132: 2745-2761

⁵¹⁸ Kastelein R.A., Helder-Hoek L., Covi J., Gransier R., Pile driving playback sounds and temporary threshold shift in harbor porpoises (*Phocoena phocoena*). Effect of exposure duration. *J. Acoust. Soc. Am.* 2016, 139 (5): 2842-2851

⁵¹⁹ Popov V.V., Ladygina T.F., Supin A.Y., Evoked potentials of the auditory cortex of the porpoise, *Phocoena phocoena*. *J Comp Physiol A.* 1986, 158: 705-711

⁵²⁰ Kastelein R.A., Gransier R., Hoek L., Rambags M., Hearing frequency thresholds of a harbour porpoise (*phocoena phocoena*) temporarily affected by a continuous 1.5 khz tone. *J. Acoust. Soc. Am.* 2013, 134: 2286-2292

⁵²¹ Lucke K., Siebert U., Lepper P.A., Blanchet M.A., Temporary shift in masked hearing thresholds in a harbor porpoise (*phocoena phocoena*) after exposure to seismic airgun stimuli, *Journal of the Acoustical Society of America* 2009, 125: 4060-4070

higher frequencies. It appears that the lower the central frequency of the noise, the greater the effect of noise exposure.⁵²²

Research on TTS was also performed for seals. Kastelein et al.⁵²³ estimated that in two common seals exposed to reproduced broadband pile driving noise, the onset of TTS occurred at a cumulative SEL of approx. 192 dB for 1 $\mu\text{Pa}^2\text{s}$. In contrast, Reichmuth et al.⁵²⁴ did not induce TTS in ringed seals exposed to projectile noise, even at levels described as initial levels for TTS. It was then suggested that seals may be learning to tolerate loud impulsive sounds. TTS in common seals exposed to longer duration of noise was studied twice.^{525, 526} Kastak et al.⁵²⁷ induced a 6 dB TTS after 25 minutes of exposure using octave noise with a centre frequency of 2.5 kHz. Kastelein et al. (2012)⁵²⁸ found that a TTS of approx. 6 dB was induced after 60 minutes of exposure to 136 dB re 1 μPa octave band noise with a centre frequency of 4 kHz. Sills et al.⁵²⁹ investigated the effects of single and multiple pulses produced by projectile seismic surveys on bearded seals. They found no evidence of TTS after a single shot at an SEL of 185 dB re 1 $\mu\text{Pa}^2\text{s}$ and at an SPL of 207 dB re 1 μPa . However, as the number of noise exposures increased, a TTS was recorded at 400 Hz (cumulative SEL 191-195 dB re 1 $\mu\text{Pa}^2\text{s}$, frequency-weighted SEL 167-171 dB re 1 $\mu\text{Pa}^2\text{s}$).

In the common seal, PTS was incidentally induced after two consecutive 60-second exposures to a 4.1 kHz pure tone. This initially resulted in a shift of the hearing threshold for 5.8 kHz above 50 dB, and more than two months later the threshold shift was 7-10 dB⁵³⁰.

The results cited above indicate that there is considerable variation in noise levels causing hearing damage in marine mammals. As a result, the determination of acoustic thresholds for TTS and PTS is a widely discussed issue. In 2007, based on data available at the time, the first set of criteria for the impact of noise on marine mammals was proposed.⁵³¹ Since then, these set criteria have been reviewed several times.⁵³² In 2018, NMFS⁵³³ issued updated general recommendations regarding acoustic thresholds for PTS and TTS in different marine mammal hearing classes, for both continuous

⁵²² Popov V.V., Supin A.Y., Wang D., Wang K., Dong L., Wang S., Noise-induced temporary threshold shift and recovery in Yangtze finless porpoises *neophocaena phocaenoides*. *Journal of the Acoustical Society of America* 2011, 130: 574-584

⁵²³ Kastelein R.A., Helder-Hoek L., Kommeren A., Covi J., Gransier R., Effect of pile-driving sounds on harbor seal (*Phoca vitulina*) hearing. *J. Acoust. Soc. Am.* 2018, 143: 3583-3594

⁵²⁴ Reichmuth, Colleen & Ghaul Bergman, Asila & Sills, Jillian & Rouse, Andrew & Southall, Brandon. (2016). Low-frequency temporary threshold shift not observed in spotted or ringed seals exposed to single air gun impulses. *The Journal of the Acoustical Society of America*. 140. 2646-2658. 10.1121/1.4964470

⁵²⁵ Kastak D., Southall B.L., Schusterman R.J., Kastak C.R., Underwater temporary threshold shift in pinnipeds. Effects of noise level and duration. *The Journal of the Acoustical Society of America* 2005, 118: 3154-3163

⁵²⁶ Kastelein R.A., Gransier R., Hoek L., Macleod A., Terhune J.M., Hearing threshold shifts and recovery in harbor seals (*phoca vitulina*) after octave-band noise exposure at 4 Khz, *Journal of the Acoustical Society of America* 2012, 132: 2745-2761

⁵²⁷ Kastak D., Southall B.L., Schusterman R.J., Kastak C.R., Underwater temporary threshold shift in pinnipeds. Effects of noise level and duration. *The Journal of the Acoustical Society of America* 2005, 118: 3154-3163

⁵²⁸ Kastelein R.A., Gransier R., Hoek L., Macleod A., Terhune J.M., Hearing threshold shifts and recovery in harbor seals (*phoca vitulina*) after octave-band noise exposure at 4 Khz, *Journal of the Acoustical Society of America* 2012, 132: 2745-2761

⁵²⁹ Sills J., Ruscher B., Nichols R., Southall B., Reichmuth C., 2020, Evaluating temporary threshold shift onset levels for impulsive noise in seals. *The Journal of the Acoustical Society of America*, 148:2973-2986

⁵³⁰ Kastak D., Mulsow J., Ghaul A., Reichmuth C., Noise-induced permanent threshold shift in a harbor seal. *The Journal of the Acoustical Society of America* 2008, 123 (5): 2986

⁵³¹ Southall B.L., Bowles A.E., Ellison W.T., Finneran J.J., Gentry R.L., Greene C.R.J., Kastak D., Ketten D.R., Miller J.H., Nachtigall P.E., Richardson W.J., Thomas J.A., Tyack P., Marine mammal noise exposure criteria. Initial scientific recommendations. *Bioacoustics* 2008, 17: 273-275

⁵³² Finneran J.J., Auditory Weighting Functions and TTS/PTS Exposure Functions for Marine Mammals Exposed to Underwater Noise. Technical Report 3026. SSC Pacific, San Diego 2016

⁵³³ National Marine Fisheries Service (NMFS), 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0). Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59, 2018

and impulsive noise. These thresholds were also described by Southall et al.⁵³⁴ with minor changes in nomenclature defining different animal hearing groups.

The hearing sensitivity of marine mammals is not the same across the range of frequencies heard by the animals. Relative to the lower and upper cut-off frequencies, the heard volume becomes lower than that predicted by the audiogram.⁵³⁵ To compensate for this discrepancy, frequency weighting functions have been proposed for specific groups of animals. Southall et al.⁵³⁶ developed the first equal volume filters for different groups of marine mammals (M-weighting). These were used by the NMFS and Southall et al.⁵³⁷ to develop noise impact criteria taking into account the weighted frequencies. These criteria are seen as the most comprehensive and were therefore used in the assessment for the BC-Wind OWF.

A summary of the values of the noise exposure criteria is presented in the table below (Tab. 9.22).

Tab. 9.22. Summary of the noise exposure criteria used to calculate impact ranges of noise generated during piling on marine mammals

(PTS = permanent shift in hearing threshold, TTS = temporary shift in hearing threshold,

SEL = sound exposure level, multiple pulses = series of consecutive pulses, SPL_{peak} = peak sound pressure level)

Source	Effect	Species	Modelled sound type	Threshold value SEL weighted	Threshold value SPL _{peak}
NMFS 2018	PTS	Common porpoise	Single impact and 24-hour accumulation	155 dB re 1 $\mu\text{Pa}^2\text{s}$	202 dB re 1 μPa
	TTS	Common porpoise	Single impact and 24-hour accumulation	140 dB re 1 $\mu\text{Pa}^2\text{s}$	196 dB re 1 μPa
	PTS	Grey seal and common seal	Single impact and 24-hour accumulation	185 dB re 1 $\mu\text{Pa}^2\text{s}$	218 dB re 1 μPa
	TTS	Grey seal and common seal	Single impact and 24-hour accumulation	170 dB re 1 $\mu\text{Pa}^2\text{s}$	212 dB re 1 μPa
Skiellerup et al.	Changes in behaviour (behavioural)	Common porpoise	Single impact	140 dB re 1 $\mu\text{Pa}^2\text{s}$ (unweighted SEL)	-
Russell et al.	Changes in behaviour (behavioural)	Common seal	Single impact	158 dB re 1 $\mu\text{Pa}^2\text{s}$ (unweighted SEL)	-

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 216, modified

The way in which sound associated with pile-driving propagates depends on many factors, such as the type of seabed, the depth of seabed penetration, the depth of the water, and hydrological conditions. Therefore, the degree of impact of the generated noise on marine organisms is strongly dependent on i.a. the location of the works. In order to estimate the potential impact of noise from piling during the construction of the BC-Wind OWF on marine mammals, numerical modelling of noise propagation was performed, using a location of the wind turbine at the greatest depth as the least favourable in terms of the underwater noise propagation range. Using the modelling, distance ranges and areas where animals could potentially be affected were calculated.

As preliminary analyses of sound propagation during piling in the area of the BC-Wind OWF showed very large noise propagation ranges, the calculations for the environmental impact assessment

⁵³⁴ Southall B.L., Finneran J. J., Reichmuth C., Nachtigall P. E., Ketten D. R., Bowles A. E., Ellison W. T., Nowacek D. P., Tyack P. L., Marine mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects, Aquatic Mammals 2019, 45(2): 125-232

⁵³⁵ Moore B.C.J., An introduction to the psychology of hearing. Emeral Group Publishing Ltd, Bingley 2012

⁵³⁶ Southall B.L., Bowles A.E., Ellison W.T., Finneran J.J., Gentry R.L., Greene C.R.J., Kastak D., Ketten D.R., Miller J.H., Nachtigall P.E., Richardson W.J., Thomas J.A., Tyack P., Marine mammal noise exposure criteria. Initial scientific recommendations. Bioacoustics 2008, 17: 273-275

⁵³⁷ Southall B.L., Finneran J. J., Reichmuth C., Nachtigall P. E., Ketten D. R., Bowles A. E., Ellison W. T., Nowacek D. P., Tyack P. L., Marine mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects, Aquatic Mammals 2019, 45(2): 125-232

were carried out assuming the use of mitigation measures. The simultaneous use of a Big Bubble Curtain (BBC) and a Hydro Sound Damper (HSD) was considered. The analysis was carried out for the spring-summer season (April to June), taking into account the planned schedule of project works.

Considering the assessment of this impact on animals, the impact of noise from a single pile strike was analysed for the effect of hearing damage (TTS and PTS), as well as the cumulative case, i.e. assuming the total time needed to drive a single pile. The assumed cumulative time was 24 hours, although with high hammer power, the driving time for a single pile can be e.g. approx. 2 hours, followed by a break associated with moving and positioning at the next foundation location. In the case of a behavioural change, the response of the animals to the sound of a single strike was taken into account. The obtained results made it possible to approximate the distances and areas where a given impact might occur. In the case of harbour porpoise, the results were also used to calculate the extent to which the planned construction works could affect the population status of this species in the Baltic Proper. This was done by estimating the number of animals potentially exposed to the impact and the proportion of the population that these individuals represent. For the calculations, data on the abundance and density of harbour porpoises from the northeast Baltic population was used, based on Amundin et al. (2022), assuming the season included in the modelling (Tab. 9.23).

Tab. 9.23. *Estimated density and abundance values of the Baltic Proper harbour porpoise population adopted for the performed calculations of noise impact from piling*

Region	Season of greatest density		Density (number of animals/1000 km ²)		Abundance	
	Literature	Modelling	Value	95% CI	Value	95% CI
Northeastern Baltic	May – October	April – June	3.70	0.54-8.33	491	71-1105

Source: own elaboration based on Amundin et al., 2022

For both harbour porpoises and seals, the modelling results for the least favourable location showed that piling without the use of mitigation measures would result in a significant negative impact on animals. For both groups of the analysed marine mammals, hearing damage in the form of TTS and PTS, as well as behavioural changes of very high magnitude, would be expected (Tab. 9.24, Tab. 9.25).

If mitigation measures are applied, the negative impact on marine mammals is clearly reduced (Tab. 9.24, Tab. 9.25). For both harbour porpoises and seals, the effect of hearing damage becomes negligible due to the very small range of noise impact (a maximum of 0.1 km). Regarding the behavioural response, the extent of impact is much greater, particularly for harbour porpoises. The predicted area of impact is approx. 1468 km², which means that behavioural changes may occur in approx. 1% of the population present in the eastern Baltic. For seals, the extent of the impact for behavioural response is much smaller, amounting to approx. 22 km².

Tab. 9.24. *Predicted noise impact ranges from piling during construction works in the BC-Wind OWF Area obtained for the harbour porpoise on the basis of numerical modelling, together with results from calculations of the proportion of the Baltic Proper population that will be affected. Results are presented with and without single turbine piling and with and without mitigation measures. The number and proportion of harbour porpoises were calculated based on the population abundance data for northeastern Baltic in Amundin et al., 2022. Results are presented assuming upper and lower density limits and animal abundance within the 95% confidence interval considered in Amundin et al., 2022*

Mitigation measure	Effect	Maximum range of impact [km]	Area of impact [km ²]	Number of affected harbour porpoises	Percentage of affected harbour porpoises [%]
No mitigation measures applied	PTS single strike	0.3	0.1	<0.01	<0.01
	PTS cum.	27.6	735	0.4-6.1	0.6-0.6
	TTS single strike	4.9	25	0.01-0.2	0.02-0.02
	TTS cum.	102	8971	4.8-74.7	6.8-6.8
	Behavioural change	>150	28073	15-233	21.4-21.2
	PTS single strike	0.1	0.03	<0.01	<0.01

Mitigation measure	Effect	Maximum range of impact [km]	Area of impact [km ²]	Number of affected harbour porpoises	Percentage of affected harbour porpoises [%]
HSD + DBBC	PTS cum.	0.1	0.03	<0.01	<0.01
	TTS single strike	0.1	0.03	<0.01	<0.01
	TTS cum.	0.1	0.03	<0.01	<0.01
	Behavioural change	33.9	1468	0.8-12.2	1.1-1.1

Source: own elaboration based on noise propagation modelling (Appendix 3, Volume III)

Tab. 9.25. Predicted impact ranges of noise caused by piling during construction works in the BC-Wind OWF Area obtained for seals on the basis of numerical modelling. Results are presented with and without mitigation measures

Mitigation measure	Effect	Maximum range of impact [km]	Area of impact [km ²]
No mitigation measures applied	PTS single strike	0.1	0.03
	PTS cum.	4.6	42.9
	TTS single strike	0.3	0.2
	TTS cum.	72.2	4779
	Behavioural change	61.9	3774
HSD + DBBC	PTS single strike	0.1	0.03
	PTS cum.	0.1	0.03
	TTS single strike	0.1	0.03
	TTS cum.	0.1	0.03
	Behavioural change	3	21.9

Source: own elaboration based on noise propagation modelling (Appendix 3, Volume III)

On the basis of the results presented above and the data on the occurrence of marine mammals in the area of the BC-Wind OWF and adjacent waters, it can be assumed that if the piling process is conducted in the period between April and June, in one location and with the use of mitigation measures in the form of HSD+DBBC or other noise reduction systems resulting in the same level of noise reduction, the impact of emitted noise on marine mammals will be limited. With a double air curtain, the impact on marine mammals will also be significantly reduced, as indicated by the draft modelling results from a single and double air curtain (Table 9.19).

The results of acoustic monitoring of harbour porpoises carried out in the BC-Wind study area showed that the highest activity of the species is recorded during the summer, primarily in August. The overall detection rate was at a low level. Surveys carried out for the nearby planned Baltic Power OWF also indicated a relatively infrequent appearance of the animals, with their highest activity in the autumn season (Subchapter 7.4.4). This indicates that if the piling process takes place between April and June, the proportion of harbour porpoises potentially exposed to behavioural effects associated with the emitted noise will be low.

With regard to seals, the pre-investment monitoring carried out for both the analysed BC-Wind OWF and the nearby Baltic Power OWF showed sporadic occurrence of grey seals, at different times of the year (Subchapter 7.4.4). Based on this information and the predicted impact ranges for behavioural response, the effect of changes in seal behaviour under the influence of piling noise can be considered negligible.

A summary of the assessment of the impact of noise generated during the piling process at the BC-Wind OWF on marine mammals is presented in Tab. 9.26. Irrespective of the modelling results and the noise reduction system that will be ultimately adopted, adequate oversight should be ensured during

the construction phase, in order to monitor the surroundings to exclude the presence of marine mammals in the vicinity of the planned start point of piling.

Use of acoustic deterrent devices (ADD)

An acoustic deterrent device is a device used to keep animals, especially marine mammals, from certain areas. They emit sounds that deter animals from approaching, which is useful in cases like protecting elements of aquaculture, reducing bycatch in fishing nets, and preventing animals from entering construction sites. ADDs can be applied during construction phases of wind farm projects, when the piling of a wind turbine foundation causes underwater impulsive noise of considerable intensity. This noise, although decreasing with distance from the source according to the physics of sound in water, can cause temporary and permanent hearing damage to marine mammals at closer distances, injury, or even death. ADDs' short-lived sound emissions preceding the piling (and the soft start procedure at the start of the operation) would help scare animals out of the zones potentially most dangerous to them.

ADDs are designed to be less intense than acoustic harassment devices (AHDs), which can cause marked discomfort, and even pain in animals. Their effectiveness can vary and depend on the species and context in which they are used. One of the challenges with AHDs is that animals can become accustomed to the sounds over time, which reduces their effectiveness. However, some studies suggest that this habituation does not always have to occur and that the devices can remain effective for longer periods of time.

Depending on the specific device, ADDs can act like a pinger used in commercial fishing operations, helping indicate an underwater hazard, or actively encourage mammals to leave the area surrounding the ADD by producing high amplitude sounds that are considered unpleasant, but harmless to the hearing of marine mammals (seal scarers). The latter type of device usually consists of an electronic base or control unit that is located on a vessel or platform and an underwater speaker (transducer) that emits the sound. During the construction of offshore wind farms, ADDs of this type are deployed for a short period of time immediately before piling begins.

Commercially available ADDs emit sounds over a fairly wide range, usually of medium frequency; however, some devices are better suited to deter certain species. The use of ADDs should be designed to minimise adverse impacts on both target and non-target species and the ecosystem as a whole, i.e. in a way that maximises effectiveness and minimises adverse impacts.

ADDs used to deter specific species and groups operate in a frequency range that is effective against these animals (the f range coincides with the hearing sensitivity of porpoises, making the sounds noticeable and potentially repellent). Sound pressure levels (SPL) emitted by an ADD can vary, but generally exceed 130-150 dB re 1 µPa. The signal can be pulse – intermittent, continuous or 'mixed' (with complex tones and random pauses between pulses, e.g. FaunaGuard). The device should be selected to suit the specific case and context.

Use of ADDs to deter marine mammals during piling operations – JNCC guidelines

In line with the JNCC guidelines to minimise the risk of injury to marine mammals from underwater noise generated by activities such as piling (UK), ADDs should be deployed prior to the commencement of noise-producing activities to create an exclusion zone, incentivising marine mammals to leave the area. In parallel, continuous monitoring using marine mammal observers (MMO) and passive acoustic monitoring (PAM) systems is recommended. The guidelines emphasise the importance of assessing the effectiveness of deterrents for different species and adjusting protocols as necessary. A 15-minute ADD deployment is preferred, which depends on the size of the impact zone, the time required for animals to leave the zone, their swimming speed, and expert recommendations (MFRAG-MM). However, the duration an ADD should be used as a mitigation measure is determined on a project-by-project basis. Consideration should be given to the need to ensure that animals are deterred from the risk zone (i.e. the auditory injury zone or collision risk zone) by allowing them to move

away from the noise source, as well the need to minimise noise introduced into the environment, which may itself have a negative impact.

Use of ADDs to deter marine mammals during piling operations – Energistyrelsen guidelines

The Danish Energy Agency (*Energistyrelsen*) has published (2022) guidelines for the use of ADDs during offshore construction. The guidelines provide detailed criteria for the use of ADDs, focusing on minimising the risk of PTS in marine mammals. The 2023 revision of the guidelines provides updated methods for numerical forecasting and in situ measurements, including detailed procedures for the deployment of ADDs. If a project is in principle eligible to authorise the use of an ADD (which is tantamount to a situation in which the PTS for all relevant mammal auditory groups associated with the piling is greater than 200 m), a separate noise forecast must be carried out (assuming the specific ADD is the only active noise source).

Moray East piling strategy

The Moray East Offshore Wind Farm project includes a piling strategy that involves the use of ADDs (the ADD use protocol) to mitigate the impact of piling noise on marine life. The strategy sets out specific protocols for the deployment of deterrent devices before and during piling. This includes the timing and duration of ADD use to ensure maximum effectiveness. Continuous monitoring is carried out to assess the effectiveness of the additional safeguards and to ensure compliance with environmental regulations. Adjustments to the strategy may be made based on the results of the monitoring.

The ADD use protocol provides guidance on the deployment of equipment, the role of the ADD operator, testing and maintenance, as well as the coordination and activation of the equipment. The rules for the use of ADDs for Moray East have been revised in 2019 in terms of the length of ADD operation prior to the start of piling (reducing this time to 5-10 min.) based on the best available scientific sources. The protocol provides for an ADD to be activated prior to the soft start procedure. Subsequent piling was to no longer be preceded by the sound of the ADD if it followed immediately (up to 10 min.) after the first one. On the other hand, after a break in piling of more than 6 hours, it was indicated that the ADD is to be used before the next piling.

The ADD Lofitech device (of a seal scarer type) was selected based on available information and test results, as well as due to the sound level and frequency being suitable for the hearing ability of key marine mammal species (seals and cetaceans) present in the Moray East area. The sound frequencies of this device are typically emitted between 10 and 20 kHz with an output level of 189-191 dB re 1 µPa. A competent/trained and independent operator has been appointed to coordinate and activate the ADD, in communication with site management and following an established protocol. The deployment of the ADD was dependent on the size of the injury zone at each piling location (based on predicted pile driver power) and the swimming speed of the animal. As per the protocol, it was planned to apply the ADD for 5-10 min. Based on a conservative swimming speed of 1.5 m/s for all marine mammal species, this was to provide a mitigation zone of approx. 900 m.

Summary of ADD use

Acoustic marine mammal deterrent devices emit sounds that are harmless in terms of injury, hearing damage, or shifts in auditory sensitivity (PTS, TTS), provided that they are carefully selected, monitored and operated, properly calibrated, and limited in use. They are a source of noise pollution in themselves, but in parallel they allow the creation of so-called exclusion zones to help reduce the risks of OWF piling noise. Some countries apply guidelines for the use of ADDs during offshore works, allowing the use of ADDs conditionally (e.g. Denmark) or recommending the use of clear protocols for risk reduction (e.g. Denmark, UK). The JNCC guidelines applied to the piling strategy for Moray East translate into an appropriate ADD use protocol that, based on updated data on the range of the noise, provides 5-10 min before piling starts from the soft start procedure. In line with this practice, it has been proposed that a strategy for piling should be developed months prior to the commencement of piling,

which would detail ADD use protocols. According to the current level of knowledge on the subject, ADD use not exceeding 15 min. can be an effective tool used in addition to an NRS.

Noise from ship traffic

The types of vessels used for OWF construction can be divided into, e.g.: wind turbine installation vessels (WTIV), cargo barges, crane barges, jack-up rigs and tugboats. Measurements of the noise emitted by a cargo vessel, 173 m long and powered by a slow-speed direct-drive diesel engine, were made by Arverson and Vendittis.⁵³⁸ The recorded sound level was 174 dB re 1 µPa at 9 Hz. Sound levels of drilling vessels were measured experimentally at 142-145 dB re 1 µPa rms at 30-2000 Hz (approximate levels for jack-up rigs)⁵³⁹. A tug towing an empty barge emitted a noise level of 145 dB re 1 µPa at 5 kHz, and with a loaded barge – 170 dB re 1 µPa at 1 kHz.⁵⁴⁰ Small high-speed vessels, such as barges and supply vessels, mainly produce noise at frequencies from <1 kHz to >10 kHz.^{541, 542}

It is likely that increased ship activity during the construction phase of the OWF will lead to an increase in the acoustic field, covering frequencies that partly affect marine mammals.⁵⁴³ Harbour porpoises, grey seals and common seals are more sensitive to higher frequencies. Studies have shown that harbour porpoises respond to lower levels of high frequency components of ship noise.^{544, 545} Wisniewska et al. (2015) studied free-ranging harbour porpoises in Danish waters using acoustic tags (DTAGs) attached to the animals. It was noted that exposure to sudden high-frequency noise caused by a fast-moving ship resulted in the observed individuals exhibiting behaviours including vigorously moving their tail fin, abandoning foraging, and occasionally even ceasing echolocation. These reactionary behaviours were registered at a distance of several kilometres from the vessel. The severity of factors disturbing harbour porpoise behaviour generally depends on the type and number of boats that emit medium- and high-frequency sounds. It is likely that vessels of this type are a minority of those used for OWF construction. Wisniewska et al. showed that free-living harbour porpoises are exposed to noise from ships during 17-89% of the time. Some of the areas with the highest vessel traffic in Danish waters (e.g. the Great Belt and the Little Belt) are also areas with a very high abundance of harbour porpoises.⁵⁴⁶ In those regions, the animals are exposed to vessel noise, but its level is relatively low.⁵⁴⁷ As the construction of the BC-Wind OWF will primarily involve vessels generating low-frequency, lower-intensity noise, it is anticipated that any potential changes in harbour porpoise behaviour will be of short duration, at distances below 10 km.

⁵³⁸ Arverson P.T., Vendittis D.J., Radiated noise characteristics of a modern cargo ship. *J. Acoust. Soc. Am.* 2000, 107 (1): 118-129

⁵³⁹ Erbe C., McPherson C., Underwater noise generated from geotechnical drilling and standard penetration testing, *The Journal of the Acoustical Society of America* 2017, 142 (3): EL281-EL285

⁵⁴⁰ Redmond L.J., Murphy M.T., Using complementary approaches to estimate survival of juvenile and adult Eastern Kingbirds. *J. Field Ornithol.* 2012, 83: 247-259

⁵⁴¹ Dyndo M., Wisniewska D.M., Rojano-Doñate L., Madsen P.T., Harbour porpoises react to low levels of high frequency vessel noise. *Scientific Reports* 2015, 5: 11083

⁵⁴² Hermannsen L., Beedholm K., Tougaard J., Madsen P.T., High frequency components of ship noise in shallow water with a discussion of implications for harbor porpoises (*Phocoena phocoena*). *The Journal of the Acoustical Society of America* 2014, 136 (4): 1640-1653

⁵⁴³ Hermannsen L., Beedholm K., Tougaard J., Madsen P.T., High frequency components of ship noise in shallow water with a discussion of implications for harbor porpoises (*Phocoena phocoena*). *The Journal of the Acoustical Society of America* 2014, 136 (4): 1640-1653

⁵⁴⁴ Dyndo M., Wisniewska D.M., Rojano-Doñate L., Madsen P.T., Harbour porpoises react to low levels of high frequency vessel noise. *Scientific Reports* 2015, 5: 11083

⁵⁴⁵ Wisniewska D.M., Johnson M., Teilmann J., Siebert U., Galatius A., Dietz R., Madsen P.T., High rates of vessel noise disruption foraging in wild harbour porpoises (*Phocoena phocoena*). *Proceedings of the Royal Society B: Biological Sciences* 2018, 285: 20172314

⁵⁴⁶ Sveegaard S., Teilmann J., Berggren P., Mouritsen K.N., Gillespie D., Tougaard J., Acoustic surveys confirm the high-density areas of harbour porpoises found by satellite tracking. *ICES Journal of Marine Science* 2011, 68: 929-936

⁵⁴⁷ Wisniewska D.M., Johnson M., Teilmann J., Siebert U., Galatius A., Dietz R., Madsen P.T., High rates of vessel noise disruption foraging in wild harbour porpoises (*Phocoena phocoena*). *Proceedings of the Royal Society B: Biological Sciences* 2018, 285: 20172314

It is assumed that similar trends related to behavioural changes will apply to the grey seals and common seals considered in this report. These animals are also often noted in areas of high marine traffic⁵⁴⁸. Mikkelsen et al.⁵⁴⁹ showed that common and grey seals were exposed to noise from ships during 2.2-20.5% of the time spent at sea in a study using acoustic tags (DTAGs), which register both sound and animal behaviour. Furthermore, it was noted that the observed individuals changed their diving behaviour in response to the presence of ships.

Continuous noise associated with boring may also occur during construction due to the need to drill piles. Impacts related to boring are described in detail for the decommissioning phase. For the construction phase, the impacts will be of a much smaller magnitude.

Overall, ambient noise levels are not expected to increase significantly as a result of increased vessel traffic associated with the construction of the BC-Wind OWF and as a result of pile drilling. The potential impact of the noise generated by vessels is assessed to be short-term and of minor importance to marine mammals.

Increase in suspended solids in water

The increase in suspended solids in the water due to the construction of the BC-Wind OWF is assumed to be short-term and of little importance to harbour porpoises, grey seals, and common seals.

Habitat changes

Habitat changes associated with the construction of the BC-Wind OWF primarily include impacts on seabed habitats, and may indirectly affect marine mammals. This is related to the impact on the food base, i.e. fish populations feeding on benthic organisms. During the construction of the OWF, a temporary loss of feeding grounds of seals and harbour porpoises may occur. As there is no abundance of marine mammals in the area of the planned wind farm, the phenomenon of temporary changes in habitat is assessed to be of minor importance.

Spills of oil derivatives into the environment as a result of shipwrecks

Marine mammals, both in the area of the planned farm and in adjacent waters, could be adversely affected by ship collisions or accidents resulting in an oil spill during the BC-Wind OWF project. Such a scenario is however highly unlikely. The possibility of occurrence of emergencies and the actions to be taken by the Investor to counteract them are more broadly described in Chapter 13.

Assessment of the significance of impacts during the construction phase

The methodology developed for the EIA Report was adopted for the assessment of these impacts. The significance of the impact of the BC-Wind OWF on marine mammals during the construction phase was estimated taking into account the application of mitigation measures in the form of a Noise Reduction System (NRS). For the purposes of the modelling, the simultaneous application of a DBBC and HSD⁵⁵⁰ was assumed, which showed the possibility of reducing the noise to the level required by the DEC, but other noise reduction solutions reducing the noise to the level adopted in the DEC may also be applied. The results are presented in the table below (Tab. 9.24). The assessment was based on the results of the numerical modelling presented in Appendix 3 (Volume III of this EIA Report), as well as the information available on the occurrence of marine mammals in the area of the planned OWF and adjacent waters. Assuming the application of a mitigation measure in the form of an appropriate Noise Reduction System (NRS) during the construction phase, all analysed impacts on harbour porpoise, grey seal and common seal were assessed as minor or moderate.

⁵⁴⁸ Jones E.L., Hastie G.D., Smout S., Onoufriou J., Merchant N.D., Brookes K.L., Thompson D., *Seals and shipping: quantifying population risk and individual exposure to vessel noise*. *Journal of Applied Ecology* 2017, 54: 1930-1940

⁵⁴⁹ Mikkelsen L., Johnson M., Wisniewska D.M., van Neer A., Siebert U., Madsen P.T., Teilmann J., *Long-term sound and movement recording tags to study natural behaviour and reaction to ship noise of seals*. *Ecol. Evol.* 2019, 9: 2588-2601

⁵⁵⁰ HSD – a Hydro Sound Damper – a noise mitigation system installed close to the pile

Tab. 9.26. Significance of impacts on marine mammals during the construction phase of the BC-Wind OWF with the use of mitigation measures (NRS) during piling

Species	Impact	Description of impact	Significance of impact
Common porpoise <i>Phocoena phocoena</i>	PTS (single strike)	Permanent shift of the hearing threshold due to a single pile driver strike	Minor
	PTS (24h cum.)	Permanent shift in hearing threshold due to cumulative noise from 24 hours of piling	Minor
	TTS (single strike)	Temporary shift of the hearing threshold due to a single pile driver strike	Minor
	TTS (24h cum.)	Temporary shift in hearing threshold due to cumulative noise from 24 hours of piling	Minor
	Behavioural response	Behavioural response to pile driving (moving away from the site)	Moderate
	Noise from shipping	Behavioural response to noise associated with shipping (moving away from the construction site)	Minor
	Suspended sediments	Behavioural changes due to the suspension of sediments released during construction	Minor
	Habitat changes	Behavioural changes due to the changes in habitat resulting from construction	Minor
Grey seal <i>Halichoerus grypus</i>	PTS (single strike)	Permanent shift of the hearing threshold due to a single pile driver strike	Minor
	PTS (24h cum.)	Permanent shift in hearing threshold due to cumulative noise from 24 hours of piling	Minor
	TTS (single strike)	Temporary shift of the hearing threshold due to a single pile driver strike	Minor
	TTS (24h cum.)	Temporary shift in hearing threshold due to cumulative noise from 24 hours of piling	Minor
	Behavioural response	Behavioural response to pile driving (moving away from the site)	Moderate
	Noise from shipping	Behavioural response to noise associated with shipping (moving away from the construction site)	Minor
	Suspended sediments	Behavioural changes due to the suspension of sediments released during construction	Minor
	Habitat changes	Behavioural changes due to the changes in habitat resulting from construction	Minor
Common seal <i>Phoca vitulina</i>	PTS (single strike)	Permanent shift of the hearing threshold due to a single pile driver strike	Minor
	PTS (24h cum.)	Permanent shift in hearing threshold due to cumulative noise from 24 hours of piling	Minor
	TTS (single strike)	Temporary shift of the hearing threshold due to a single pile driver strike	Minor
	TTS (24h cum.)	Temporary shift in hearing threshold due to cumulative noise from 24 hours of piling	Minor
	Behavioural response	Behavioural response to pile driving (moving away from the site)	Minor
	Noise from shipping	Behavioural response to noise associated with shipping (moving away from the construction site)	Minor
	Suspended sediments	Behavioural changes due to the suspension of sediments released during construction	Minor

Species	Impact	Description of impact	Significance of impact
	Habitat changes	Behavioural changes due to the changes in habitat resulting from construction	Minor

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 221, *modified*

In summary, impulse noise associated with the piling process was identified as the most significant threat to marine mammals during the construction phase. The time required for the positioning of one pile is projected to be up to approx. 2 hours (this time will be extended by approx. 15 minutes due to the application of the soft start procedure). This pile driver operating time is followed by a technical break to move the vessel and position the next pile. In view of the above, the impact of impulse noise will occur once at a time in a short period, but will be repeated at intervals of several hours or more, regardless of the time of day (continuous operation). Interruptions due to adverse weather conditions are also possible. It is estimated that the entirety of the OWF turbine foundation operations will take a maximum of approx. 3 months. Therefore, the impact of impulsive noise generated by pile driving will be a short-term impact (repeated series of short sounds of high intensity for up to 3 months).

The final selection of a Noise Reduction System will depend on the final choice of hammer power and the parameters of the monopile and the seabed depth. Details on how noise reduction will be implemented and how marine mammals will be protected from acoustic impacts, primarily hearing damage, will be developed 6 months prior to the commencement of piling and submitted to the RDEP in Gdańsk for approval in the form of a document entitled 'Piling strategy'. Currently, the adopted modelling parameters and the obtained results are based on conservative assumptions and were intended to demonstrate the possibility of achieving the threshold set in the environmental decision. In the 'Piling strategy' they will be made more realistic and precisely planned. For more information on the 'Piling strategy', please refer to Chapter 15 *Proposed Minimisation Measures*.

Exploitation phase

During the exploitation phase of the BC-Wind OWF, **potential impacts** on marine mammals will result from:

- noise generated by wind turbines;
- noise generated by sonars;
- noise generated by servicing ships;
- habitat changes;
- their collisions with ships.

Noise generated by wind turbines

Underwater noise generated during the exploitation phase of the OWF comes mostly from the vibrations generated by the generator and gearbox, transmitted through the foundation and/or support structure into the water. It is significantly lower than the noise generated during the construction phase of the OWF due to piling.^{551, 552, 553} It should be noted, however, that wind turbine noise emissions will accompany the entire life cycle of the project, which may exceed even 30 years.

⁵⁵¹ Betke K., *Underwater construction and operational noise at alpha ventus*, [in:] Beierdorf A., Radecke A. (eds.), *Ecological Research at the Off-shore Windfarm alpha ventus. Challenges, Results and Perspectives*. Federal Maritime and Hydrographic Agency (BSH), Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Springer Spektrum, Wiesbaden 2014: 171-180

⁵⁵² Thomsen F., Gill A., Kosecka M., Andersson M., Andre M., Degraer S., Folegot T., Gabriel J., Judd A., Neumann T., Norro A., Risch D., Sigra P., Wood D., Wilson B., *MaRVEN – Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy. Final study report*. RTD-KI-NA-27-738-EN-N. DHI 2015

⁵⁵³ Tougaard J., Henriksen O.D., Miller L.A., *Underwater noise from three types of offshore wind turbines. Estimation of impact zones for harbor porpoises and harbor seals*. *The Journal of the Acoustical Society of America* 2009, 125: 3766-3773

Knowledge on noise generated by OWF operations prior to 2006 was summarised by Madsen et al.⁵⁵⁴ and Thomsen et al.⁵⁵⁵. Both works showed that existing OWFs only increase ambient noise to a very limited extent and consequently, their impact on marine mammals was assessed to be low.

Nedwell et al.⁵⁵⁶ carried out a survey campaign in 2007 covering offshore wind farms located in the United Kingdom: North Hoyle, Scroby Sands, Kentish Flats and Barrow (with pile diameters of 4-4.7 m). It was found that the acoustic background in the area of an operating OWF was characterised by sound levels approximately 2 dB higher for fish than in waters without operational offshore wind farms. In contrast, no differences were found for marine mammals. Based on the obtained results, it was concluded that the noise generated during the operation of an OWF was very low and no evidence was found to indicate that the noise reached levels that would influence the studied marine mammals to avoid these areas.

Tougaard et al.⁵⁵⁷ measured operational noise from three smaller wind turbines (0.4-2 MW) at the Middelgrunden OWF and Vindeby OWF in Denmark and the Bockstigen-Valar OWF in Sweden. The generated sounds were measured above ambient noise levels for frequencies below 500 Hz, for which marine mammal hearing is generally poor.⁵⁵⁸ It was found that only the peak noise levels increased with increasing wind speed, not the frequency, as the wind turbines were kept in constant rotation. This confirmed that the noise was coming mainly from the gearbox. A very small range of noise heard by porpoises (<100 m) was also estimated in the study. In the case of seals, depending on the propagation losses assumed, audibility of the noise ranged from 2.5 to 10 km from the sound source.

Marmo et al.⁵⁵⁹ modelled the acoustic power of operating offshore wind farms and its dependence on the type of foundation structure used (truss structure, large diameter pile and gravity foundation). The vibrations generated by a typical 6 MW wind turbine were modelled in the frequency band from 10 Hz to 2 kHz. The results of the model calculations indicated that the sound fields tended to be tonal with peak sound pressure levels (SPLs) associated with gear mesh frequencies and electromagnetic interactions in the generator. The conclusions of this study were as follows: harbour porpoises can detect noises from single-pile foundations during OWF operation at a distance of at least 18 km, and from truss (jacket) foundations, in the 630 Hz band at wind speeds of 10 and 15 ms⁻¹ – only at distances of 4 and 11 km, respectively. Seals, on the other hand, are unable to detect the noise of operating wind turbines in the frequency band below 100 Hz, regardless of the wind speed or foundation type. They can, however, hear an operating wind turbine in the 1/3 octave bands between 125 and 630 Hz at all wind conditions up to at least 18 km. The obtained ranges were based on ambient noise levels from the work of Wenz⁵⁶⁰, which is a very conservative approach, as the described levels were characterised by low energy and were probably not representative of shallow waters such as in the planned area of the BC-Wind OWF project.

⁵⁵⁴ Madsen P.T., Wahlberg M., Tougaard J., Lucke K., Tyack P., *Wind turbine underwater noise and marine mammals. Implications of current knowledge and data needs. Marine Ecology – Progress Series* 2006, 309: 279-295.

⁵⁵⁵ Thomsen F., Lüdemann K., Kafemann R., Piper W., *Effects of offshore wind farm noise on marine mammals and fish. biola, Hamburg, Germany on behalf of COWRIE Ltd.* 2006

⁵⁵⁶ Nedwell J.R., Parvin S.J., Edwards B., Workman R., Brooker A.G., Kynoch J.E., *Measurement and interpretation of underwater noise during construction and operation of offshore windfarms in UK waters. Subacoustech Report No. 544R0738 to COWRIE Ltd.* 2007.

⁵⁵⁷ Tougaard J., Henriksen O.D., Miller L.A., *Underwater noise from three types of offshore wind turbines. Estimation of impact zones for harbor porpoises and harbor seals. The Journal of the Acoustical Society of America* 2009, 125: 3766-3773

⁵⁵⁸ Thomsen F., Laczny M., Piper W., *A recovery of harbour porpoises (Phocoena phocoena) in the southern North Sea? A case study off Eastern Frisia, Germany. Helgol. Mar. Res.* 2006, 60: 189-195

⁵⁵⁹ Marmo B., Roberts I., Buckingham M.P., King S., Booth C., *Modelling of Noise Effects of Operational Offshore Wind Turbines including noise transmission through various foundation types. Scottish Government, Edinburgh* 2013

⁵⁶⁰ Wenz G.M., *Acoustic ambient noise in ocean. Spectra and sources. The Journal of the Acoustical Society of America* 1962, 34(12): 1936-1956

As part of the MarVEN project⁵⁶¹, measurements were taken of two Belgian OWFs with 3 MW wind turbines on large diameter steel piles (Belwind and Northwind) and one with 5 and 6.15 MW turbines on truss (jacket) foundations (the C-Power OWF). The recordings showed sound peaks at 50, 150, 400, 500 and 1200 Hz in the 1/3 octave spectrum. Measurements were taken at several distances from the source, and the recorded sound levels from the Northwind OWF were comparable to those from the C-Power OWF. The measured noise values were significantly higher for Northwind when the distance was increased to 150 m, which suggests that the type of foundation may have an impact on the noise level generated by wind turbines, especially at larger distances.

One of the most extensive studies of noise from OWF operations was the RAVE (Research at Alpha Ventus) programme, which measured the sounds originating from the Alpha Ventus OWF in the North Sea over a period of 165 days in 2010 and 2011.^{562, 563} The analysis focused on the noise from two wind turbines from different manufacturers, each with a rated capacity of 5 MW. A very characteristic tonal noise of 90 Hz with harmonics changes, dominating especially at a full operational load at 450, 630 and 810 Hz, was measured for one of the wind turbines (Fig. 9.16). Contrary to expectations, the project also showed that the noise level at the OWF site decreased with increasing wind speed and power output. It was noted that ambient noise (e.g. from distant ships) was drowned out due to the increased sea state, which compensated for the increase in wind turbine noise. Based on the performed studies, Betke suggested that although operational noise levels may be higher for bigger wind turbines, they are likely to be outside the range of frequencies that marine mammals can hear.

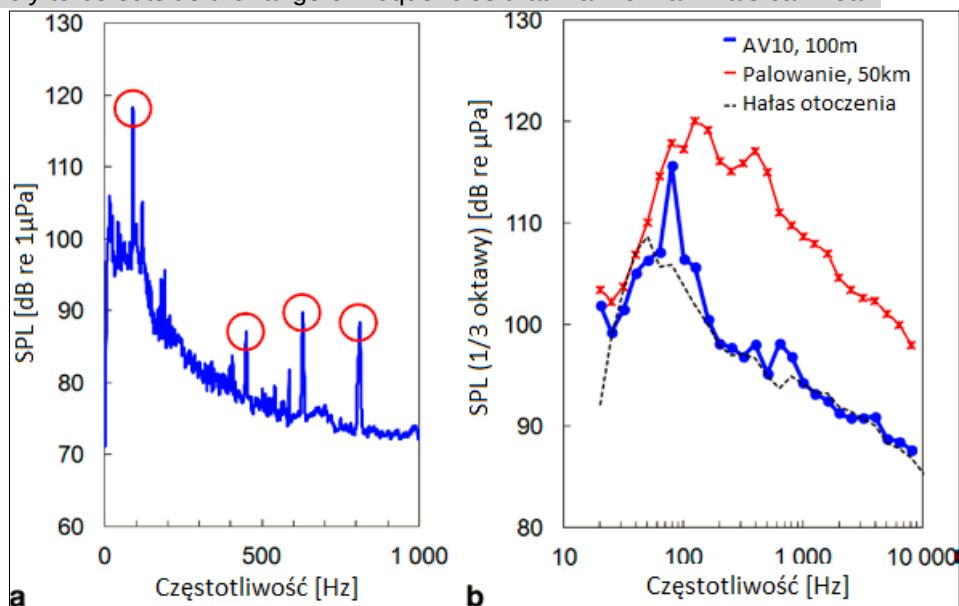


Fig. 9.16. Noise from the 5 MW wind turbine measured at 100 m from the Alpha Ventus OWF: (a) noise spectral density – red circles indicate the tonal component at 90 Hz and harmonics at 450, 630 and 810 Hz; (b) noise spectrum in the 1/3 octave bands from fig. a (blue line), acoustic background at the same wind speed and without wind turbine operation (dashed line) and noise from distant piling (red line).

⁵⁶¹ Thomsen F., Gill A., Kosecka M., Andersson M., Andre M., Degraer S., Folegot T., Gabriel J., Judd A., Neumann T., Norro A., Risch D., Sigraay P., Wood D., Wilson B., MaRVEN - Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy. Final study report. RTD-KI-NA-27-738-EN-N. DHI 2015

⁵⁶² Betke K., Underwater construction and operational noise at alpha ventus, [in:] Beierdorf A., Radecke A. (eds.), Ecological Research at the Off-shore Windfarm alpha ventus. Challenges, Results and Perspectives. Federal Maritime and Hydrographic Agency (BSH), Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Springer Spektrum, Wiesbaden 2014: 171-180

⁵⁶³ van Radecke H., Benesch M., Messung der Betriebsgeräusche von Offshore-WEA zur Bestimmung des Schalleintrags durch die Schallübertragungsfunktion zwischen Turm und Wasser an Anlagen im Testfeld Offshore. Schlussbericht. Dieses Forschungsvorhaben wurde unter der Bezeichnung RAVE Betriebsschall im Rahmen der Forschungsinitiative RAVE - Research at alpha ventus durchgeführt. Fachhochschule Flensburg, Flensburg 2012

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 263

In 2020, Tougaard et al.⁵⁶⁴ reviewed published noise measurements from operating offshore wind farms. Sound source levels were at least 10-20 dB lower than the noise emitted from ships, in the same frequency range. In addition, the factor of distance from the operating OWF proved to be the most important variable explaining the measured sound levels, with a smaller influence of the wind speed and wind turbine size.

The noise levels from the studies described above were normalised to a distance of 25 m and summarised in the table below (Tab. 9.27).

⁵⁶⁴ Tougaard J., Hermannsen L., Madsen, P.T., How loud is the underwater noise from operating offshore wind turbines? *The Journal of the Acoustical Society of America* 2020, 148: 2885-2893

Tab. 9.27. Recorded noise levels normalised to a distance of 25 m

Offshore wind farm	Rated output of the wind power plant [MW]	Water depth [m]	Max. broadband sound pressure level at 25 m [dB re 1 µPa]	Max. 1/3 octave band levels at 25 m [dB re 1 µPa]	1/3 octave band centre frequency [Hz]	Measuring distance [m]	References
Vindeby	0.45	4	120	120	125	14	Tougaard et al.
Bockstigen-Valar	0.5	10	109	106	160	20	Tougaard et al.
Utgrunden	1.5	-	-	118	160	1	Thomsen et al.
Middelgrunden	2	5	105	102	25	20	Thomsen et al.
North Hoyle	2	12	125	-	-	In the area of the OWF	Nedwell et al.
North Hoyle	2	12	117	-	-	Beyond the OWF	Nedwell et al.
Scroby Sands	2	5	127	-	-	In the area of the OWF	Nedwell et al.
Scroby Sands	2	5	129	-	-	Beyond the OWF	Nedwell et al.
Northwind	3	20	135	-	-	40	Thomsen et al.
Northwind	3	20	142	-	-	150	Thomsen et al.
Kentish Flats	3	5	111	-	-	In the area of the OWF	Nedwell et al.
Kentish Flats	3	5	110	-	-	Beyond the OWF	Nedwell et al.
Barrow	3		121	-	-	In the area of the OWF	Nedwell et al.
Barrow	3		119	-	-	Beyond the OWF	Nedwell et al.
Alpha Ventus	5	30	-	123	90	1	Van Radecke and Benesch
C-Power	5	25	137	-	-	40	Thomsen et al.

Offshore wind farm	Rated output of the wind power plant [MW]	Water depth [m]	Max. broadband sound pressure level at 25 m [dB re 1 μ Pa]	Max. 1/3 octave band levels at 25 m [dB re 1 μ Pa]	1/3 octave band centre frequency [Hz]	Measuring distance [m]	References
C-Power	5	25	131	-	-	60	Thomsen et al.
C-Power	5	25	131	-	-	150	Thomsen et al.

The water depths refer to the depth of the measured wind turbines, the entire OWF or the measuring point, and serve only as a guide.

The 1/3 octave centre frequencies refer to the maximum sound pressure level of 1/3 octave.

The corresponding distances for the specified sound pressure level were adopted as measurement distances.

If the noise level has already been determined (e.g. for the Alpha Ventus), the value is shown below.

In the case of the North Hoyle, Scroby Sands, Kentish Flats and Barrow OWFs, measurements taken within or outside the OWF area have been adopted.

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 262

Although harbour porpoises and seals can detect noise from operating wind turbines during OWF operation, the abundance of these animals does not necessarily decrease relative to the abundance pre-construction phase. Scheidat et al.⁵⁶⁵ demonstrated that after the completion of construction works of the Egmond aan Zee OWF in Dutch waters, harbour porpoises returned to the area of the operating OWF even in higher numbers than to the surrounding control areas. It was suggested that the area of the wind farm, where vessel traffic and trawling are prohibited, may provide a refuge and foraging grounds compared to areas with increased shipping. During the survey period, there was an overall increase in the abundance of harbour porpoise in the southern North Sea.^{566, 567} Therefore, the higher animal activity registered in the area of the OWF may have been related to a general trend. At the same time, however, no increasing trend was found in the analysed reference areas, which suggested that the OWF area could be attractive for harbour porpoises. During another study, a 10-year monitoring period of the Nysted OWF in the Danish part of the Baltic Sea⁵⁶⁸, a strong decline in the detections of harbour porpoise after the construction phase was found. Subsequently, the detection level returned to 29% of the initial level, probably due to the positive effects accompanying the OWF (e.g. the artificial reef effect). Teilmann et al. did not find either that the presence of wind turbines affected the number of harbour porpoises in the Rødsand II OWF area, which is located in the vicinity of Nysted. However, it should be mentioned that at Nysted, the number of detected harbour porpoises was relatively low from the beginning, so the results may not have been representative due to the small sample sizes. In conclusion, available data indicates that offshore wind farms operating under different environmental conditions may have different effects on the distribution of harbour porpoises in a given area.

The impact of OWF operations has also been studied in terms of effects on seals. Russell et al.⁵⁶⁹ showed that several tagged common seals actively sought out the foundations and/or support structures of the wind turbines at the Alpha Ventus (Germany) and Sheringham Shoal (UK) OWF, presumably to forage, as indicated by their movement pattern. Furthermore, Russell et al. (2016) found that in the area of an OWF operating in the North Sea, there was an almost statistically significant (at the 5% level) increase in the use of the area by seals compared to before the construction of the OWF (an increase in the proportion of seals occupying the analysed area from 0.01-1.16% to 0.54-2.82%). In another study, McConnell et al.⁵⁷⁰ noted that seals completely ignored the infrastructure of the Nysted and Rødsand II OWF, suggesting that, as is the case with harbour porpoises, seals are not deterred from an OWF and, under certain conditions, these locations are attractive to animals.

It should be added that the noise and impact levels discussed above apply to geared turbines. However, newer turbines operate with direct drive technology. As the gearbox is one of the main sound sources, direct drive turbines are expected to generate lower noise levels, especially underwater, where blade noise plays a minor role. Consequently, the impact of the BC-Wind OWF project during the exploitation phase may be even smaller than described above. Noise impacts generated during the exploitation phase of the OWF for harbour porpoise, grey seals and common seals was therefore assessed to be of minor importance.

⁵⁶⁵ Scheidat M., Tougaard J., Brasseur S., Carstensen J., van Polanen Petel T., Teilmann J., Reijnders P., *Harbour porpoises (Phocoena phocoena) and wind farms. A case study in the Dutch North Sea. Environmental Research Letters* 2011, 6: 025102

⁵⁶⁶ Peschko V., Ronnenberg K., Siebert U., Gilles A., *Trends of harbour porpoise (Phocoena phocoena) density in the southern North Sea. Ecological Indicators* 2016, 60: 174-183

⁵⁶⁷ Thomsen F., Laczny M., Piper W., *A recovery of harbour porpoises (Phocoena phocoena) in the southern North Sea? A case study off Eastern Frisia, Germany. Helgol. Mar. Res.* 2006, 60: 189-195

⁵⁶⁸ Teilmann J., Carstensen J., *Negative long term effects on harbour porpoises from a large scale offshore wind farm in the Baltic. Evidence of slow recovery. Environmental Research Letters* 2012, 7: 045101

⁵⁶⁹ Russell D.J.F., Hastie G.D., Thompson D., Janik V.M., Hammond P.S., Scott-Hayward L.A.S., Matthiopoulos J., Esther L. Jones E.L., McConnell B.J., *Avoidance of wind farms by harbour seals is limited to pile driving activities. Journal of Applied Ecology* 2016, 53 (6): 1642-1652

⁵⁷⁰ McConnell, B., Lonergan, M. i Dietz, R. 2012. *Interactions between seals and offshore wind farms. The Crown Estates Report*, 41

Noise generated by sonars

It is possible that security systems, e.g. sonar ones, will need to be installed in the OSS area. This will involve the introduction of approx. 2-4 devices in the vicinity of the OSS, as well as equipping them with cables. The system designed in this way will serve to improve the safety of the offshore wind farm, achieved by increasing the possibility to detect and record the activity of remotely operated underwater vehicles, divers or unwanted manned vehicles approaching the station and submarine cables within the OWF infrastructure, in the area surrounding the OSS.

Sonars as hydrographic devices are divided into two basic types depending on their mechanism of operation - active and passive sonars:

- Passive sonars – they are used to detect underwater objects by receiving acoustic waves generated by these objects or waves reflected from these objects, without emitting their own signal – they are not a source of noise;
- Active sonars – they emit acoustic signals into the water; if there is an object (e.g. a ship, animal) in the path of the acoustic wave generated by the sonar, the sound reflects off the object and returns as an 'echo' to the sonar transducer, which can measure signal strength, range and orientation of the object.

In addition to the deliberately located object, there are many others in the sea that can reflect acoustic signals. These include surface waves, seabed roughness, suspended solids, fish and marine mammals. The multiple echoes from these unwanted elements combine to create the background level at which active sonar must detect the desired target. The principle of active sonar is reflected in the natural mechanism of echolocation in animals such as cetaceans (*Cetacea*) or bats (*Chiroptera*), which use what is known as a biosonar.

Active sonars are subdivided by operational signal frequency:

- low frequency (<1000 Hz),
- medium frequency (1-20 kHz),
- high frequency (>20 kHz) (Hildebrandt 2004).

High-frequency sonars (even with frequency measured in MHz) enable more precise identification and have a close range, the opposite of the low- and medium-frequency sonars used in long-range systems. Until recently, low- and mid-frequency sonars were mainly used in hydrolocation. Today's devices, which are used in a variety of marine applications, often allow the selection of high-frequency operation – reducing the negative impact of undesirable frequencies, i.e. those audible to marine animals. High-frequency sonar is sometimes used to mitigate the potential impact of a medium-frequency sonar (Evans and Miller 2004). As indicated above, the frequency of the sonar and the intensity of the sounds emitted directly affects their audibility (remaining within the range of auditory sensitivity of the animal species concerned). Low and mid-frequency sonars used in military operations, e.g., have the potential to have a negative impact on marine mammals. This type of sonar is the focus of research concerns and problems regarding the potential effects on this group of animals (in particular the likely more or less negative effects of MFAS military sonars on many deep-diving toothed and whalebone whales). The higher frequencies emit sound that is attenuated relatively quickly in seawater, and the narrow beam widths further limit the potential range of impact.

Noise emitted by sonar has some characteristics of impulsive noise, but the NOAA classifies sonar as a source of non-impulsive sound. Non-impulsive sound is emitted by sources that produce sounds that may be broadband, narrowband or tonal, short- or long-lived, continuous or intermittent, and typically do not have a high peak sound pressure (SPL) with a rapid rise time like impulsive sounds do.

Sonar systems planned to be placed around substations have a frequency-dependent potential to affect Baltic marine mammals. It is believed that no marine species are functionally sensitive to sounds

above 200 kHz. Sonars and other active acoustic systems operating at this frequency and above are generally considered inaudible and therefore incapable of affecting marine mammals or other species.

The use of sonar above 200 kHz significantly reduces the risk of impact on marine mammals. However, a more accurate assessment of the response of Baltic marine mammals to high frequency sonar is hampered by a lack of empirical data. There is a lack of sufficient measurement data as well as studies and assessments of the probability of marine mammal response, let alone biological and population effects to these signals. The theoretical or real ability to detect a signal does not imply a behavioural response, and the extent to which a response can be observed should be based on in situ observations. However, according to the current state of knowledge, active sonar is unlikely to cause damage to the auditory systems of marine mammals, or the areas where hearing damage may occur are relatively very small.

Assuming the least favourable scenario for the Baltica 2 OWF, i.e. a constant use of sonars with frequencies from 70 to 200 kHz and their deployment within 400 m from the OSS, it can be assumed that the extent of sonar impact on marine mammals will be limited to the immediate vicinity of the OSS within a radius of approx. 400 m, which means that the impact will not be significant in the context of occasional use of the basin by harbour porpoise. Permanent use of sonars will enable marine mammals to avoid exposure to noise in the immediate vicinity of the devices (by staying away from them). The loss of potential habitat/feeding grounds, if it occurs, will be on a scale identical to that of the marine mammal intolerant noise impact area and will be marginal in relation to the total of areas used (or at least if the OSS area has not been an attractive foraging location so far).

Noise generated by ships

It is presumed that small- to medium-sized vessels will be used to service and maintain the BC-Wind OWF. Vessels of this type mainly emit sounds between 160-180 dB re 1 µPa at 1 m, covering frequencies from <1 kHz to >10 kHz. It is possible that this will lead to an increase in the local acoustic field during the operation of the OWF, covering frequencies that are partly relevant to marine mammals. The total number of OWF service and maintenance works is not yet known, however it is likely that only one vessel will be in use at any given time, meaning that the increase in acoustic field will be limited locally and in duration. Therefore, the significance of the impact of noise generated by ships during the exploitation phase can be considered of low importance for marine mammals.

Habitat changes

The visual impact of an operational OWF underwater is likely to be minimal. Underwater parts of the foundations and/or support structures become quickly overgrown, resembling other reef structures found in the sea. At the sea surface, an OWF represents a significant change to the surrounding landscape, but it has not yet been determined whether and how this may affect harbour porpoises and seals underwater. Above the sea surface, on the other hand, harbour porpoise vision is very poor – for seals, although they have sharpened vision, it is unknown to what extent the sight of wind farms causes them distress and behavioural changes.

The introduction of hard elements in the form of foundations and/or support structures on a sandy bottom will result in habitat changes, which may have a positive effect on marine mammals in the long term. This is because they can serve as artificial reefs for harbour porpoises and seals or refuges with lower noise levels compared to areas with high ship traffic.^{571, 572} The impact of changes in habitat was assessed to be of low significance or negligible for marine mammals.

⁵⁷¹ Scheidat M., Tougaard J., Brasseur S., Carstensen J., van Polanen Petel T., Teilmann J., Reijnders P., Harbour porpoises (*Phocoena phocoena*) and wind farms. A case study in the Dutch North Sea. *Environmental Research Letters* 2011, 6: 025102

⁵⁷² Teilmann J., Tougaard J., Carstensen J., Effects on harbour porpoises from Rødsand 2 Offshore Wind Farm. Aarhus University. DCE – Danish Centre for Environment and Energy. Scientific Report from DCE – Danish Centre for Environment and Energy No. 42, 2012

Collisions with vessels

Collisions with vessels mainly affect large cetaceans. Available data however suggests that this factor may be a significant source of mortality also among small cetaceans in areas with heavy vessel traffic. Fast ferries are of particular concern due to the high speed at which they travel (often >40 knots) and the relatively low noise levels they generate.⁵⁷³ Collisions with ships have also been documented in the case of seals, but in small numbers of mostly juveniles.⁵⁷⁴ In the case of the BC-Wind OWF, collisions with vessels are unlikely due to the low density of marine mammals in the study area, as well as the lower speeds of vessels used for the purposes of servicing and maintaining the OWF. The significance of this factor for harbour porpoises and seals was assessed as low.

Assessment of the significance of impacts during the exploitation phase

The results of the assessment of the impact of factors during the OWF exploitation phase on marine mammals are presented in the table below (Tab. 9.28). The effect on harbour porpoises and seals during the exploitation phase of the OWF is generally negligible, minor or moderate. In some cases, positive factors can even be identified, such as reef effects, which may contribute to increased foraging opportunities for all the analysed marine mammals.⁵⁷⁵

Tab. 9.28. Comprehensive effect on marine mammals associated with activities during the exploitation phase following the application of an NRS

Species	Impact	Description of impact	Significance of impact
Common porpoise <i>Phocoena phocoena</i>	Noise from operating power plants	Behavioural response to wind turbine noise (moving away from the site)	Minor
	Noise associated with operation and maintenance	Behavioural response to noise associated with OWF operation and maintenance (moving away from the site of operation)	Minor
	Visual effects	Behavioural changes caused by created obstacles (moving away from the site of operation)	Minor
	Reef effects	Increased foraging opportunities due to increased fish abundance	Minor
	Collisions with vessels	Physical injuries from collisions between marine mammals and vessels	Minor
Grey seal <i>Halichoerus grypus</i>	Noise from operating power plants	Behavioural response to wind turbine noise (moving away from the site)	Minor
	Noise associated with operation and maintenance	Behavioural response to noise associated with OWF operation and maintenance (moving away from the site of operation)	Minor
	Visual effects	Behavioural changes caused by created obstacles (moving away from the site of operation)	Minor
	Reef effects	Increased foraging opportunities due to increased fish abundance	Minor
	Collisions with vessels	Physical injuries from collisions between marine mammals and vessels	Minor
Common seal <i>Phoca vitulina</i>	Noise from operating power plants	Behavioural response to wind turbine noise (moving away from the site)	Minor
	Noise associated with operation and maintenance	Behavioural response to noise associated with OWF operation and maintenance (moving away from the site of operation)	Minor
	Visual effects	Behavioural changes caused by created obstacles (moving away from the site of operation)	Negligible

⁵⁷³ Carrillo M., Ritter F., Increasing numbers of ship strikes in the Canary Islands. Proposals for immediate action to reduce risk of vessel-whale collisions. *Journal of Cetacean Research and Management* 2010, 11: 131-138

⁵⁷⁴ Goldstein T., Johnson S.P., Phillips A.V., Hanni K.D., Fauquier D.A., Gulland F.M.D., Human-related injuries observed in live stranded pinnipeds along the central California coast 1986-1998. *Aquatic Mammals* 1999, 25 (1): 43-51

⁵⁷⁵ Leonhard S.B., Stenberg C., Støttrup J., van Deurs M., Christensen A., Pedersen J., Benefits from offshore wind farm development, [in:] Danish offshore wind – key environmental issues – a follow up. The Environmental Group: Danish Energy Agency, Danish Nature Agency, DONG Energy and Vattenfall, Copenhagen 2013: 30-45

Species	Impact	Description of impact	Significance of impact
	Reef effects	Increase in foraging opportunities due to increase in fish abundance	Minor
	Collisions with vessels	Physical injuries from collisions between marine mammals and vessels	Minor

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 266

Decommissioning phase

It is assumed that the decommissioning process of the OWF will involve similar types of impacts as the construction phase. The removal of large diameter piles from the BC-Wind OWF Area may involve the following activities, some of which will be associated with underwater noise propagation:

- mobilisation of a floating crane, a transport pontoon with a tug and a work vessel;
- connecting the crane hook to the transition piece of the large diameter pile foundation;
- cutting the cables;
- removal of foundation soil or substructure up to the cutting height;
- cutting the large diameter pile with a cutting tool at an appropriate height;
- raising the large diameter pile;
- placing the large diameter pile on a pontoon and securing it, or using other technology to make the disposed item buoyant, and towing it to the disposal site;
- transport to the land;
- recycling and disposal of materials.

Activities most closely associated with underwater noise emissions include cutting and drilling (in the process of soil removal), and vessel traffic.

It should be emphasised that there is limited knowledge on the noise generated by the cutting of large diameter piles. Hinzmann et al.⁵⁷⁶ measured the sound emissions during the removal of a metal mast from the Amrumbank West OWF site in the North Sea. The jet cutting took approximately 32 hours. The sound exposure level (SEL) of the cutting noise was 150.6 dB re 1 µPa and the peak level (L_{peak}) was 175.4 dB re 1 µPa at a distance of 750 m. The limits of the BSH standards – SEL = 160 dB re 1 µPa and L_{peak} = 190 dB re 1 µPa – were not exceeded during the cutting process of the large diameter pile. The highest sound levels were in the frequency band between 250 and 1000 Hz. Above 1 kHz, the noise levels decreased steadily. The decommissioning of a large-diameter pile with a remotely operated cutting tool can be described as a continuous noise with different sound levels depending on the applied pressure. The impact of the cutting noise on the acoustic background is described as local and largely related to low-frequency sounds. In the Baltic Sea, the noise emitted during the cutting of a large diameter pile will locally increase the ambient noise sound field, which is already dominated by the sound of shipping.

The noise generated during drilling depends largely on the rig used for drilling. Drilling vessels produce the highest noise levels (up to 174-185 dB re 1 µPa in the frequency band of 20-1000 Hz).⁵⁷⁷ Erbe and McPherson⁵⁷⁸ recorded noise levels associated with geotechnical drilling of 142-145 dB re 1 µPa in the 30-2000 Hz frequency band. Noise from bottom-anchored drilling rigs, such as jack-up rigs, is likely to be low both in terms of sound source level and frequency. Kyhn et al.⁵⁷⁹ recorded noise from the drilling vessel Stena Forth in Baffin Bay, Greenland. They noted that the broadband noise was 184

⁵⁷⁶ Hinzmann N., Stein P., Gattermann J., Bachmann J., Duff G., *Measurements of hydro sound emissions during internal jet cutting during monopile decommissioning*, [w:] COME – Conference on Maritime Energy 2017, *Decommissioning of Offshore Geotechnical Structures*, TUHH, Hamburg, 2017

⁵⁷⁷ Redmond L.J., Murphy M.T., *Using complementary approaches to estimate survival of juvenile and adult Eastern Kingbirds*. *J. Field Ornithol.* 2012, 83: 247-259

⁵⁷⁸ Erbe C., McPherson C., *Underwater noise generated from geotechnical drilling and standard penetration testing*, *The Journal of the Acoustical Society of America* 2017, 142 (3): EL281-EL285

⁵⁷⁹ Kyhn L.A., Tougaard J., Sveegaard S., *Underwater noise from the drillship Stena Forth in Disko West, Baffin Bay, Greenland*. NERI Technical Report No. 838. National Environmental Research Institute, Aarhus University, Denmark, 2011

dB re 1 μ Pa rms during drilling and 190 dB re 1 μ Pa rms during maintenance. Noise from two example drill ships is presented in the figure below (Fig. 9.17). The spectral energy of the noise from the two drill ships was mainly below 1 kHz, and the impact on the local noise background was largely related to low-frequency sound. However, Kyhn et al. (2011) found elevated noise levels and peaks at frequencies above 10 kHz, but these were highly correlated with the productivity and use of onboard machinery.⁵⁸⁰ In the Baltic Sea, the noise generated during drilling will increase the local acoustic field, which is already dominated by sounds generated by vessels.

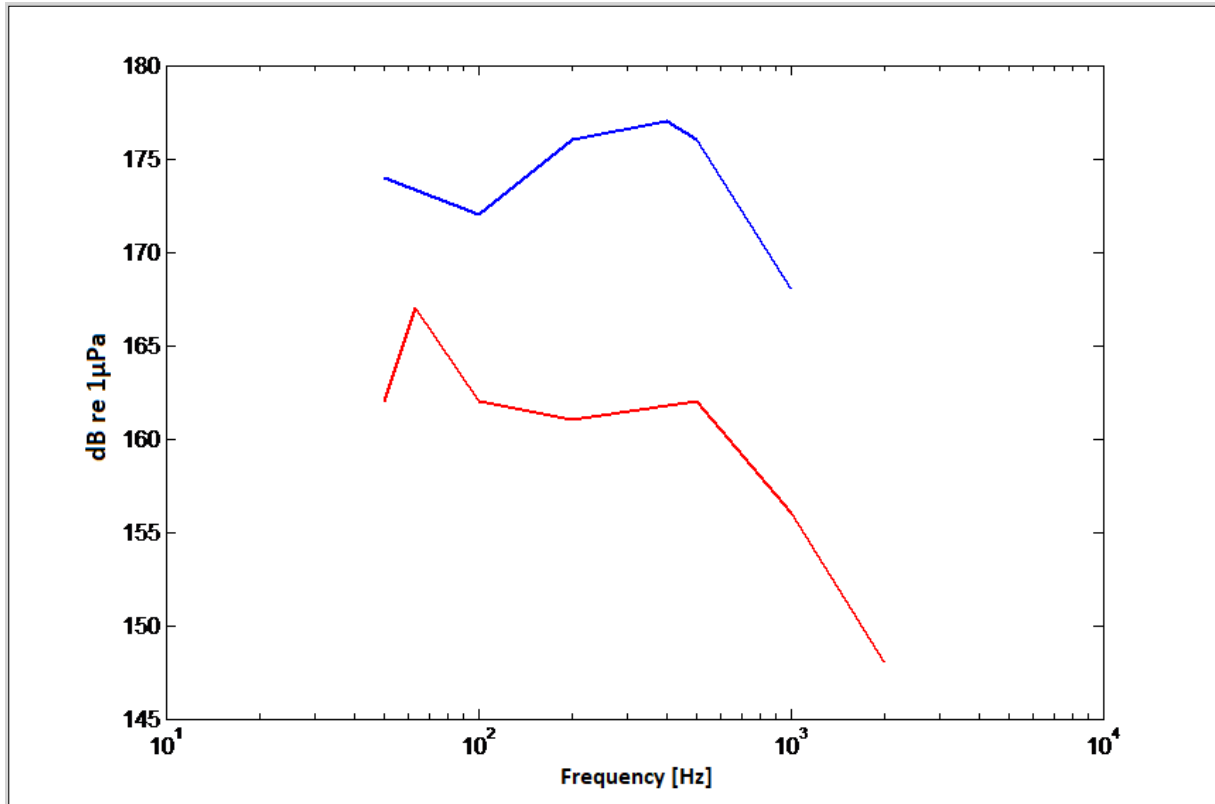


Fig. 9.17. Sound levels from two different drill ships in 1/3 octave bands. Modified from Richardson et al.

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 290

As during construction, noise from small and medium-sized vessels is expected, which mainly emit sounds at levels of 160-180 dB re 1 μ Pa at a distance of 1 m, at frequencies from <1 kHz to >10 kHz. This is likely to lead to an increase in the local acoustic field, covering frequencies that are partially relevant to marine mammals.

Assessment of significance of impacts during the decommissioning phase

According to the presented information, it is assumed that the decommissioning of the large diameter piles will involve the generation of underwater noise during cutting, drilling and vessel traffic. However, the impact on the acoustic field will be local and of short duration. Therefore, the significance of the noise emitted during the dismantling of the OWF was assessed as minor to moderate for marine mammals. As mentioned before, ship collisions leading to an oil spill in the project area may adversely affect marine mammals, but it is assumed that an oil spill is very unlikely. In general, the impact significance during the decommissioning phase was determined to be minor and moderate (Tab. 9.29).

⁵⁸⁰ Redmond L.J., Murphy M.T., Using complementary approaches to estimate survival of juvenile and adult Eastern Kingbirds. *J. Field Ornithol.* 2012, 83: 247-259

Tab. 9.29. *Impacts on marine mammals associated with activities during the decommissioning phase*

Species	Impact	Description of impact	Significance of impact
Common porpoise <i>Phocoena phocoena</i>	Cutting	Behavioural response to noise associated with large diameter pile cutting (moving away from the decommissioning site)	Minor
	Noise from shipping	Behavioural response to noise associated with shipping (moving away from the decommissioning site)	Minor
	Drilling	Behavioural response to noise associated with drilling (moving away from the decommissioning site)	Minor
Grey seal <i>Halichoerus grypus</i>	Cutting	Behavioural response to noise associated with large diameter pile cutting (moving away from the decommissioning site)	Minor
	Noise from shipping	Behavioural response to noise associated with shipping (moving away from the decommissioning site)	Minor
	Drilling	Behavioural response to drilling noise (moving away from the decommissioning site)	Minor
Common seal <i>Phoca vitulina</i>	Cutting	Behavioural response to noise associated with large diameter pile cutting (moving away from the decommissioning site)	Minor
	Noise from shipping	Behavioural response to noise associated with shipping (moving away from the decommissioning site)	Minor
	Drilling	Behavioural response to noise associated with drilling (moving away from the decommissioning site)	Minor

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 298

9.4.5 Seabirds

Construction phase

Identification of main factors affecting seabirds during the construction phase

The impact of the planned project in the construction phase will have a primarily local character, i.e. limited to the construction area – the BC-Wind OWF will be located outside protected areas, including Natura 2000 sites.

In order to identify the significance of the impact, its scale was assessed to be high for the long-tailed duck, the velvet scoter and the common scoter, moderate for the razorbill and the common guillemot and negligible for the European herring gull.

The factors identified and the assessment of their impact on the marine avifauna in the construction phase is presented below.

Vessel traffic

Construction works will require the presence of various types of vessels which will disturb seabirds with their physical presence, noise (including the noise generated by pile driving, if such foundations are selected), and the emission of light. The first two factors should not impact flight route changes of those waterbird species that do not use this area, but only fly over it (e.g. the common scoter). However, it cannot be ruled out that such an impact will occur at night, especially if the construction site is strongly illuminated. This is because during migration, birds navigate in relation to natural light sources such as stars and the Sun. It has been observed that at night they also fly towards lighthouses, drilling rigs and other structures illuminated with artificial light.⁵⁸¹ The impact scale shall

⁵⁸¹ Wiese F.K., Montevecchi W.A., Davoren G.K., Huettmann F., Diamond A.W., Linke J., Seabirds at risk around offshore oil platforms in the North-west Atlantic. *Marine Pollution Bulletin* 2001, 42: 1285-1290

depend on the number of vessels involved, their sizes, their illumination type and the intensity of light sources. It also depends on the duration of the construction phase and the location of the wind turbines within the area of the OWF, in which the increased vessel traffic shall take place. The period in which the work occurs is important, as most seabird species, including the long-tailed duck, show very large differences in abundance between phenological periods. The effect of scaring will increase with the progressing development of the OWF area. Initially, it will be of local nature and the birds will be able to find feeding grounds nearby (e.g. in the neighbouring Baltic Coastal Waters Natura 2000 site), however, in the final phase of the construction, the range of this impact will visibly increase, strongly limiting the birds' ability to feed and rest in the area of the OWF.

The presence of vessels and fixed structures protruding from the water, on the other hand, will lead to a greater presence of gulls, which use these elements as resting places and search for food near the vessels. Three species of large gulls, including the most abundant in the area, the European herring gull, gather in the open sea around the fishing boats. If during the construction (or later operation) of the OWF, commercial fishing becomes restricted in this sea area, the gulls will move (at least partially) to other fishing locations.

The traffic of vessels in the construction phase shall result in a direct, negative, and local impact on seabirds. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter this is a medium-term impact, and for the long-tailed duck it is short-term and temporary.

The sensitivity to this impact was assessed to be low for the European herring gull and high for the other species.

The significance of this impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as high for the analysed species – the long-tailed duck, the velvet scoter, and the common scoter.

Emission of noise and vibrations

The presence and movement of construction vessels shall constitute the main reason for seabird disturbance in the sea area covered by the construction of the BC-Wind OWF. This impact shall be much greater than other pressures associated with the construction phase, such as underwater noise propagation.

However, it is worth noting that the monitoring of birds during the construction of the Egmond aan Zee OWF in Holland did not indicate any noticeable reaction of the bird species that are not sensitive to disturbances related to the presence of vessels (mainly gulls and terns) to piling.⁵⁸²

The environmental impact assessment for the BC-Wind OWF Area indicated the presence of a possible significant impact of underwater noise on fish, which constitute the food supply for some of the seabird species (diving piscivorous birds). The use of an NRS and the application of a mitigating measure (the soft-start method during piling) will minimise the negative impact.

Noise and vibrations during the construction phase are direct, negative impacts on seabirds of local range, medium-term, reversible, repeatable during the construction period, and of species-dependent intensity.

The sensitivity to impact was assessed to be low for the European herring gull and high for the other species.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

⁵⁸² Topham E., Gonzalez E., McMillan D., João E., *Challenges of decommissioning offshore wind farms. Overview of the European experience. Journal of Physics: Conference Series* 2019, 1222: 012035

Illumination of the project site

During migration, birds navigate in relation to natural light sources, such as stars and the Sun. It has been observed that at night they also fly towards lighthouses, drilling rigs and other structures illuminated with artificial light.⁵⁸³ During surveys of bird behaviour near drilling rigs, it has been observed that illumination causes seabirds to gather around such structures not only during the migration period. This mostly applied to the Procellariiformes, which are usually most active at night, but was also observed in the case of little auks (*Alle alle*)⁵⁸⁴, which are closely related to razorbills and common guillemots, found in the area of the planned project. However, in the case of the majority of typical seabirds (sea ducks, divers), the impact of artificial lighting on birds residing in the near and distant vicinity of light sources remains very poorly studied.

The illumination of the project location during the construction phase shall cause direct and negative impact on seabirds, of local range, medium-term, reversible, repeatable during the construction period, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other species.

The impact significance varies for individual species and it was assessed as negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

Barrier creation

The structures of the power station, gradually appearing during the construction phase, will deter birds. This impact shall depend on the rate of the OWF construction. At the beginning, individual wind turbines will have a small impact, however the animal deterrence effect will gradually increase. Literature data clearly indicates that seabirds avoid sea areas occupied by wind turbines and their abundance decreases within the radius of 2, or even 4, km.^{585, 586, 587, 588} Adult birds are likely to be able to get used to the presence of the OWF to some extent. However, individuals starting their migration towards the wintering grounds for the first time in their lives may have problems avoiding the extensive barrier of the aggregation of OWFs. This may result from smaller experience, which is the cause of higher bird mortality in the first year of life.^{589, 590, 591} The lack of data on cases of bird disease in the vicinity of spatially extensive offshore wind farms indicates the necessity to plan surveys of a post-investment monitoring character. It must be emphasised that a parameter affecting the level of impact is the number of power stations under construction. The distance between particular wind turbines at a farm and the neighbouring offshore wind farms is also important. Both the construction and operation of the wind

⁵⁸³ Wiese F.K., Montevecchi W.A., Davoren G.K., Huettmann F., Diamond A.W., Linke J., *Seabirds at risk around offshore oil platforms in the North-west Atlantic*. *Marine Pollution Bulletin* 2001, 42: 1285-1290

⁵⁸⁴ Wiese F.K., Montevecchi W.A., Davoren G.K., Huettmann F., Diamond A.W., Linke J., *Seabirds at risk around offshore oil platforms in the Northwest Atlantic*. *Marine Pollution Bulletin* 2001, 42: 1285-1290

⁵⁸⁵ Otremba Z., Jakubowska M., Urban-Malinga B., Andruliewicz E., *Potential effects of electrical energy transmission – the case study from the Polish Marine Areas (southern Baltic Sea)*. *Oceanological and Hydrobiological Studies* 2019, 48 (2): 196-208

⁵⁸⁶ Leopold M.F., Dijkman E.M., Teal L., OWEZ-Team, *Local Birds in and around the Offshore Wind Farm Egmond aan Zee (OWEZ)*. Report No. C187/11. Wageningen UR IMARES (Institute for Marine Resources & Ecosystem Studies), 2011

⁵⁸⁷ Krijgsveld K.L., Fijn R.C., Japink M., van Horssen P.W., Heunks C., Collier M.P., Poot M.J.M., Beuker D., Dirksen S., *Effect studies Offshore Wind Farm Egmond aan Zee. Fluxes, flight altitudes and behaviour of flying birds*. Final report No. OWEZ_R_231_T1_20111114_flux&flight. Bureau Waardenburg bv, Culemborg 2011

⁵⁸⁸ BSH, *Bundesamt für Seeschifffahrt und Hydrographie, Standard – Investigation of the Impact of Offshore Wind Turbines on the Marine Environment (StUK 4)*. Hamburg 2013

⁵⁸⁹ Clark M.E., Martin T.E., *Modelling tradeoffs in avian life history traits and consequences for population growth*. *Ecol. Model.* 2007, 209: 110-120

⁵⁹⁰ McKim-Louder M.I., Hoover J.P., Benson T.J., Schelsky W.M., *Juvenile Survival in a Neotropical Migratory Songbird is Lower than Expected*. *PLoS One* 2013, 8: e56059

⁵⁹¹ Redmond L.J., Murphy M.T., *Using complementary approaches to estimate survival of juvenile and adult Eastern Kingbirds*. *J. Field Ornithol.* 2012, 83: 247-259

turbine located at a small distance from the BC-Wind OWF will create a cumulative barrier effect for the birds.

Moreover, the presence of a large number of vessels used during the construction of the OWF may result in the creation of an additional barrier effect, thus reducing the possibility for birds to travel between stopover areas during migration. The impact scale will depend on the number of vessels involved in the construction phase, their size, the duration of the construction phase, and the phenological period in which the work will be carried out.

The sensitivity to the impact was assessed as low for the European herring gull and high for the other species under analysis.

The impact significance varies for individual species and it is assessed as negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as important for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

Collisions with vessels

Collisions of birds with vessels used for the construction of the OWF may take place, mainly at night, when the birds will be attracted by the light they emit. The impact scale shall depend on the number of vessels involved in the construction phase, their size, the configuration of lights and their intensity, the duration of the construction phase and the phenological period in which the work will be carried out.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other species.

The significance of the impact of collisions with vessels varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

Destruction of benthic habitats

The laying of internal power cables will cause numerous disturbances to the seabed communities in the project area.

Some of the habitats used by seabirds as stopover areas during migration will be lost due to the erection of foundations or support structures. This process will have a direct impact on the seabed, however it will be of a smaller scale due to the proposed changes to the DEC including the exclusion of the gravity foundation and the reduction in the length of the cables inside the farm from 188 km to approx. 100 km. The natural benthic environment will be lost, however new ones will most likely be created in their place (the artificial reef effect). The range of impact will mainly depend on the number of foundations or support structures of wind turbines, as well as their type and size.

Bird species exposed to impacts related to the loss of benthic habitats as a result of space occupation are mainly the benthivorous sea ducks. However, these species are very sensitive to being disturbed by the presence of vessels and other human activities at sea; therefore, it is estimated that the impact involving disturbances as a result of the presence of construction vessels will be the main impact in this area, which will lead to the displacement of the sensitive species to other areas. As a result, these birds will not additionally experience the impact related to the occupation of space during the construction phase.

The destruction of benthic habitats during the construction works poses an indirect and negative impact on some of the seabirds (mostly benthivorous birds), of a local range, medium-term, reversible, repeatable in the construction period (for each of the wind turbines or infrastructure elements), and with a species-dependent intensity.

The sensitivity to the impact was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter, and the common scoter.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as low for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

Increase in the content of suspended solids in the water and sedimentation of the disturbed sediment

The increase in the content of suspended solids in the water may affect the ability of diving benthivorous and piscivorous birds to find food.

During the construction of the OWF, seabed sediments will be disturbed and the concentration of suspended solids in the water will increase. This phenomenon is most intense in the case of gravity foundations, which require prior preparation of the seabed. However, the use of gravity foundations has been excluded at this stage of project implementation.

The direct transfer of sediments and their resuspension will result in the decrease in water transparency. If it exceeds naturally occurring levels, it could cause difficulties for birds using their eyes to hunt while foraging (divers, sea ducks, razorbills), and could result in the displacement of birds that prefer clearer waters. No impact is expected on the birds foraging on the water surface (gulls).

A local decrease in the water transparency in the OWF area will be short-term, and its impact shall be mitigated by other, more intense disturbances causing birds to leave the area.

The deposition of sediments related to the preparation of the OWF seabed for the erection of foundations or support structures of wind turbines may impact the benthic environment located in the OWF area and in its vicinity. A layer of disturbed sediment will deposit on benthic organisms, which will interfere with the gas exchange ability of these organisms and their uptake of nutrients. This phenomenon may lead to a reduction in benthic resources and the fish that feed on it (reduction of biomass, reduction of growth and productivity), and thus affect the food supply of seabirds in the area.

The increase in the content of suspended solids during construction works and the deposition of the disturbed sediment constitutes an indirect, negative impact on some seabirds (birds diving in search of food), which is local, medium-term, reversible, repeatable in the construction period, and of low intensity.

The sensitivity to the impact was assessed as negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter, and the common scoter.

The significance of the impact varies for individual species and it is assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as low for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

The table below (Tab. 9.30) presents the compilation of individual impacts of the BC-Wind OWF on seabirds during the construction phase.

Tab. 9.30. Significance of the project impact on seabirds during the construction phase

Species	Impact	Impact description	Impact significance
European herring gull <i>Larus argentatus</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	Negligible
	Emission of noise and vibrations	Presence and movement of construction vessels	Negligible

Species	Impact	Impact description	Impact significance
	Illumination of the project site	Attracting and gathering birds around the investment	Negligible
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	Negligible
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	Negligible
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	Negligible
	Increase in the content of suspended solids in the water and sedimentation of the disturbed sediment	Disturbance of seabed sediments during submarine cable-laying	Negligible
Razorbill <i>Alca torda</i> , Common guillemot <i>Uria aalge</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	Moderate
	Emission of noise and vibrations	Presence and movement of construction vessels	Moderate
	Illumination of the project site	Attracting and gathering birds around the investment	Moderate
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	Moderate
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	Moderate
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	Low
	Increase in the content of suspended solids in the water and sedimentation of the disturbed sediment	Disturbance of seabed sediments during submarine cable-laying	Low
Velvet scoter <i>Melanitta fusca</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	High
	Emission of noise and vibrations	Presence and movement of construction vessels	High
	Illumination of the project site	Attracting and gathering birds around the investment	High
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	High
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	High
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	High
	Increase in the content of suspended solids in the water and sedimentation of the disturbed sediment	Disturbance of seabed sediments during submarine cable-laying	Moderate
Long-tailed duck <i>Clangula hyemalis</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	High
	Emission of noise and vibrations	Presence and movement of construction vessels	High
	Illumination of the project site	Attracting and gathering birds around the investment	High

Species	Impact	Impact description	Impact significance
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	High
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	High
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	High
	Increase in the content of suspended solids in the water and sedimentation of the disturbed sediment	Disturbance of seabed sediments during submarine cable-laying	Moderate
Common scoter <i>Melanitta nigra</i>	Vessel traffic	Species disturbance as a result of transportation carried out to and from the project location as well as of construction works, operation of machinery and the equipment necessary for the project implementation	High
	Emission of noise and vibrations	Presence and movement of construction vessels	High
	Illumination of the project site	Attracting and gathering birds around the investment	High
	Collisions with vessels	Attracting birds to vessels at night and collisions with ships	High
	Barrier creation	Barrier formation by the structures of subsequent wind turbines	High
	Destruction of benthic habitats	Loss of habitats due to the erection of foundations or support structures	High
	Increase in the content of suspended solids in the water and sedimentation of the disturbed sediment	Disturbance of seabed sediments during submarine cable-laying	Moderate

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 230

In summary, the impacts of the construction phase on wintering seabirds remain at the same level as for the variant for which the Investor obtained the DEC. The only difference relates to the reduced significance of the impact of suspended solids in water due to the significant reduction in the amount of suspended solids generated during construction. This is due to the exclusion of gravity foundations at this stage of project implementation and the much shorter route of the submarine cables. It is worth noting that the currently adopted design assumptions will be more favourable environmentally, primarily due to the reduction in the number of wind turbines.

The negative impacts of the construction phase identified for the three duck species of the long-tailed duck, the velvet scoter and the common scoter can be minimised by:

- using lighting in a minimalist manner (limiting lighting directed towards the sky, concentrating lighting on the equipment and the construction site), taking into account the safety of the performed works, and with the aim of reducing the number of birds attracted to the light during nocturnal migration;
- the introduction of environmental surveillance during piling at times of possible higher duck density, i.e. from August to March;
- constructing structures in the area of the OWF as gradually as possible to reduce bird scaring.

Measures to minimise negative impacts on wintering birds are described in more detail in Chapter 15.

Exploitation phase

Identification of main factors affecting seabirds during the exploitation phase

The potential impact of wind turbines located in open sea areas on seabirds involves increased mortality due to collisions with wind turbines, as well as changes in the distribution and behaviour of birds. The highest mortality is recorded in the case of wind farms located within feeding grounds and along regular flight routes.

To identify the significance of the impact, its scale was assessed to be high for the long-tailed duck, the velvet scoter and the common scoter, as moderate for the razorbill and the common guillemot, and as negligible for the European herring gull.

The identified factors and the assessment of their impact on marine avifauna in the exploitation phase is presented below.

Vessel traffic

The presence of vessels and fixed structures protruding from the water will lead to a greater presence of gulls and cormorants, which use these elements as resting places and search for food near the vessels. Three species of large gulls, including the most abundant in the area, the European herring gull, gather in the open sea around the fishing boats. If commercial fishing becomes restricted during the operation of the OWF in this marine area, the gulls will move (at least partially) to other fishing locations.

The operation of the BC-Wind OWF will involve the traffic of various types of vessels supporting the OWF.

The traffic of vessels in the exploitation phase shall cause direct and negative impact on seabirds, of local range, long-term, reversible, repeatable during the operation period, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

Deterrence and displacement from habitats

After the construction of the OWF, most bird species will avoid the area and, as a result, largely lose access to the feeding grounds there.

The operation of the OWF will cause the deterrence and displacement of some of the seabirds residing in the sea area occupied by the power stations and the adjacent strip of waters with a width of approx. 2, or even 4 km. The degree and area of birds' displacement from this marine area and its surroundings will depend on the species.

A single OWF is a barrier for birds, which, in the vast majority of cases, avoid the sea area with wind turbines. Such a behaviour minimises the risk of collision, especially during the day, at good visibility. However, the area of the OWF will become excluded as feeding grounds for a long time for a large part of the individuals, which may have a negative impact on some species.

The most important parameters affecting the level of impact are:

- the number of wind turbines – in comparison to 2021, the number of wind turbines has decreased from 41 to approx. 34 (39 sites are analysed in this Report, of which approx. 34 will be implemented);
- the density of wind turbines – the reduction in the number of wind turbines will result in a lower density of facilities within the farm compared to the density assessed in 2021;
- the clearance between the sea surface and the lower level of the rotor blade (the majority of flights take place at the altitude of 20 m above the water surface) – the clearance remains unchanged from 2021, i.e. at 20 m above the water surface;
- the diameter of the rotor – it has been reduced by 30 m;
- the distance from neighbouring OWFs – adjacent OWFs intensify the barrier effect – in accordance with the reduced size of the BC-Wind OWF Development Area (in comparison to 2021), the distance from the power plant (the rotors) of the Baltic Power OWF remained at 4 km as per the MSPPSA, while the farm development was moved away from the southern boundary of the BC-Wind OWF

Area by 500 m (at this point, the BC-Wind OWF borders on the basin with the primary function of E - power generation with code POM.46.E).

The deterrence and displacement from habitats in the exploitation phase will result in a direct, negative, and local-range impact on seabirds. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter, this is a long-term and permanent impact, and for the long-tailed duck, it is short-term and temporary.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of this impact varies for individual species and it was assessed at the same level as in the 2021 Report as the essence of the impact remains unchanged despite the reduction of the most important parameters of the BC-Wind OWF. The significance of the impact was found to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

Barrier creation

The structures of the wind turbines will occupy a part of the OWF sea area, creating a barrier for the seabirds travelling locally between the feeding or resting grounds and reluctant to fly over obstacles. The scale of the barrier effect will depend on the number of erected wind turbines and their size. However, the selection of a particular variant will not significantly affect the size and significance of the impact of the project on the seabirds. A distinct avoidance of the area occupied by the wind turbines by seabirds and a decrease in their abundance in the area surrounding the turbines is observed e.g. for the long-tailed duck at a radius of up to 2 or even 4 km.^{592, 593, 594} Gulls and cormorants are an exception since they often use the structures protruding above the water as their resting places, and, as a result, their abundance may even increase.

The barrier effect created by the BC-Wind OWF applies mainly to migratory birds. However, some of the seabirds migrating across the OWF area may fly to the nearby Natura 2000 sites – the Słupsk Bank, Baltic Coastal Waters and Pobreże Słowińskie, where they can find their stopover, wintering or breeding grounds. The creation of a uniform barrier in this area may also impede the movement of these populations between the nearest similar wintering grounds, such as the Słupsk Bank, the Middle Bank and the Hoburgs Bank. Currently, there is no scientific data available on the significance of links between these areas, but they cannot be excluded.

The new structures present during the OWF exploitation phase will be a source of direct, negative impacts on seabirds, long-term, reversible, permanent in the exploitation phase, with a species-dependent intensity, and of a local range.

Operating wind turbines will create a physical barrier posing a risk of collision, and, on the other hand, disturbing the birds and resulting in the loss of feeding grounds. The bird-scaring effect of the OWF minimises the risk of collision. However, the risk applies, to a larger extent, to the migrants flying at night and in limited visibility conditions rather than to the birds residing in the project area.

The creation of a barrier in the exploitation phase shall result in a direct, negative impact on seabirds, of a local range. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter, this is a long-term and permanent impact, and for the long-tailed duck, it is short-term and temporary.

⁵⁹² Otremba Z., Jakubowska M., Urban-Malinga B., Andrulewicz E., *Potential effects of electrical energy transmission – the case study from the Polish Marine Areas (southern Baltic Sea)*. *Oceanological and Hydrobiological Studies* 2019, 48 (2): 196-208

⁵⁹³ Posford Duvivier Environment, Hill M.I., *Guidelines on the impact of aggregate extraction on European Marine Sites*. Countryside Council for Wales (UK Marine SACs Project), 2001

⁵⁹⁴ BSH, Bundesamt für Seeschifffahrt und Hydrographie, *Standard – Investigation of the Impact of Offshore Wind Turbines on the Marine Environment (StUK 4)*. Hamburg 2013

The sensitivity to the impact was assessed as low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

Collisions with wind turbines

The risk of birds colliding with wind turbines will increase with the progression of the construction of the OWF, reaching its maximum in the OWF exploitation phase.

Wind turbines change the way in which birds use space, which applies also to marine areas. In the majority of cases, wind turbines scare the birds away, and the birds avoid fields with wind turbines at a distance from 100 to even 3000-4000 m during flyover.^{595, 596, 597} In consequence, the areas directly adjacent to the wind turbines are used as feeding and resting grounds much less frequently. The area in which the towers of the wind turbines are erected becomes to a large extent unavailable to birds as feeding grounds, and, in some cases, a distinctly lower density of birds is observed at a distance of up to 2 or even 4 km from the wind turbine.⁵⁹⁸ The avoidance of the area in which the wind turbines are erected by seabirds and the low altitude of their flight between the power station towers reduces the risk of collision, and, as a result, the mortality due to collisions with power station structures in marine areas is low. However, at poor visibility caused by fog or precipitation, the risk of collision increases. The number of collisions with wind turbines visibly increases when they are located in the marine areas that are attractive to birds, with high bird density, and also when the wind turbines are located along regular flight routes connected to migration or local passages.

The risk of collision also depends on the bird species. Large species of waterbirds such as swans are at a higher risk of collision with wind turbines due to their difficulty with making sudden manoeuvres in the air.⁵⁹⁹ The majority of seabird species travel low above the water surface, and when between wind turbines, lower their flight altitude and maintain equal distances from the obstacles.^{600, 601, 602} This means that the risk of collision is affected by the clearance between the lower position of the rotor blade and the sea surface. The smaller the clearance, the higher the risk of bird collision with the operating rotor.

The collisions with wind turbines during the exploitation phase will result in a direct, negative, local impact on the seabirds. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter, this is a long-term and permanent impact, and for the long-tailed duck, it is short-term and temporary.

The sensitivity to the impact was assessed to be low for the European herring gull, moderate for the razorbill, the common guillemot, the velvet scoter and the common scoter, and high for the long-tailed duck.

⁵⁹⁵ Otremba Z., Jakubowska M., Urban-Malinga B., Andruliewicz E., Potential effects of electrical energy transmission – the case study from the Polish Marine Areas (southern Baltic Sea). *Oceanological and Hydrobiological Studies* 2019, 48 (2): 196-208

⁵⁹⁶ Posford Duvivier Environment, Hill M.I., Guidelines on the impact of aggregate extraction on European Marine Sites. Countryside Council for Wales (UK Marine SACs Project), 2001.

⁵⁹⁷ BSH, Bundesamt für Seeschifffahrt und Hydrographie, Standard – Investigation of the Impact of Offshore Wind Turbines on the Marine Environment (StUK 4). Hamburg 2013

⁵⁹⁸ Petersen I.K., Bird numbers and distribution on the Horns Rev offshore wind farm area. *Annual Status Report 2004*. NERI Report. Commissioned by Elsam Engineering A/S 2005. National Environmental Research Institute, Ministry of the Environment, 2005

⁵⁹⁹ Brown M.J., Linton E., Rees E.C., Causes of mortality among wild swans in Britain. *Wildfowl* 1992, 43: 70-79

⁶⁰⁰ Otremba Z., Jakubowska M., Urban-Malinga B., Andruliewicz E., Potential effects of electrical energy transmission – the case study from the Polish Marine Areas (southern Baltic Sea). *Oceanological and Hydrobiological Studies* 2019, 48 (2): 196-208

⁶⁰¹ Hüppop O., Dierschke E.J., Exo K.-M., Fredrich E., Hill R., Bird migration studies and potential collision risk with offshore wind turbines. *Ibis* 2006, 148 (Suppl. 1): 90-109

⁶⁰² Desholm M., Kahlert J., Avian collision risk at an offshore wind farm. *Biology Letters* 2005, 1: 296-298

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, low for the razorbill and the common guillemot, moderate for the velvet scoter and the common scoter, and high for the long-tailed duck.

Formation of an artificial reef

Habitat changes caused by the creation of an artificial reef may have a certain positive impact on seabirds feeding on benthos by expanding their food base. Rich benthic communities will form on the underwater parts of the construction, as well as on the seabed of the area occupied by the OWF, which may translate to the increase in the abundance of fish. However, these resources will be exploited by birds to a small degree, or even not at all. The deterrence effect of the structures protruding from the water will be dominant there. The most important parameters affecting the level of impact are the shape, diameter of the base, and the number of foundations or support structures.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter, and the common scoter.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, low for the razorbill and the common guillemot, as well as high for the analysed duck – the long-tailed duck, the velvet scoter, and the common scoter.

Creation of an enclosed marine area

The OWF area can be an area completely or partially closed to commercial fishing during the exploitation phase. In the case of such a partial or complete closure of the marine area, it may be expected that fish will find very good habitat conditions (no fishing, rich benthic communities) there. However, the birds shall use the formed food base to a small degree due to the deterrence effect of the structures protruding high from the water being dominant in the area.

The sensitivity to the impact was assessed to be irrelevant for the European herring gull, moderate for the long-tailed duck, the velvet scoter and the common scoter, and high for the razorbill and the common guillemot.

The significance of the impact varies for individual species and was assessed to be negligible for the European herring gull and moderate for the remaining species.

The table below (Tab. 9.31) presents the compilation of individual impacts of the BC-Wind OWF on seabirds during the exploitation phase.

Tab. 9.31. *Significance of the impact of the project on seabirds during the exploitation phase*

Species	Impact	Impact description	Impact significance
European herring gull <i>Larus argentatus</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Negligible
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	Negligible
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	Negligible
	Deterrence and displacement from habitats	Caused by the operation of wind turbines	Negligible
	Barrier creation	Depending on the number of wind turbines and the emission of light and noise	Negligible
	Collisions with wind turbines	Depending on bird movement, densities, flight altitude, and the parameters of wind turbines	Negligible

Species	Impact	Impact description	Impact significance
Razorbill <i>Alca torda</i> , Common guillemot <i>Uria aalge</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Moderate
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	Moderate
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	Low
	Deterrence and displacement from habitats	Caused by the operation of wind turbines	Moderate
	Barrier creation	Depending on the number of wind turbines and the emission of light and noise	Moderate
	Collisions with wind turbines	Depending on bird movement, densities, flight altitude, and the parameters of wind turbines	Low
Velvet scoter <i>Melanitta fusca</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Moderate
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	High
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	High
	Deterrence and displacement from habitats	Caused by the operation of wind turbines	High
	Barrier creation	Depending on the number of wind turbines and the emission of light and noise	High
	Collisions with wind turbines	Depending on bird movement, densities, flight altitude, and the parameters of wind turbines	Moderate
Long-tailed duck <i>Clangula hyemalis</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Moderate
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	High
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	High
	Deterrence and displacement from habitats	Caused by the operation of wind turbines	High
	Barrier creation	Depending on the number of wind turbines and the emission of light and noise	High
	Collisions with wind turbines	Depending on bird movement, densities, flight altitude, and the parameters of wind turbines	High
Common scoter <i>Melanitta nigra</i>	Creation of an enclosed sea area	The OWF Area may be partially closed for fishing	Moderate
	Traffic of vessels and helicopters	Scaring caused by the traffic of vessels, helicopters	High
	Formation of an artificial reef	Formation of a new hard substratum for macrozoobenthos	High
	Deterrence and displacement from habitats	Caused by the operation of wind turbines	High
	Barrier creation	Depending on the number of wind turbines and the emission of light and noise	High

Species	Impact	Impact description	Impact significance
	Collisions with wind turbines	Depending on bird movement, densities, flight altitude, and the parameters of wind turbines	Moderate

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 274

In summary, the impacts of the exploitation phase of the BC-Wind OWF on wintering seabirds remain at the same level as in the case of the variant for which the Investor obtained the DEC, but it is worth emphasising that they will be more beneficial environmentally, mainly due to the reduction of the number of station facilities – from 41 to 39 wind turbines (of which approx. 34 will be implemented, with the remaining locations being backups) and from 2 to 1 OSS. The impacts were assessed to be from negligible to significant, depending on the species and the nature of the impact.

The most important identified threats to wintering birds relate to habitat/feeding grounds loss, which is related to the observed avoidance of wind turbine development areas and their immediate vicinity (100 m to 4 km) by wintering birds.

The risk of collision is much lower for wintering birds because:

- birds are assumed to avoid the farm area;
- the location of the BC-Wind OWF is outside areas of valuable feeding grounds (i.e. low to medium density of birds during wintering) and important migration routes (although this is an aspect that still requires further research);
- most seabird species fly low over the water, and when they are between wind turbines, they lower their flight and maintain equal distances from obstacles. A clearance of 20 m from the water surface, assumed in the design of the BC-Wind OWF, reduces the risk of collision.

For the predicted impacts of the exploitation phase on seabirds, minimisation measures have been applied, consisting of:

- keeping a corridor free of wind turbines with a width of 4 km, and moving 500 m away from the southern boundary of the BC-Wind Development Area;
- locating the BC-Wind OWF outside the area of important feeding grounds for wintering birds;
- monitoring bird species flying at collision heights and reacting appropriately to their presence (e.g. slowing down the turbine), which is described in more detail in the chapter on monitoring of migratory birds during the exploitation phase (Chapter 16).

In addition, as part of the pre-construction and post-construction monitoring of the BC-Wind OWF, seabird monitoring will be conducted to assess the extent of their avoidance of the area of the operational BC-Wind OWF, which is described in more detail in Chapter 16 of this Report.

Decommissioning phase

Identification of potential impacts on seabirds during the decommissioning phase

The impact of the OWF on the marine avifauna in the decommissioning phase will be similar to the one of the construction phase of the planned project. It was assumed that the medium-term impact of the project in the construction and decommissioning phases would have a similar character in the case of vessel traffic, increased noise level, demolition location illumination and disturbances in the benthic communities. The specific impact of the decommissioning phase is the gradual removal of the tall OWF structures, resulting in the disappearance of the barrier blocking the access to the rich benthic communities that will form in the area of the OWF during its exploitation.

With the gradual removal of the wind turbine towers, the negative impact involving the deterrence of birds from the area occupied by the structures protruding high above the water will decrease. Increased vessel traffic and the noise related to the disassembly of the power station will continue to disturb the birds. However, it should be expected that after the complete removal of all wind turbines, the area will attract diving benthivorous birds (mainly the long-tailed duck and the velvet scoter), because in the exploitation phase of the power station, zoobenthic communities that constitute

food for these birds will develop on the seabed of the area occupied by the wind turbines. Benthivorous birds have a very strong impact on the population of their prey, leading to a significant reduction in its abundance and biomass^{603, 604}. The decrease in the abundance of birds in the area occupied by the power stations during their operation will result in a high zoobenthos biomass as their populations will not be exploited by birds as much as would be the case during their normal presence in the area. This effect will probably be temporary in nature; however, it is difficult to predict for how long the area left after the power station removal will constitute attractive feeding grounds for this group of birds.

To identify the significance of the impact, its scale was assessed to be high for the long-tailed duck, the velvet scoter and the common scoter, moderate for the razorbill and the common guillemot, and negligible for the European herring gull.

The identified factors and the assessment of their impact on the marine avifauna in the decommissioning phase are presented below.

Vessel traffic

Decommissioning works will involve the presence of various types of vessels that will disturb seabirds with their physical presence and emission of noise and light. The impact scale will be similar to the one during the project construction phase. The impact will gradually decrease with the progress of the decommissioning works.

For all the assessed species, the traffic of vessels constitutes a negative impact subject to cumulation. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter, this is a direct and medium-term impact, and for the long-tailed duck, it was assessed to be temporary and short-term. Except for the European herring gull, the sensitivity to this impact of which was assessed as low, birds are highly sensitive to the traffic of vessels.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

Emission of noise and vibrations

The presence and movement of construction vessels during the decommissioning works will constitute the main reason for seabird disturbance in the sea area covered by the development of the BC-Wind OWF. This impact will be much greater than other pressures associated with the construction phase, such as, e.g., underwater noise emission. Noise and vibrations in the decommissioning phase are direct, negative impacts on seabirds, of local range, medium-term, reversible, repeatable during the decommissioning period, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

The impact will gradually decrease with the progress of decommissioning works.

Illumination of the project site

During migration, birds navigate in relation to natural light sources such as stars and the Sun. It has been observed that at night birds also fly towards lighthouses, drilling rigs and other structures

⁶⁰³ Leopold M.F., Dijkman E.M., Teal L., OWEZ-Team, *Local Birds in and around the Offshore Wind Farm Egmond aan Zee (OWEZ)*. Report No. C187/11. Wageningen UR IMARES (Institute for Marine Resources & Ecosystem Studies), 2011

⁶⁰⁴ Guillemette M., Reed A., Himmelman J.H., *Availability and consumption of food by common eiders wintering in the Gulf of St. Lawrence. Evidence of prey depletion*. Can. J. Zool. 1996, 74: 32-38

illuminated with artificial light.⁶⁰⁵ The illumination of the location of the project in the decommissioning phase will cause a direct and negative impact on seabirds, of a local range (and of a regional range for the long-tailed duck due to the possible impact on the biogeographical population of the species), medium-term, reversible, repeatable during the decommissioning period, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

The impact will gradually decrease with the progress of the decommissioning works.

Barrier creation

The construction structures present during the decommissioning works on the OWF, as well as the presence of vessels necessary for supporting the decommissioning works of the OWF, will be a source of direct, negative impacts on seabirds, which will be of a local range, reversible, repeatable in the decommissioning phase, and of species-dependent intensity.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

The impact will gradually decrease with the progress of the decommissioning works.

Collisions with vessels

Collisions of seabirds with vessels are possible during the decommissioning phase of the planned project. The impact scale will be similar to the one in the construction phase of the project. For all the analysed species, collisions with vessels constitute negative impacts subject to cumulation. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter, this is a temporary or short-term impact, while for the long-tailed duck, it is permanent or long-term.

The sensitivity to the impact was assessed to be low for the European herring gull and high for the other bird species.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

The impact will gradually decrease with the progress of the decommissioning works.

Destruction of benthic habitats

The destruction of benthic habitats during the decommissioning works poses an indirect, negative impact on some of the seabirds (mostly benthivorous birds), which is of a local range, medium-term, reversible, repeatable in the decommissioning period (for each of the wind turbines or infrastructure elements), and with a species-dependent intensity. The scale of the impact will mainly depend on the number of foundations or support structures of wind power turbines, their type, and size.

⁶⁰⁵ Wiese F.K., Montevecchi W.A., Davoren G.K., Huettmann F., Diamond A.W., Linke J., *Seabirds at risk around offshore oil platforms in the North-west Atlantic. Marine Pollution Bulletin* 2001, 42: 1285-1290

The sensitivity to the impact was assessed as irrelevant for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter, and the common scoter.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, as well as low for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

The impact will gradually decrease with the progress of decommissioning works, and the destroyed habitats will be restored within several years from the moment the works are completed.

Increase in the content of suspended solids in the water

These factors may affect the ability of diving benthivorous and piscivorous birds to find food. During the decommissioning of the OWF, seabed sediments will be raised and the content of the suspended solids in the water will increase. The impact scale will be similar to the one in the construction phase of the project.

For all the assessed bird species, this is a direct, negative impact subject to cumulation. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter, this is a temporary or short-term impact, while for the long-tailed duck it is long-term or permanent.

The sensitivity to the impact was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter, and the common scoter.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and low for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

The impact will gradually decrease with the progress of decommissioning works.

Deposition of the disturbed sediment

These factors may affect the ability of diving benthivorous and piscivorous birds to find food. During the decommissioning of the OWF, seabed sediments will be raised and the content of the suspended solids in the water will increase. The impact scale will be similar to the one in the construction phase of the project.

For all the assessed bird species, this is a direct, negative impact subject to cumulation. For the razorbill, the common guillemot, the European herring gull, the velvet scoter and the common scoter, this is a medium-term impact, while for the long-tailed duck it is long-term or permanent.

The sensitivity to the impact was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and high for the long-tailed duck, the velvet scoter, and the common scoter.

The significance of the impact varies for individual species and it was assessed to be negligible for the European herring gull, moderate for the razorbill and the common guillemot, and low for the analysed duck species – the long-tailed duck, the velvet scoter, and the common scoter.

The impact will gradually decrease with the progress of decommissioning works.

The table below (Tab. 9.32) presents the compilation of impact significance of the BC-Wind OWF on seabird species during the decommissioning phase.

Tab. 9.32. Significance of the impact of the project on seabirds during the decommissioning phase

Species	Impact significance
European herring gull <i>Larus argentatus</i>	Negligible

Species	Impact significance
Razorbill <i>Alca torda</i>	Moderate
Common guillemot <i>Uria aalge</i>	Moderate
Velvet scoter <i>Melanitta fusca</i>	High
Long-tailed duck <i>Clangula hyemalis</i>	High
Common scoter <i>Melanitta nigra</i>	High

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 301

In summary, the impacts of the decommissioning phase of the BC-Wind OWF on wintering seabirds remain at the same level as in the case of the variant for which the Investor obtained the DEC. It is worth emphasising that they will be more beneficial environmentally, mainly due to the reduction of the number of station facilities of the BC-Wind OWF, from 41 to 31 wind turbines (of which approx. 34 will be implemented, with the remaining locations being backup) and from 2 to 1 OSS.

9.4.6 Migratory birds

Construction phase

During the construction phase of an OWF, there is a gradual disturbance of the space above the marine area where assembly and construction works are carried out. Both the vessels involved in these works and the erected OWF structures create obstacles for migrating birds. Also taking into account the parameters of bird migration, i.e. height and direction, the impact on different bird species will be of different significance. This assessment mainly takes into account the presence of construction vessels during the works. Impacts on migratory birds due to barrier effects and collisions with the BC-Wind OWF structures were assessed for the exploitation phase, when their effects are greatest, based on modelling results. A detailed assessment of the impacts of the BC-Wind OWF on migratory birds during the construction phase is included in Appendix 4 to the EIA Report, Volume III.

The significance of the impact of the BC-Wind OWF, i.e. the barrier and collision effects, on migratory birds during the construction phase, was assessed to be of at the most minor importance (Tab. 9.33).

Tab. 9.33. Significance of impacts associated with the construction phase of the OWF on birds migrating through the BC-Wind OWF Area; equal impacts were assumed for both wind farm variants, i.e. the WWR 2024 and the RAV 2024

Species	Impact	Scale of impact	Duration	Intensity	Frequency of impact	Reversibility of impact	Magnitude of impact	Significance of impact
All migratory bird species listed in the table (Tab. 7.16) of moderate and high importance	Vessel barrier	Local	Temporary	Small	Repeatable	Reversible	Irrelevant	Minor
	Collisions with vessels	Local	Temporary	Small	Repeatable	Reversible	Irrelevant	Minor
All migratory bird species listed in the table (Tab. 7.16) of minor importance	Vessel barrier	Local	Temporary	Small	Repeatable	Reversible	Irrelevant	Negligible
	Collisions with vessels	Local	Temporary	Small	Repeatable	Reversible	Irrelevant	Negligible

Source: own elaboration

Exploitation phase

Barrier effect

The presence of an OWF creates a barrier effect affecting the behaviour (movement) of migratory birds. The scale of the impact will depend on the number of wind turbines, their size and distribution in the area of the BC-Wind OWF. Birds may be forced to divert horizontally or vertically, which may slightly lengthen migration and increase energy requirements. Research to date on this topic indicates that bypassing even a few offshore wind farms slightly increases both the total length of the migration route and the energy expenditure associated with the migration.^{606, 607, 608} These results are included as a reference for this paper, but it should be noted that studies presented in this literature concern other marine areas. Masden et al.⁶⁰⁹ presented results for the Nysted OWF in the Baltic Sea (165 MW). A report prepared by Jensen et al.⁶¹⁰ presents the situation for the Horns Rev 3 OWF (400 MW, North Sea). For the Horns Rev 3 OWF, which borders two other farms – the Horns Rev 1 OWF (160 MW) and the Horns Rev 2 OWF (209 MW) – cumulative impacts were considered not to occur.

The forced reroute to avoid the BC-Wind OWF may be extended by an average of 12.4 km, which lengthens migration routes by an average of approx. 0.5%, and for cranes – by approx. 1.0%. The lengthening of the route by 12.4 km associated with the barrier effect of the OWF will increase the energy expenditure to cover the route by a negligible amount.^{611, 612} In addition, in the case of passerine birds that cover the migration route mainly at night and at high altitudes (above the range of the rotor), the barrier effect will not occur, as the birds will fly over the OWF. Therefore, the significance of the impact related to the barrier effect for all groups of birds and species considered in the analysis was considered negligible.

Risk of collision

For the WWR 2024 variant under analysis, a new modelling of the collision risk between rotor blades and migratory birds was performed for the specified parameters of the BC-Wind OWF (Appendix 4, Volume III). The specified parameters have lower values than those adopted in the collision modelling in the 2021 EIA Report: wind turbines (2 fewer), rotor diameter (30 m smaller), maximum height (30 m lower), the height of the nacelle above sea level. Compared to the data adopted for the collision modelling during the work on the 2021 EIA Report, the clearance range between the bottom position of the rotor blade and the water surface has been taken into account for the WWR 2024 variant, as well as a larger value for the maximum blade width, a larger productivity parameter defined as operating time per month, and the same rotor speed and blade pitch as included in the collision risk modelling. The remodelling enabled a more precise determination of the potential impacts of the BC-Wind OWF on migratory birds, and a comparison of the predicted impacts.

The impact in the form of collision risk, i.e. mortality of birds resulting from collisions with OWF components, is presented as a total number of collisions of a given species during spring and autumn migration. The collision risk depends on the parameters of the OWF, such as the number of wind turbines, the rotor diameter, the amount of clearance between the lower reach of the rotor and the water

⁶⁰⁶ Dansk Ornitologisk Forening (DOF) (Danish Ornithological Association). DOFbasen; available at: <https://dofbasen.dk>

⁶⁰⁷ European Red Birdlist, Data Zone, 2019; available at: <http://datazone.birdlife.org/info/euroredlist>

⁶⁰⁸ Offshore WIND, Lely Wind Farm Fully Decommissioned (VIDEO); available at: <http://www.offshorewind.biz/2016/12/07/lely-wind-farm-fully-decommissioned-video>

⁶⁰⁹ Masden E.A., Cook A.S.C.P., Avian collision risk models for wind energy impact assessments. *Environmental Impact Assessment Review* 2016, 56: 43-49

⁶¹⁰ Jensen F., Laczny M., Piper W., Coppack T., Horns Rev 3 Offshore Wind Farm. Technical report no. 8, Migratory birds (with an annex on migrating bats). *energinet.dk*, 2014

⁶¹¹ Merkel F.R., Johansen K.L., Light-induced bird strikes on vessels in Southwest Greenland. *Marine Pollution Bulletin* 2011, 62: 2330-2336

⁶¹² Pennycuik C.J., Speeds and wingbeat frequencies of migrating birds compared with calculated benchmarks. *J. Exp. Biol.* 2001, 204: 3283-3294

surface, as well as on the biological parameters and the individual species – body size, flight speed, flight height, collision avoidance rate, and on the weather parameters. In case of limited visibility (low clouds, night, dense fog), birds are able to spot the OWF from a much shorter distance, resulting in a higher collision risk. Both the variant selected for implementation (WWR 2024) and the Rational Alternative Variant (RAV 2024) were analysed.

Of all the species considered in this analysis, the significance of the impact resulting from collision was assessed to be at the most of low importance for the long-tailed duck, the common scoter, and the velvet scoter. For these species, the collision risk did not exceed single individuals.

For geese, the risk of collision in the most restrictive scenario with a collision avoidance rate of 99.0% involved 4-5 individuals (5-9 individuals in the case of the RAV 2024), but due to the very large populations of the species included in this category (estimated at more than 3.5 million individuals), the significance of the impact was assessed to be negligible.

For crane, the impact significance associated with collision risk was assessed as moderate. The estimated maximum number of collisions was 8 individuals, with 14 individuals in autumn estimated for the RAV 2024. The significance of the impact was assessed as negligible.

For the remaining species, the significance of collision risk was assessed as negligible (Tab. 9.34).

Tab. 9.34. Summary of impacts of the BC-Wind OWF on migratory birds during the exploitation phase. The impacts of barrier effect and collision risk were assessed for both variants at the same level

Species/species group	Receptor value/significance	Impact	Reversibility of impact	Magnitude of impact	Significance of impact
Long-tailed duck <i>Clangula hyemalis</i>	Large	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Minor
Common scoter <i>Melanitta nigra</i>	Large	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Minor
Velvet scoter <i>Melanitta fusca</i>	Large	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Minor
Ducks (wigeon, etc. <i>Anatinae</i>)	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Greater scaup <i>Aythya marila</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Geese <i>Anserinae</i>	Moderate	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Moderate	Negligible
Swans <i>Cygnidae</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Divers <i>Gaviidae</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Auks <i>Alcidae</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Great cormorant <i>Phalacrocorax carbo</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Little gull <i>Hydrocoloeus minutus</i>	Large	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
	Small	Barrier effect	Reversible	Irrelevant	Negligible

Species/species group	Receptor value/significance	Impact	Reversibility of impact	Magnitude of impact	Significance of impact
Black-headed gull <i>Larus ridibundus</i>		Risk of collision	Irreversible	Irrelevant	Negligible
Lesser black-backed gull <i>Larus fuscus</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
European herring gull <i>Larus argentatus</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Common gull <i>Larus canus</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Terns <i>Sternidae</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Plovers <i>Charadriidae</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Common crane <i>Grus grus</i>	Large	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Moderate	Negligible
Passerines <i>Passeriformes</i>	Small	Barrier effect	Reversible	Irrelevant	Negligible

Source: own elaboration based on the collision modelling, Appendix 4, Volume III

In summary, the impacts of the exploitation phase of the BC-Wind OWF on migratory seabirds remain at the same level as in the case of the variant for which the Investor obtained the DEC. It is worth emphasising that they will be somewhat smaller, mainly due to the reduction of the number of station facilities of the BC-Wind OWF, from 41 to 31 wind turbines (of which approx. 34 will be implemented, with the remaining locations being backup) and from 2 to 1 OSS.

During the exploitation phase of the farm, it is necessary to monitor the behaviour of birds in order to minimise collisions between birds and turbine blades. To this end, as a minimising measure, it has been proposed to equip the farm with devices that allow birds to be recorded at collision height and slow down the movement of the blades, thus significantly reducing the risk of collision. This issue is described in more detail in Chapters 15 and 16.

Decommissioning phase

Impacts on birds during the decommissioning phase are assumed to be similar to those estimated for the construction phase. There is little knowledge on impacts during the decommissioning phase, as most offshore wind farms are still in operation. Some conclusions can be drawn from the example of the wind farm in the Netherlands, Lely⁶¹³, although the nature of this project was different (the wind farm was built on Lake IJsselmeer). Taking the significance of the impacts for the exploitation phase as a benchmark, a many times smaller magnitude of impacts during the decommissioning phase should be expected. Given that the decommissioning phase is not a permanent impact, the barrier in the form of decommissioned power plants will decrease and, as the number of power plants decreases, the risk of collision will also decrease progressively. On this basis, the significance of impacts during the decommissioning phase of the project was assessed to be negligible (Tab. 9.35).

⁶¹³ Offshore WIND, Lely Wind Farm Fully Decommissioned (VIDEO); available at: <http://www.offshorewind.biz/2016/12/07/lely-wind-farm-fully-decommissioned-video>

Tab. 9.35. Significance of impacts associated with the decommissioning phase of the OWF on birds migrating through the BC-Wind OWF Area; equal impacts were assumed for both OWF variants

Species	Impact	Scale of impact	Duration	Intensity	Frequency of impact	Reversibility of impact	Magnitude of impact	Significance of impact
All migratory bird species listed in the table (Tab. 7.16) of moderate and high importance	Vessel barrier	Local	Temporary	Small	Repeatable	Reversible	Irrelevant	Minor
	Collisions with vessels	Local	Temporary	Small	Repeatable	Reversible	Irrelevant	Minor
All migratory bird species listed in the table (Tab. 7.16) of minor importance	Vessel barrier	Local	Temporary	Small	Repeatable	Reversible	Irrelevant	Negligible
	Collisions with vessels	Local	Temporary	Small	Repeatable	Reversible	Irrelevant	Negligible

Source: own elaboration

In summary, significant impacts on migrating birds in all phases and for all analysed species were assessed to be negligible or of low significance.

However, due to the fact that the farm is expected to operate for approx. 35 years and the risk of collisions with birds, monitoring of the exploitation phase was proposed to control the farm area during the migration period, using a radar and camera system. This issue is described in detail in Chapters 15 and 16.

9.4.7. Bats

Impacts on bats were analysed in the context of migratory species.

Migratory (non-sedentary) bat species have different migration patterns. Some bats migrate over short distances (up to approx. 100 kilometres). Bats migrating long distances, from several hundred to several thousand kilometres, are considered the most vulnerable to offshore wind farms.⁶¹⁴ Information on the risks (e.g. potential collision risks) to bats from offshore wind turbines is limited, although data is now being acquired at offshore wind turbines through a combination of methods such as visual surveys, radars, cameras, acoustic detectors – these aim to determine species composition, assess behavioural changes, and detect collisions. Minimisation strategies that are used at onshore wind farms are less developed and less verified for bat species moving through the marine environment.

Construction phase

During the construction phase, there will be activities related to the movement of installation/transport vessels with structural components to and from the construction site and works associated with the embedding of foundations and installing individual wind farm components, as well as laying cables. Works conducted under the sea surface do not have a direct impact on bats. However, as a result of these works, vessel traffic in the OWF area, as well as light and noise emissions, will increase. Migratory bats may be attracted by the illumination of the vessels and construction site.⁶¹⁵ In those cases, there may be a risk of collision with vessels and structural components in the development area, however this risk is very low as bats rarely collide with stationary structures such as buildings, communication towers and non-functioning wind turbines.

Due to construction works and increased vessel traffic in the vicinity, noise levels will increase. The noise increase may cause the dispersion of bats during flight and act as a barrier effect. The noise, particularly emitted at night and during migration periods, may cause bats to change their flight direction, which, in turn, means increased energy expenditure.

Surveys conducted during the spring and autumn migration periods indicated a possibility of bats migrating through the BC-Wind OWF Area, but low migration intensity was found.

The impacts on bats during the construction phase, described above, will be negative, direct, local and short-term. The sensitivity to the impact was assessed to be low, whereas the significance of the impact of the BC-Wind OWF during the construction phase was determined to be negligible due to the low activity of bats found during the surveys carried out in the seasonal migration periods.

Exploitation phase

The potential impact of the BC-Wind OWF on migratory bats during the exploitation phase will be caused by:

- possible collisions with wind turbines;
- noise and light emissions;
- the barrier effect and habitat change.

⁶¹⁴ Arnett et al. 2016, Kruszynski et al. 2021

⁶¹⁵ Poerink B.J., Lagerveld S., Verdaat H., Bat activity in the Dutch offshore wind farm OWEZ and PAWP. Pilot study. IMARES Report No. C026/13 / tFC Report No. 20120402, 2013

Collisions with wind turbines

Bats both fly low over the sea surface and can migrate at higher altitudes. However, some bats rapidly change altitude when approaching high vertical obstacles, and on land, bats have been observed foraging near turbine blades or nesting on nacelles. The limitations of assessing the actual number of collisions between bats and offshore wind turbines remain a challenge; there are very few studies that clearly identify which taxa may be particularly vulnerable, especially under adverse circumstances.⁶¹⁶

Studies show that in late summer, wind turbines in the Baltic Sea at a distance of up to 10 km from the Swedish coast attract bats.⁶¹⁷ Increased activity of bats probably results from a high concentration of food enticing bats migrating over the Baltic Sea, and potentially also species that do not migrate seasonally.⁶¹⁸ Migrating bats fly over the sea at low altitudes. However, if they encounter a wind turbine, they can momentarily change flight altitude from the water surface to the top of the turbine. In addition, bats may be attracted to concentrations of food that accumulates around wind turbines under certain weather conditions, such as low wind speeds, high temperatures and lack of rainfall.⁶¹⁹ As a result, bats attracted in this way may be at a higher risk of collisions with the rotor blades.

In addition to collision risk, bats are potentially at risk of barotrauma. Barotrauma (i.e. injury caused by sudden pressure changes around moving blades) was initially identified as a major source of bat mortality for onshore wind turbines, however there is little empirical evidence of this impact.⁶²⁰

Most bats migrate over the sea at night when the wind speed does not exceed $10 \text{ m}\cdot\text{s}^{-1}$, with the highest activity of bats being recorded at wind speed below $5 \text{ m}\cdot\text{s}^{-1}$.⁶²¹ The highest feeding intensity of bats was observed during windless weather. Very low wind speeds are rare in the open sea. Therefore, it is rather unlikely that there will be days in which bats will gather for feeding while the OWF is operating.

The effects of collisions with masts and rotors, as well as the risk of barotrauma, are assessed to be negative, direct, local and permanent, of moderate intensity. However, as the surveys conducted in the area of the BC-Wind OWF indicated mainly very low or low bat activity, the impact of the risk of collision and barotrauma was assessed to be low.

Noise and light emissions

Ultrasonic noise generated by the nacelle may attract bats, but this hypothesis has not been confirmed and seems unlikely.⁶²² Bats are likely to be attracted to bright lights at sea during migration⁶²³ and may seek refuge there. This raises the risk of collisions with offshore wind turbines (which must be brighter at sea than on land).

The effects of the impact of noise and light emissions are classified as local and permanent, but of low intensity; they are also likely to concern a small number of animals.

⁶¹⁶ Hüppop, O., Michalik, B., Bach, L., Hill, R., Pelletier, S., 2019. Migratory birds and bats. In Perrow M.R. (ed): *Wildlife and Wind Farms, Conflicts and Solutions. Volume 3 Offshore: Potential Effects*, 142-173, Pelagic Publishing, Exeter

⁶¹⁷ Ahlén I., Baggøe H.J., Bach L., 2009. Behavior of Scandinavian bats during migration and foraging at sea. *Journal of Mammalogy* 2009, 90 (6): 1318-1323

⁶¹⁸ Rydell J., Bach L., Dubourg-Savage M.-J., Green M., Rodrigues L., Hedenström A., Mortality of bats at wind turbines links to nocturnal insect migration? *Eur. J. Wildlife Res.* 2010, 56: 823-827

⁶¹⁹ Poerink B.J., Lagerveld S., Verdaat H., 2013. Bat activity in the Dutch offshore wind farm OWEZ and PAWP. Pilot study. IMARES Report No. C026/13 / tFC Report No. 20120402, 2013

⁶²⁰ Bennun, L., van Bochove, J., Ng, C., Fletcher, C., Wilson, D., Phair, N., Carbone, G. (2021). *Mitigating biodiversity impacts associated with solar and wind energy development. Guidelines for project developers*. Gland, Switzerland: IUCN and Cambridge, UK: The Biodiversity Consultancy

⁶²¹ Ahlén I., Bach L., Baaggøe H.J., Pettersson J., *Bats and offshore wind turbines studied in southern Scandinavia. Report 5571*. The Swedish Environmental Protection Agency, 2007

⁶²² Rydell J., Ottvall R., Pettersson S., Green M., 2017. *The effect of wind power on birds and bats – an updated synthesis report 2017. Report 6791*. The Swedish Environmental Protection Agency, Stockholm 2017

⁶²³ Hüppop, Ommo & Hill, Reinhold. (2016). *Migration phenology and behaviour of bats at a research platform in the southeastern North Sea*. *Lutra*. 59. 5-22

Barrier effect

The operating OWF may exert a barrier effect on migrating bats. The noise emitted by operating wind turbines can contribute to the barrier effect. Due to the barrier effect, bats may be forced to change the migration direction. This, in turn, will result in additional energy expenditure disadvantageous to migratory bats.⁶²⁴

Habitat change

Structural components can be used as places of rest along the migration route or can constitute attractive hiding places due to the aforementioned insect concentrations.⁶²⁵

Surveys conducted in the autumn and spring migration periods indicated a possibility of bats migrating in the OWF area. However, the migration intensity was low due to the low activity of bats.

In summary, the impacts of the BC-Wind OWF on bats during the exploitation phase described above, just like in the case of the variant assessed at the stage of obtaining the DEC, will be negative, direct, and long-term. The sensitivity to the impact was assessed as low, whereas the significance of the impact of the BC-Wind OWF during the exploitation phase was assessed to be low due to the low activity of bats found during the surveys carried out in the seasonal migration periods. However, due to the lack of knowledge on bat migration and the associated risks, bat monitoring is planned after the operations of the farm are commenced, as described in more detail in Chapter 16.

Decommissioning phase

The decommissioning phase will include activities similar to those of the construction phase. Therefore, it can be assumed that the impacts of the decommissioning phase will also be similar to those listed for the construction phase. The following activities during the decommissioning phase may affect migratory bats:

- the removal of the components of the OWF;
- the presence of vessels;
- dismantling works under and above the sea surface.

The removal of the components of the OWF and the related vessel traffic will lead to an increase in noise. Bats may be scared by noise, which may also act as a barrier. Lighting systems on ships and dismantling locations may attract bats. This may lead to a risk of collision with vessels and structures intended for removal. The vessels and the components of the OWF to be removed may serve as resting sites for migratory bats.

Impacts on bats during the decommissioning phase will be negative, direct, local, short-term, temporary, and of low intensity.

The sensitivity to the impact was assessed to be negligible, whereas the significance of the impact of the BC-Wind OWF during the decommissioning phase was assessed to be negligible due to the low activity of bats found during the surveys carried out in the seasonal migration periods.

9.5 IMPACT ON PROTECTED AREAS, ECOLOGICAL CORRIDORS AND BIODIVERSITY

Due to the location of the BC-Wind OWF at a significant distance from the protected area of the Słowiński National Park, there will be no significant impacts on this area, including on any of the elements for which it was established, i.e. biodiversity, resources, works and components of inanimate nature, and landscape values of the park.

⁶²⁴ Wind energy developments and Natura 2000. Guidance Document; available at: <https://op.europa.eu/en/publication-detail/-/publication/65364c77-b5b8-4ab6-919d-8f4e3c6eb5c2>

⁶²⁵ Rydell J., Ottvall R., Pettersson S., Green M., The effect of wind power on birds and bats – an updated synthesis report 2017. Report 6791. The Swedish Environmental Protection Agency, Stockholm 2017

In the Annex to the Ordinance of the Minister of Environment of 16 February 2017 on protective tasks for the Słowiński National Park (Official Journal of the Ministry of the Environment of 2017, item 10, as amended), which identifies and assesses existing and potential internal and external threats, as well as ways to eliminate or reduce these threats and their effects, in the category of external existing threats, the threat resulting from the increase of areas for the development of wind farms in the municipalities neighbouring the park was indicated. In the category of potential external threats, it was indicated that only the emergence of wind farms in the park's buffer zone constitutes a potential external threat, and therefore it should be concluded that the BC-Wind OWF will not pose a threat to the Słowiński National Park.

9.5.1 Natura 2000 sites

The assessment of the impact of the planned project on the subjects of protection of the Natura 2000 sites Baltic Coastal Waters (PLB990002) and Słupsk Bank (PLC990001) will be the same as in the variant for which the Investor obtained the DEC (the RAV 2024). The impacts during the construction and exploitation phases will not result in significant negative impacts on the analysed areas.

Despite the lack of differences in the final assessment of the impact on the subjects of protection and on the integrity of the area and the coherence of the network of Natura 2000 sites, it should be pointed out that the WWR 2024 variant is, however, more favourable from the environmental point of view than the APV 2021 (currently the RAV 2024) due to the specified parameters of the project, i.e. the smaller number of wind turbines, the smaller diameter of the rotor and height of the structure, as well as the smaller amounts of suspended matter generated during the construction phase resulting from gravity foundations being excluded at the current stage, as well as the significant shortening of the length of the cable routes. These determine the consequently smaller scale of impacts on individual environmental elements.

Taking into account the long-term nature of this impact (the assumed duration of the exploitation phase is several decades), these differences can also be an important indication that WWR 2024 is the more favourable option for the environment, including Natura 2000 sites. The assessment for Natura 2000 sites is presented below.

Preliminary assessment

The primary conservation objective of the sites of the Natura 2000 ecological network is to maintain or restore the favourable conservation status of the species and natural habitats which constitute the objects of conservation and for the protection of which the areas were designated.

The BC-Wind OWF project is not directly related or necessary to the management of Natura 2000 sites. This rationale implies that an assessment of the impact on these sites is necessary.

Detailed information on Natura 2000 sites located in the closer or further vicinity of the BC-Wind OWF area is presented in Chapter 7.5.

An essential element of the preliminary assessment of the impact of the BC-Wind OWF on the sites of the Natura 2000 ecological network is to determine whether a given Natura 2000 site lies within the range of potential impacts of the BC-Wind OWF. The location of the BC-Wind OWF Area against the locations of Natura 2000 sites is shown in Fig. 7.18.

The distance between the area and the area of the project and the extent of the impacts are the basic prerequisites for assuming whether the planned project may impact a Natura 2000 protected site. Due to the specifics of the functioning of the Natura 2000 network and possible functional connections between the areas, the location of the project area in relation to the Natura 2000 sites is also important. The table below (Tab. 9.36) presents the distances (understood as the distances from the closest points of both areas) of the Natura 2000 site from the BC-Wind OWF Area and the list of objects of conservation present in those areas.

Tab. 9.36. Subjects of protection within Natura 2000 sites taken into account in this Report - bold type indicates species protected in at least two areas

Name/code of the area	Distance from the BC-Wind OWF Area [km]	Subjects of protection in the area		
		Marine habitats	Marine animal species	Bird species
Baltic Coastal Waters (PLB990002)	approx. 12	-	-	Long-tailed duck (A064) Common scoter (A065) Velvet scoter (A066) European herring gull (A184) Razorbill (A200) Guillemot (A202)
Ostoja Słowińska (PLH220023)	approx. 37	Stony bottom, reefs (1170)	Sea lamprey (1095) River lamprey (1099) Twaite shad (1103) Salmon (1106) Harbour porpoise (1351) Grey seal (1364) Sabrefish (2522)	-
Słupsk Bank (PLC990001)	approx. 42	Offshore sandbanks (1110) Rocky bottom, reefs (1170)	-	Long-tailed duck (A064) Guillemot (A202)
Hoburgs bank och Midsjöbankarna (SE0330308)	approx. 63	Offshore sandbanks (1110) Rocky bottom, reefs (1170)	Harbour porpoise (1351)	Common eider (A063) Long-tailed duck (A064) Guillemot (A202)

Source: own elaboration

In addition, the table above (Tab. 9.36) highlights the bird species and other marine animals that are subject to protection in at least two areas. The species indicated include: the harbour porpoise (1351) and three bird species: the long-tailed duck (A064), the European herring gull (A184) and the guillemot (A202). The assignment of these animal species as objects of conservation to Natura 2000 sites indicates that these sites are important locations for them and, at the same time, that there is a likelihood of movement of these species between the sites. Taking this into account, it can be assumed that the long-tailed duck and the guillemot are more likely to migrate between sites: Baltic Coastal Waters (PLB990002), Słupsk Bank (PLC990001) and Hoburgs bank och Midsjöbankarna (SE0330308). In the case of the lesser black-backed gull, which is the object of protection in Baltic Coastal Waters (PLB990002) and not an object of protection in the other analysed Natura 2000 sites, a lower probability of migration of this species between the coastal zone and areas north of it can be assumed.

The harbour porpoise (1351) is not a migratory species. It uses its area of residence in relation to foraging or breeding. This area may change, but there is no migration between areas. Hence, there is little connection between the different Natura 2000 sites that would require an assessment of the impact on the network between these sites.^{626, 627}

⁶²⁶ Dietz R., Teilmann J., Henriksen O.D., Laidre K., Movements of seals from Rødsand seal sanctuary monitored by satellite telemetry. Relative importance of the Nysted Offshore Wind Farm area to the seals. NERI Technical Report No 429. National Environmental Research Institute, Copenhagen 2003

⁶²⁷ Teilmann J., Sveegaard S., Dietz R., Petersen I.K., Berggren P., Desportes G., High density areas for harbour porpoises in Danish waters. National Environmental Research Institute, University of Aarhus, NERI Technical Report No. 657, 2008

Determining the extent of the impact of the project

The BC-Wind OWF Area is located outside the areas of the European Ecological Network Natura 2000 (Tab. 9.36). Hence, when determining the impacts of the planned project on Natura 2000 sites, impacts that go beyond the BC-Wind OWF Area were assumed. Tab. 9.37 indicates the impacts which may extend beyond the BC-Wind OWF Area, and the protected elements of the Natura 2000 sites which may be affected.

Tab. 9.37. List of potential impacts and the elements of Natura 2000 sites that may be affected

Impact	Element of Natura 2000 sites
Increase in suspended solids concentration in the water and its sedimentation	Objects of conservation: fish species and habitats
Underwater noise	Objects of conservation: marine mammal and fish species
Disturbance of space	Objects of conservation: bird species, integrity of the area of Baltic Coastal Waters (PLB990002), network coherence

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 310

Suspended solids and their sedimentation

The following assumptions were made for the purposes of determining the extent of the impact of the increase in suspended solids in the water and the resulting sedimentation:

- the maximum range of the suspended solids at a concentration of 5 mg/l is approx. 2.1 km from the place of their origin;
- the maximum thickness of the newly formed sediment layer of approx. 1.4 mm will be deposited in the close vicinity of the excavation, and it will not exceed 0.5 mm at distances of more than 350 m from the excavation.

The impact of the increase in suspended solids on biotic elements is described in Chapter 9.4. For fish eggs and juveniles only, there is data in literature that indicates at which values of suspended solids concentrations significant impacts may occur. The values indicated there for significant adverse effects on the described organisms are 10-12 mg/l, and already at suspended solids concentrations of 3-5 mg/l, avoidance reactions are observed. Hence, using the precautionary approach, it was assumed that the limit of significant impact is an increase in suspended solids content to 5 mg/l.

Destruction of benthic organisms could indirectly impair the food base for birds. A precautionary value of 1.5 mm of deposited sediment was used to determine the extent of significant impact of suspended solids, assuming that dissolved oxygen reaches a depth of 2 mm into the sediment by diffusion.⁶²⁸

Increased concentrations of suspended solids and sedimentation due to their maximum extent will not affect the following habitats: Offshore sandbanks (1110) and Reefs (1170) of the Słupsk Bank (PLC990001) site, as well as Reefs (1170) of the Ostoja Słowińska (PLH220032) site. Changes to the morphology of the seabed will be caused by the works associated with cable laying activities within the area of the BC-Wind OWF. At this stage, using gravity foundations for the power plant, which causes much higher turbidity and which was considered at the stage of issuing the DEC, has been ruled out. They will be local in scope and limited to the locations of these activities. Given the remoteness of the nearest BC-Wind OWF structures from the boundaries of the habitats indicated above and the maximum extent of suspended sedimentation, the habitat boundaries will not change. For the same reason, i.e. the significant distance of protected habitats (receptors) from the impact source, the increase in

⁶²⁸ Hinchey E.K., Schaffner L., Hoar C., Vogt B., Batte L., Response of estuarine benthic invertebrates to sediment burial. The importance of mobility and adaptation. *Hydrobiologia* 2006, 556 (1): 85-98

suspended solids and their sedimentation will not fragment these habitats, nor will their structure and function be affected (Fig. 9.18).

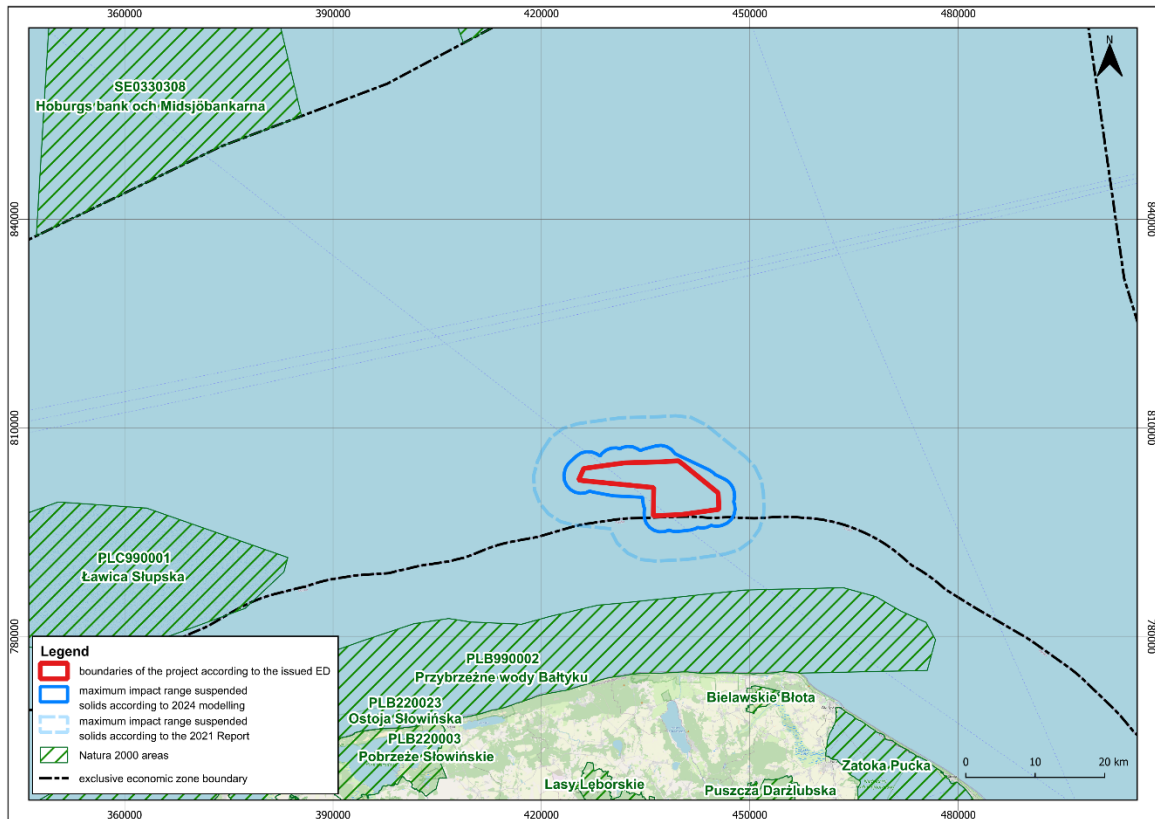


Fig. 9.18. The extent of the impact of the increase in suspended solids and resulting sedimentation for the BC-Wind OWF

Source: own elaboration

Underwater noise

In order to assess whether noise emitted from piling may exceed acceptable sound levels in Natura 2000 sites where marine mammals are protected, numerical modelling (Appendix 3, Volume III) was carried out. Analyses were performed for scenarios with and without the use of mitigation measures. Calculations were performed for the effects of hearing damage, taking into account the cumulative effect. The analysed Natura 2000 sites were Ostoja Słowińska and Hoburgs bank och Midsjöbankarna (Tab. 9.38). Modelling was carried out using acoustic thresholds for the hearing damage present in harbour porpoise, as these are lower than for seals. The results are presented as differences in noise levels between the calculated SEL values and the threshold values (Tab. 9.38, Tab. 9.39).

Tab. 9.38. Natura 2000 sites with marine mammal protection in closest proximity to the BC-Wind OWF

Natura 2000 code	Name of the site	Land/sea area	Area [km ²]	Approximate distance to the centre of the BC-Wind OWF Area [km]
SE0330308	Hoburgs bank och Midsjöbankarna	Maritime	1226	69.4
PLH220023	Ostoja Słowińska	Maritime/land	321	43.2

Source: EIA Report for BC-Wind, MEWO S.A., 2021

The obtained results showed that for a single site, the permissible limit for noise generating cumulative TTS and PTS in harbour porpoise will not be exceeded, both at the Polish and Swedish

Natura 2000 site boundaries, even without mitigation measures (Tab. 9.39). In the case of Ostoja Słowińska, the sound emitted during piling will not reach the border of the protected site at all (Fig. 9.19).

Tab. 9.39. Modelled noise levels at the Natura 2000 site boundary according to HF-weighted SEL limits for TTS and PTS for piling at one location, with and without the use of mitigation measures

Mitigation measure	Natura 2000 site	Impact	HF-weighted SEL value at the Natura 2000 site boundary [dB re 1 $\mu\text{Pa}^2\text{s}$]	Modelled HF-weighted SEL value at the Natura 2000 site boundary [dB re 1 $\mu\text{Pa}^2\text{s}$] *	Difference between the modelled HF-weighted SEL value and the threshold value [dB]*
No mitigation measures	Ostoja Słowińska	TTS cum.	140	-	-
		PTS cum.	155		-
	Hoburgs bank och Midsjöbankarna	TTS cum.	140	132.8	-7.2
		PTS cum.	155		-22.2
HSD+DBBC	Ostoja Słowińska	TTS cum.	140	-	-
		PTS cum.	155		-
	Hoburgs bank och Midsjöbankarna	TTS cum.	140	88.1	-51.9
		PTS cum.	155		-66.9

* no SEL value (-) indicates that the sound generated during piling does not reach the boundary of the Natura 2000 site

Source: own elaboration

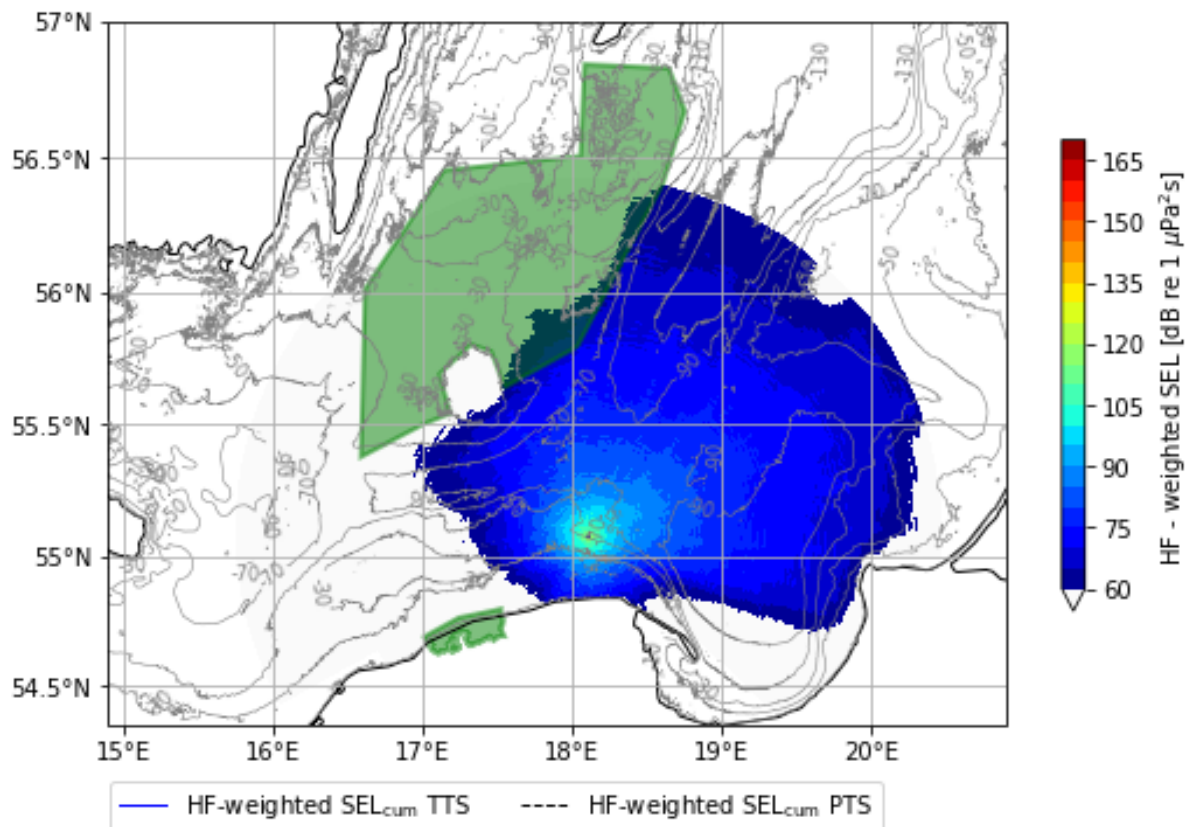


Fig. 9.19. HF-weighted SEL noise level in the BC-Wind OWF Area and at the boundary of Natura 2000 sites including ranges of impact on the harbour porpoise calculated for piling at one location with the use of mitigation measures in the form of HSD+DBBC (impact ranges for TTS and PTS are not visible on the map because of their small reach)

Source: Appendix 3 to the Report, Volume III

Based on the results obtained for the piling scenarios at two locations at the same time, it was concluded that without the use of mitigation measures, the threshold for TTS could be exceeded at the border of the Swedish Natura 2000 site if construction works were carried out at two locations, 20 km apart (Tab. 9.40). After the application of a mitigation measure in the form of a Noise Reduction System (for modelling purposes these were two systems: HSD+DBBC), this effect was negated. An appropriate NRS will be matched to the contracted equipment (hammer power) for the construction phase, assuming that the conditions set in the DEC must be met. In the case of the Ostoja Słowińska site, the acceptable thresholds for hearing damage were not exceeded in any of the cumulative scenarios (Tab. 9.40). With the use of mitigation measures, the sound emitted during piling will not even reach the boundary of this site (Fig. 9.20, Fig. 9.21).

Tab. 9.40. Modelled noise levels at the Natura 2000 site boundary according to HF-weighted SEL limits for TTS and PTS for piling at two locations, with and without the use of mitigation measures

Mitigation measure	Sound source	Natura 2000 site	Impact	HF-weighted SEL threshold value at the Natura 2000 site boundary [dB re 1 $\mu\text{Pa}^2\text{s}$]	Modelled HF-weighted SEL value at the Natura 2000 site boundary [dB re 1 $\mu\text{Pa}^2\text{s}$]*	Difference between the modelled HF-weighted SEL value and the threshold value [dB]*
No mitigation measures	2 sources < 1 km	Ostoja Słowińska	TTS cum.	140	75.4	-64.6
			PTS cum.	155		-79.6
		Hoburgs bank och Midsjöbankarna	TTS cum.	140	139.0	-1.0
			PTS cum.	155		-16.0
	2 sources 20 km	Ostoja Słowińska	TTS cum.	140	-	-
			PTS cum.	155		-
		Hoburgs bank och Midsjöbankarna	TTS cum.	140	143.0	+3.0
			PTS cum.	155		-12.0
HSD+DBBC	2 sources < 1 km	Ostoja Słowińska	TTS cum.	140	-	-
			PTS cum.	155		-
		Hoburgs bank och Midsjöbankarna	TTS cum.	140	91.1	-48.9
			PTS cum.	155		-63.9
	2 sources 20 km	Ostoja Słowińska	TTS cum.	140	-	-
			PTS cum.	155		-
		Hoburgs bank och Midsjöbankarna	TTS cum.	140	93.8	-46.2
			PTS cum.	155		-61.2

* no SEL value ('-') indicates that the sound generated during piling does not reach the boundary of the Natura 2000 site

Source: own elaboration

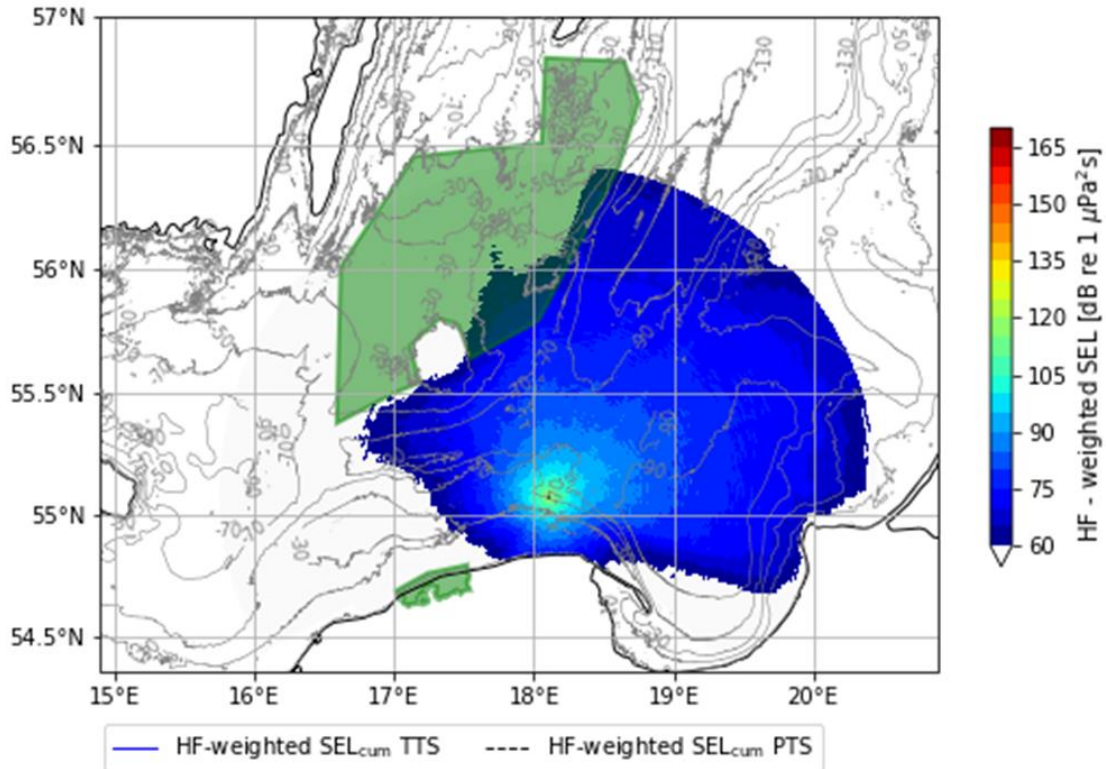


Fig. 9.20. HF-weighted SEL noise level in the BC-Wind OWF area and at the boundary of Natura 2000 sites including ranges of impact on the harbour porpoise calculated for simultaneous piling at two locations located less than 1 km apart, with the use of mitigation measures in the form of HSD+DBBC (impact ranges for TTS and PTS are not visible on the map because of their small reach)

Source: Appendix 3 to the Report, Volume III

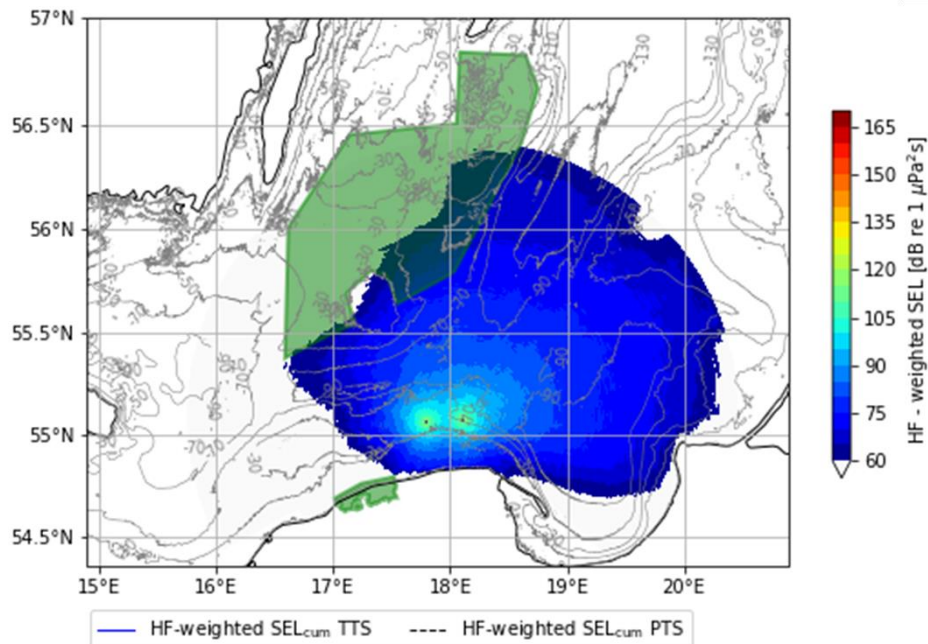


Fig. 9.21. HF-weighted SEL noise level in the BC-Wind OWF area and at the boundary of Natura 2000 sites including ranges of impact on the harbour porpoise calculated for simultaneous piling at two locations located 20 km apart, with the use of mitigation measures in the form of HSD+DBBC (impact ranges for TTS and PTS are not visible on the map because of their small reach)

Source: Appendix 3 to the Report, Volume III

If only the double air curtain is used, the impact on marine mammals will also be significantly reduced, as indicated by the draft modelling results for the single and double air curtains (Tab. 9.41).

Tab. 9.41. Maximum range for cumulative TTS and PTS for seals, harbour porpoises and fish with a swim bladder (in kilometres)

Receptor	Maximum impact range [km]					
	Big Bubble Curtain (BBC)		Double Big Bubble Curtain (DBBC)		Hydro Sound Damper (HSD)	
	TTS _{cum.}	PTS _{cum.}	TTS _{cum.}	PTS _{cum.}	TTS _{cum.}	PTS _{cum.}
	[km]	[km]	[km]	[km]	[km]	[km]
Fish with a swim bladder	46.8	4.9	31.4	2.9	9.2	0.4
Seals	7.2	0.1	3.7	0.1	0.1	0.1
Harbour porpoises	0.2	0.1	0.1	0.1	0.1	0.1

Source: working material developed as part of noise propagation modelling

The obtained results indicate that the use of a single bubble curtain makes it possible to meet the threshold for harbour porpoise and seals established in the BC-Wind DEC, as well as the PTS for fish at a distance of 4.9 km.

The final selection of a Noise Reduction System will depend on the final choice of hammer power and the parameters of the monopile and the seabed depth. Details on how noise reduction will be implemented and how marine mammals will be protected from acoustic impacts, primarily hearing damage, will be developed 6 months prior to the commencement of piling and submitted to the RDEP in Gdańsk for approval in the form of a document entitled 'Piling strategy'. Currently, the adopted modelling parameters and the obtained results are based on conservative assumptions and were intended to demonstrate the possibility of achieving the threshold set in the environmental decision. In the 'Piling strategy' they will be made more realistic and precisely planned. For more information on the 'Piling strategy', please refer to Chapter 15 *Proposed Minimisation Measures*.

Spatial disturbances

As a result of the implementation of the BC-Wind OWF, large-size structures will be built in the currently undeveloped marine area, as well as the airspace above it. The maximum height of the wind turbines will be 300 m above the sea level, and the maximum rotor diameter will equal up to 250 m. In the WWR 2024, the maximum number of wind turbines will be 34 (with 39 total locations analysed in this Report, with 5 being backup locations), and the maximum number of additional structures will be 5 (including one OSS).

Compared to the current situation (initial state), the construction of such a number of large-size structures in the environment may result in a significant disturbance of the coastal space within the BC-Wind OWF Development Area. All erected structures will not form a uniform barrier. The distances between individual wind turbines will be at least four times the rotor diameter. For a rotor with a maximum diameter of 250 m, it will be more than 1 km. The location of individual wind turbines and other facilities, including the OSS, will be indicated at the stage of the building permit design. At the current stage of amendment of the DEC, preliminary locations have been selected, however they are subject to change within the boundaries of the current development area, in the course of further design work and during the construction phase.

When comparing these two spaces, the airspace above the marine area will be occupied to a greater extent. The diameter of submerged structures connecting the foundation or support structure with the towers of the wind turbines will be equal to up to 20 m, whereas the rotor diameter will be equal to up to 250 m. The occupation of airspace above the marine area will also vary at different heights of the structure. The space from the sea surface to the height of at least 20 m will not be occupied (excluding parts of the wind turbine towers). It is noteworthy that the reduction in the number of wind turbines and their height results in less spatial disturbance than in the variant assessed at the stage of obtaining the DEC (adopted in this Report as the RAV 2024).

The subsea space, understood as the sea surface including the water depth, is used by fish, marine mammals and birds sitting on the water. Observations carried out in Danish wind farm areas indicate that, due to the possibility of active movement of fish, the construction of structural elements in the subsea space will not significantly disturb their migration processes. A similar situation will occur in the case of marine mammals, for which the possibility of active movement means that the sparsely distributed construction components in the subsea space will not significantly affect their previous behaviour. In the case of birds sitting on the water, given the minimum distance of the tips of the rotor to the water surface (20 m), the restriction of the useable space will also be negligible, just like in the case of the subsea space for fish and marine mammals.

The airspace above the marine area is used by migratory birds or seabirds both in seasonal migrations and in local flights between feeding grounds. Disturbances of these flights may affect the populations of birds subject to protection in the Natura 2000 sites of Baltic Coastal Waters (PLB990002) and Słupsk Bank (PLC990001). In the event of a significant impact of the OWF on birds caused by the disturbance of airspace, the coherence of the Natura 2000 network could be compromised, however such impact is not expected. At the same time, the amendment of the DEC, which is underway in order to have the parameters of the project specified, including, above all, the reduction in the number of wind turbines and their height, reduces this threat. In order to eliminate it, the OWF will be equipped with appropriate monitoring and slowing systems, as described in more detail in Chapters 15 and 16.

Summary of the preliminary assessment

As a result of the preliminary impact assessment of the planned project on Natura 2000 sites, taking into account the scope and nature of the impacts, it was indicated, both for the BC-Wind OWF and for the cumulative effect of the impacts generated by other projects, that no Natura 2000 site is situated within the range of any impacts. The lack of impacts regards, in particular, the subjects of protection (species and habitats) within the areas established for their protection.

In this respect, the main impact assessment of the BC-Wind OWF on Natura 2000 sites covered the aspect related to the probable impact caused by the disturbance of the airspace over the BC-Wind OWF Development Area in the context of the integrity of the Baltic Coastal Waters site (PLB990002), and the coherence of the Natura 2000 network.

Main assessment

The main assessment, due to the nature of the impact, was focused on the exploitation phase of the BC-Wind OWF. In this phase, the airspace above the marine area will be maximally occupied by the structures both of wind turbines and platforms, thus the impact will be the largest in comparison to the other phases of the project. In the construction phase, the effect of the disturbance of the airspace will be incremental: from the undisturbed, baseline state to the maximum state lasting for the duration of the entire exploitation phase. In the decommissioning phase, the situation shall be reversed, passing from the maximum state to the undisturbed state.

Coherence of the Natura 2000 network

In the context of the protection of seabird populations as part of the Natura 2000 network, the following characteristics of the Słupsk Bank (PLC990001) and Baltic Coastal Waters (PLB990002) sites are crucial:

- the location of these sites on the migration route of the Eurasian seabird populations to their wintering grounds;
- the availability of these areas to the populations of wintering birds and birds resting during migration;
- the appropriate habitat conditions that make these sites attractive as wintering or resting grounds for seabirds during the autumn and spring migrations.

In the context of maintaining the coherence of the Natura 2000 network, it is first of all important to maintain the possibility of movement between sites for the seabird populations without the risk of

significant population depletion or significant energy expenditures, which could affect the ecology and biology of these populations, including the survival of the individuals from these populations.

At the moment, before the implementation of the BC-Wind OWF and other wind farm projects in the PMA, the status of the birds wintering and migrating at the Słupsk Bank site (PLC990001) and the Baltic Coastal Waters site (PLB990002) is appropriate.

In the assessment of the BC-Wind OWF on Natura 2000 sites in connection to birds, the results of ornithological surveys conducted for the EIA Report, information from the Standard Data Forms for the Słupsk Bank (PLC990001) and Baltic Coastal Waters (PLB990002) sites, and also the recommendations from the European Commission's 'Guidebook on the development of wind energy 2000' were used.

The results of the maximum abundance of the bird species selected in the BC-Wind OWF Area and the Natura 2000 network sites are presented in Fig 9.22 and Tab. 9.42. The results of the abundance modelling during the seabird wintering period were used for comparison in accordance with the accepted standards, because the long-distance movements of birds during winter are less probable than in other phenological periods.

In this respect, an assessment of the usefulness and significance of the BC-Wind OWF Area and the neighbouring Natura 2000 sites the Słupsk Bank (PLC990001) and Baltic Coastal Waters (PLB990002) to the seabirds was conducted.

Tab. 9.42. Comparison of the abundances of wintering seabirds in the BC-Wind OWF Area and Natura 2000 sites

Species	Abundance of birds wintering in the areas [ind.]			
	BC-Wind OWF	Słupsk Bank (Ławica Słupska) (PLC990001)	Fragment of the Baltic Coastal Waters (Przybrzeżne wody Bałtyku) (PLB990002)	Total
Long-tailed duck <i>Clangula hyemalis</i>	62	139086	20467	159677
Velvet scoter <i>Melanitta fusca</i>	3	8859	84246	93108
Razorbill <i>Alca torda</i>	288	459	756	1503
European herring gull <i>Larus argentatus</i>	631	2148	4788	7567
Black guillemot <i>Cepphus grille</i>	1*	14*	0*	15*
Common scoter <i>Melanitta nigra</i>	0*	0*	142*	142*
Total	985	150566	110399	261950

* Field survey results

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 319

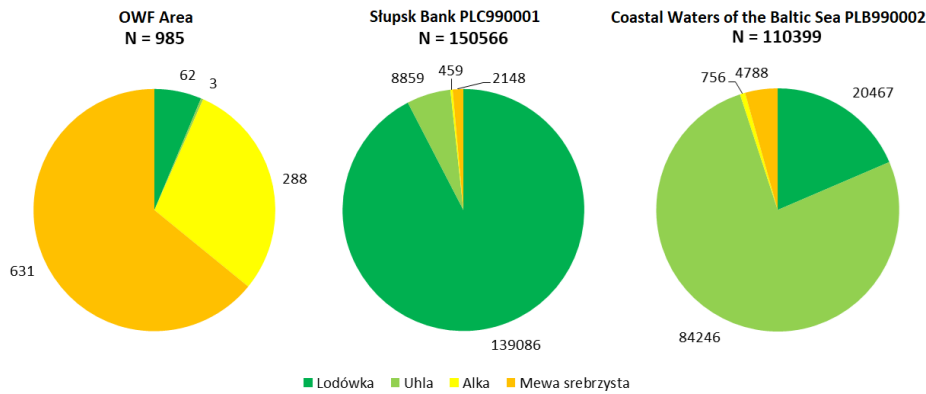


Fig. 9.22. Species structure of the seabirds subject to protection within the BC-Wind OWF Area and the Natura 2000 sites

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 311

For comparison, the results of the modelling for the maximum abundances of the wintering seabirds that are subject to protection within the Natura 2000 sites (the long-tailed duck, the velvet scoter, the razorbill and the European herring gull) carried out as part of the EIA Report were used. The black guillemot and the common scoter were also included in the assessment. The black guillemot is the subject of protection within the Słupsk Bank (PLC990001) and Baltic Coastal Waters (PLB990002) Natura 2000 sites, but its abundance in the area of the BC-Wind OWF was very low. In total, only one single individual was recorded during the winter survey campaigns. No individual of the black guillemot species was found in the Baltic Coastal Waters (PLB990002) site, and within the Słupsk Bank (PLB990001) site, 14 individuals were recorded. It should be noted that these abundances apply only to the individuals observed along the survey cruise route and that they are not identical to the total number of black guillemots residing in these areas.

The common scoter is the subject of protection in the Baltic Coastal Waters (PLB990002) site and its abundance in winter in this survey area was 142 individuals observed along the survey cruise route. It was not recorded in the area of the BC-Wind OWF.

The wintering period was assessed as representative as the long-distance travels of birds in the wintering period are much less probable than in other phenological periods, and the bird abundances are the highest. The Słupsk Bank (PLC990001) and the Baltic Coastal Waters (PLB990002) sites are located on the migration route of Eurasian seabird populations to their wintering grounds. Their distribution and the abundance of birds result mainly from the availability of food. From the point of view of the habitat conditions, which make these areas attractive, the obtained results clearly indicate that the area of the BC-Wind OWF is used by birds much less in contrast with the Natura 2000 sites. This confirms the value and importance of the areas included in the Natura 2000 network. Seabirds show strong attachment to their wintering grounds and are reluctant to travel greater distances.^{629, 630, 631} Surveys of birds in flight using a radar have shown that wintering birds flying in this part of the Baltic Sea move in all directions, without a clear pattern, which indicates short foraging flights rather than long-distance travels. It has been found that at vantage points located along the Baltic Coastal Waters site, birds fly more frequently in the west-south and north-east directions, i.e. along the shoreline. The highest

⁶²⁹ Oppel S., Powell A.N., Dickson D.L., Timing and distance of king eider migration and winter movements. *The Condor* 2008, 110: 296-305

⁶³⁰ Ojaveer H., Olenin S., Narščius A., Florin A.-B., Ezhova E., Gollasch S., Jensen K.R., Lehtiniemi M., Minchin D., Normant-Saremba M., Stråke S., Dynamics of biological invasions and pathways over time: a case study of a temperate coastal sea. *Biological Invasions* 2016, 19: 799-813

⁶³¹ Iverson S.A., Esler D., Site fidelity and the demographic implication of winter movements by a migratory bird, the harlequin duck *Histrionicus histrionicus*. *Journal of Avian Biology* 2006, 37: 219-228

number of flights recorded was documented in the strip between the Natura 2000 sites of Słupsk Bank and Baltic Coastal Waters.

Although the availability of the area of the BC-Wind OWF for the populations of wintering birds and birds resting during migration, which are subject to protection in the neighbouring Natura 2000 sites, will be restricted, the impact was assessed to be negligible for the long-tailed duck and the European herring gull, while for the black guillemot and the common scoter the impact will not occur. Furthermore, the existence of corridors (development-free areas) to the west of the development area of the BC-Wind (between the Baltic Power OWF and the BC-Wind OWF) and between the Baltica 2 OWF and Baltica 3 OWF will significantly increase the flight possibility for birds migrating within the area of wind farms in this region.

European herring gulls gather in the open sea areas where fishing is conducted by fishing boats. If during the construction (or later exploitation) of the BC-Wind OWF, fishing becomes restricted in this sea area, seagulls may relocate to a different location in which fishing will be continued, or may use the new structural elements protruding from the sea as their resting places. The underwater parts of these structures shall fulfil the function of an artificial reef constituting a hard substratum for the macrozoobenthos, which is food for the birds.

Long-tailed ducks, velvet scoters and razorbills present in the area of the BC-Wind OWF before the commencement of works will in majority permanently abandon this area, relocating to the neighbouring areas. Populations wintering within the sites of Słupsk Bank (PLC990001) and Baltic Coastal Waters (PLB990002), where the habitats are better, are not at risk due to the significant distance of these areas from the area of the BC-Wind OWF. The potential possibility of an increase in the population densities of the long-tailed duck, the velvet scoter and the razorbill at both Natura 2000 sites as a result of the movement of birds previously staying in the sea area of the planned project will not have a negative impact on them. In the planned OWF area, these species occupied suboptimal habitats, mainly due to the depth for diving in search of food being too great. On the other hand, at the Natura 2000 sites, the foraging conditions are optimal for the aforementioned species, which is indicated by the very high values of their densities.

In summary, it should be noted that due to the low number of seabirds in the area of the planned project, no significant negative impacts of the BC-Wind OWF consisting of displacing bird species subject to protection within the sites of Słupsk Bank (PLC990001) and Przybrzeżne wody Bałtyku from habitats is expected.

Integrity of the Natura 2000 site

Due to the location of the BC-Wind OWF, the issue of the impact of the planned project on the integrity of a Natura 2000 site could be considered in the context of the nearest Natura 2000 site, i.e. the Baltic Coastal Waters site (PLB990002).

The key impacts of the BC-Wind OWF on the long-tailed duck is the ducks being scared away and the loss of important habitats in which the species winters. As shown in the publication by Petersen et al.⁶³², a multi-annual pre- and post-implementation surveys of the Nysted OWF in Denmark prove that the long-tailed duck avoids the area of the constructed OWF. It is also significantly displaced from the 2 km zone, and to a lesser extent from the 2-4 km zone around the boundaries of the power plant development area. The decrease in abundance in the 2-4 km zone was not statistically significant.

In this context, the Baltic Coastal Waters site (PLB990002) is located at a relatively large distance from the BC-Wind OWF area (more than 12 km), and thus, the displacement of these birds from their habitats located in the Baltic Coastal Waters site (PLB990002) will not take place. Moreover,

⁶³² Petersen I.K., Christensen T.K., Kahlet J., Desholm M., Fox A.D., Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. Report request. Commissioned by DONG energy and Vattenfall A/S. National Environmental Research Institute, Ministry of the Environment, 2006

due to the large distances between them and the presence of other appropriate habitats at a similar distance, it should not be expected that a large number of birds displaced from the BC-Wind OWF area would relocate to the Baltic Coastal Waters site (PLB990002). Therefore, it is unlikely that negative impacts of the OWF related to the increase in bird density will occur for the Baltic Coastal Waters site (PLB990002), especially since the abundance of avifauna in the BC-Wind OWF area was low. In consequence, the negative impact on the Baltic Coastal Waters site (PLB990002) associated with scaring birds away and their displacement from habitats can be excluded.

In summary, no significant, negative impacts of the BC-Wind OWF, resulting in the displacement of bird species subject to protection within the Baltic Coastal Waters site (PLB990002) from their habitats, are expected.

Summary of the main assessment

As a result of the main assessment of the impact of the BC-Wind OWF on bird species that are subjects of protection within the Słupsk Bank (PLC990001) and Baltic Coastal Waters (PLB990002) sites, as well as on the integrity of the Baltic Coastal Waters site (PLB990002) and the coherence of the Natura 2000 network, it can be concluded that the planned project, both in the WWR 2024 and the RAV 2024, will not cause any significant impacts on the analysed Natura 2000 sites.

9.5.2. Environmental corridors

An ecological corridor, according to the Nature Conservation Act of 16 April 2004 (Journal of Laws of 2016, item 2134, as amended), is an area allowing the migration of plants, animals or fungi. The network of ecological corridors connecting the European ecological network Natura 2000 in Poland was developed in 2011⁶³³ – no ecological corridors were identified in the PMA. There are regular migrations of birds in the Baltic Sea area during spring and autumn, but the migration tactics and routes are very poorly understood.

The largest proportion of seabirds in the grouping during spring and autumn migration was the European herring gull. It is likely that such a large presence of this species was due to the intensification of fishing done by fishing boats in the area, as such high concentrations of gulls in the open sea are determined by fishing activity. The fact that fish are more abundant coincides with the high proportion of ichthyophagous fish (the razorbill, the guillemot) in the aforementioned phenological periods.

In the case of the analysed sea duck species, i.e. the long-tailed duck, the velvet scoter and the common scoter, the increase in the number of individuals flying over during the spring and autumn period did not result in an increase in the number of individuals found on the water in the area of the planned BC-Wind OWF. Moreover, a total of 14 individuals of the long-tailed duck, 9 individuals of the common scoter and 2 individuals of the velvet scoter were recorded during the survey campaigns in the aforementioned phenological periods. Thus, it can be concluded with certainty that the area of the planned BC-Wind OWF does not constitute good feeding grounds for benthophaguses.

Taking into account the lack of information on the occurrence, functioning and importance of ecological corridors in maritime areas, it was precautionarily assumed that the value of this resource is average. Taking into account the spatial scale of the area of the BC-Wind OWF in relation to the size of the Baltic marine area, including the increasing effect of spatial development, it was assessed that the impact of the BC-Wind OWF during the construction phase on potential migration routes of migrating species will be negligible.

However, this issue will be subject to monitoring once the farm is operational, as described in more detail in Chapters 15 and 16.

⁶³³ Jędrzejewski W., Nowak S., Stachura K., Skierczyński M., Mysłajek R.W., Niedziałkowski K., Jędrzejewska B., Wójcik J.M., Zalewska H., Pilot M., Górny M., Kurek R.T., Ślusarczyk R., *Projekt korytarzy ekologicznych łączących Europejską Sieć Natura 2000 w Polsce. Zakład Badań Ssaków PAN, Białowieża 2011*

9.5.3. Biodiversity

Construction phase

Phytobenthos

No impacts shall occur as phytobenthos is absent in the area of the OWF before the beginning of the implementation of the project.

Macrozoobenthos

The impact of the project that has the most negative character which may cause a change in the biodiversity of macrozoobenthos in the area of the BC-Wind OWF is the disturbance of the structure of seabed sediment. Physical destruction of the macrozoobenthos complex in the area of foundation and/or supporting structure installation and along the cable routes within the OWF area will occur on no more than 3.3% of the BC-Wind OWF Development Area. This will not result in a significant change in the quality structure of soft-bottom macrozoobenthos communities, consisting of taxa typical and common for the medium deep seabed and the open waters of the Southern Baltic (up to the depth of 60 m b. s. l.).

Ichthyofauna

Impacts occurring during the construction phase may reduce the diversity of ichthyofauna through the deterrence of fish caused by noise. Fish may react to an increased level of noise by leaving the affected area (avoidance reaction).^{634, 635, 636} Avoidance reaction will be stronger in the case of clupeids and cod, but it will probably affect flatfish to a lesser extent due to the absence of the swim bladder and the associated low sensitivity to noise impact. An increased concentration of suspended solids may cause a similar avoidance reaction and a periodic reduction in diversity. Similarly, as in the case of noise emissions, the impact effect will be negligible in relation to demersal fish species (flatfish, common seasnail, gobies). However, in the case of the last two species, their reproduction may be restricted due to demersal spawn being covered by the sediment from the water depth. A local decrease in diversity may occur throughout the construction period.

Marine mammals

In the area of the BC-Wind OWF and in the neighbouring marine areas, there are three species of marine mammals: the harbour porpoise, the grey seal, and the harbour seal. Thanks to the application of noise mitigating measures in the form of an NRS, the construction of the BC-Wind OWF shall have no impact on this relatively low biodiversity, with the assumption that there will be no more than two simultaneous pilings in the BC-Wind OWF area and/or in the area of another planned OWF.

Seabirds

The analysis of the possible impacts resulting from the construction works conducted during the OWF construction phase indicates that their effects will be mostly temporary and local. This applies to all types of emissions (noise, suspended solids, and the release of nutrients from the sediments).

As a result of the construction works, a temporary change in the structure of the species may occur in the BC-Wind OWF Area and its immediate vicinity. In the case of seabirds from the OWF area, the most sensitive species will be displaced already in the construction phase, and the abundance of sea ducks will gradually decrease. An increase in the number of gulls and cormorants is expected, since they use the structures protruding from the water as their resting places. Therefore, it cannot be said

⁶³⁴ Nedwell J., Langworthy J., Howell D., *Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms, and comparison with background noise. Report No. 544 R 04. Report commissioned by COWRIE. Subacoustech Ltd, Southampton 2003*

⁶³⁵ Mojski J.E. (red.), *Atlas geologiczny południowego Bałtyku – 1:500 000. Wydawnictwo Kartograficzne Polskiej Agencji Ekologicznej, Sopot-Warszawa 1995*

⁶³⁶ Aarts G., Brasseur S., Kirkwood R., *Behavioural response of grey seals to pile driving. Wageningen Marine Research report C006/18. Wageningen Marine Research, Den Helder 2018*

that the bird biodiversity will remain intact. It should be emphasised that this change applies to the location in which the OWF will be constructed and its immediate surroundings. After the completion of the OWF construction phase and the commissioning of the wind turbines, some of the birds from the species more sensitive to the impact of wind farms (razorbills, sea ducks) may abandon the OWF area and move to neighbouring feeding grounds. Less sensitive species will remain unaffected and some species (the European herring gull, the great black cormorant), may increase their abundance at the OWF. The loss of zoobenthos in the amounts negligible from the point of view of food resources for the seabirds will not result in the disturbance of food relations, which will not disrupt the existing balance and will not lead to a permanent elimination of species.

The fragmentation of the sea habitat in which the populations permanently or temporarily associated with the BC-Wind OWF Area and the adjacent sea areas could be isolated, will not occur.

In summary, the impact of the discussed project on biodiversity can be considered as low due to the local range of this impact, limited to the area occupied by the OWF – including the surrounding buffer zone with a width of 2-4 km.

Exploitation phase

Phytobenthos and macrozoobenthos

During the exploitation phase of the BC-Wind OWF, structures permanently submerged in water will be founded in the environment, creating favourable conditions for the development of animal and plant periphyton organisms. On a local scale, within the structural elements area, there will be an increase in species diversity, although the character of ecological quality of this habitat may be ambiguous. This results from the fact that, on the one hand, periphyton complexes will be a new biocenosis component of this area, additionally increasing the food supply for fish, birds and, incidentally, for marine mammals. On the other hand, this location may facilitate the spread of foreign species, which lowers the ecological quality of this microhabitat.

Ichthyofauna

The artificial reef effect present during the exploitation phase will probably result in an increase in biodiversity due to the appearance of a new habitat providing favourable conditions for the existence and reproduction of many fish species. The results of surveys on the long-term impact of the Horns Rev 1 OWF on the abundance and taxonomic composition of fish have shown that the artificial reef effect was significant enough to cause an increase in the number of fish that prefer a hard substrate and, at the same time, too small to cause a decrease in the number of fish that prefer a sandy substrate.

Possible limiting or ceasing of fishing in the OWF area due to legal regulations or navigation problems may have a positive impact on diversity. The impact of the artificial reef effect will probably be only local, and will not increase biodiversity in a larger area.

Marine mammals

The BC-Wind OWF exploitation phase shall have no negative impact on the biodiversity of marine mammals in the survey area and the neighbouring waters. Moreover, the reef effect may contribute to the increase in the abundance of fish inhabiting the survey area, and, in consequence, in the abundance of marine mammals as well.

Seabirds

The analysis of the possible impacts resulting from the exploitation of the OWF indicates that their effects in terms of changes in the biodiversity of seabirds will be of a local character.

This will involve a potentially increased mortality as a result of collisions with wind turbines or vessels. The highest mortality is recorded in the case of wind farms located within feeding grounds and along regular flight routes. The risk of collision depends also on the bird species. Large species of

waterbirds, such as swans, are at higher risk of collision with wind turbines due to the difficulty in making sudden manoeuvres in the air.⁶³⁷

Moreover, a different hazard identified in connection with biodiversity is the disturbance and displacement of some of the seabirds residing in the marine area occupied by a power station and the adjacent strip of water with a width of approx. 2 km or even 4 km. The degree and area of bird displacement from this sea area and its surroundings shall depend on the bird species. In the exploitation phase, this will cause an indirect, negative and local impact on seabirds. This impact is dependent on the number of operating wind turbines and electrical substations, as well as the number of vessels used for their servicing. Light and noise emissions constitute another bird-scaring factor. During the first season of operation, birds will gradually become acclimated to the situation in which the marine area designated for the project becomes inaccessible to them (the so-called habituation), which will result in changes in their distribution. Therefore, this period can be treated as a transitional one, and only in the second year after the completion of the construction of the entire project, the scale of the impact of the BC-Wind OWF on the seabirds residing in this area will stabilise. However, habituation shall not make the birds return to the area occupied by the OWF.

The barrier created by the BC-Wind OWF applies mainly to the migratory birds. However, some of the seabirds migrating across the OWF area may fly to the nearby Natura 2000 sites, where they can find their stopover, wintering or breeding grounds. The creation of a uniform barrier in this area may also impede the movement of these populations between the nearest similar wintering grounds, such as the Słupsk Bank, the Middle Bank and Hoburgs Bank. Currently, there is no scientific data available on the significance of the links between these sites, however, in line with the precautionary principle, they cannot be excluded. The scale of the barrier effect shall depend on the number of the wind turbines, as well as their size. A distinct avoidance by the seabirds of the area occupied by wind turbines and a decrease in the seabird abundance in the area surrounding the turbines is observed, e.g., for the long-tailed duck at a radius of up to 2 or even 4 km.^{638, 639, 640} Gulls and cormorants are an exception, since they often use the structures protruding above the water as their resting places, thus their abundance may even increase. This impact can be important for the seabird species sensitive to it, which may negatively affect biodiversity in the area of the OWF.

In summary, the impact of the exploitation phase of the BC-Wind OWF on the biodiversity of seabirds coincides largely with the effect of the loss of their habitats.

Decommissioning phase

Phytobenthos and macrozoobenthos

Due to the decommissioning of the underwater structures of the OWF, the macrozoobenthos complex that recolonised the seabed around the foundations and along the cable routes in the exploitation phase will be destroyed, which may result in the deterioration of the qualitative and quantitative structures of this group of organisms. However, the local range of this impact should not affect the biodiversity of the macrozoobenthos complex inhabiting the entire seabed area of the BC-Wind OWF. The removal of the artificial substrates will have a greater negative impact on the biodiversity (habitat and taxonomic), as well as the local reduction of benthos resources constituting a new food supply for fish and seabirds in terms of plant and animal periphyton complexes which will have grown

⁶³⁷ Brown M.J., Linton E., Rees E.C., *Causes of mortality among wild swans in Britain. Wildfowl* 1992, 43: 70-79

⁶³⁸ BSH, *Bundesamt für Seeschifffahrt und Hydrographie, Standard – Investigation of the Impact of Offshore Wind Turbines on the Marine Environment (StUK 4). Hamburg* 2013

⁶³⁹ Leopold M.F., Dijkman E.M., Teal L., OWEZ-Team, *Local Birds in and around the Offshore Wind Farm Egmond aan Zee (OWEZ). Report No. C187/11. Wageningen UR IMARES (Institute for Marine Resources & Ecosystem Studies), 2011*

⁶⁴⁰ Otremba Z., Jakubowska M., Urban-Malinga B., Andruliewicz E., *Potential effects of electrical energy transmission – the case study from the Polish Marine Areas (southern Baltic Sea). Oceanological and Hydrobiological Studies* 2019, 48 (2): 196-208

on these structures during the approx. 30 to 35 years of the operation of the OWF.⁶⁴¹ On the other hand, the original natural state of the seabed habitats in the area of the OWF will be restored.

Ichthyofauna

Works associated with the decommissioning of the OWF may have a negative impact on the diversity of the species, and the nature of this impact should be similar to the one observed during the construction phase. After the decommissioning phase, ichthyocenosis can be expected to return to the original state.

Marine mammals

Taking into account all available information and data, it is assumed that the decommissioning phase will have no negative impact on the biodiversity of marine mammals in the survey area and in the neighbouring waters.

Seabirds

The analysis of the possible impacts resulting from decommissioning works conducted in the decommissioning phase of the OWF indicates that their effects will be short-term, local and reversible. This applies to all types of emissions (noise, suspended solids and the release of nutrients from the sediment). The intensity of environmental impact will decrease as the distance from their source increases. Mobile species (fish, marine mammals, birds) will avoid the space in which they encounter a deterioration in their optimum conditions. Due to the time-limited animal-scaring effect for these species and the large volume of space in the marine environment, once the emissions cease and the previous habitat conditions are restored, the species (fish, marine mammals) will return to the area from which they were displaced, or they will use adjacent areas. Decommissioning works will result in the restoration of the previous conditions in the habitat, modified due to the construction of the OWF. Therefore, the restoration of the qualitative and quantitative structure of zoobenthos to the pre-project condition is expected.

As a result of the implementation of the project, the fragmentation of the sea habitat in which populations permanently or temporarily associated with the BC-Wind OWF Area and the adjacent sea areas could be isolated, will not occur.

As a result of the conducted construction works, no direct or indirect destruction of benthic and pelagic habitats will occur, which could, in consequence, lead to the extinction of the species living there. Also, as a result of the performed works, no physical barriers which the marine organisms would be unable to overcome will be created.

Taking the above into account, it can be stated that the decommissioning phase of the OWF may lead to a short-term change in the number of species residing in the development area. Individual species may be temporarily scared off to adjacent areas, where they will not be exposed to disturbances. However, such movement of individuals does not entail a change in biodiversity at the species level. The performed operations will also not lead to changes at the level of ecosystem and genetic diversity.

The impact significance of the discussed project on biodiversity can be considered as low.

9.6. IMPACT ON UNDERWATER CULTURAL HERITAGE

9.6.1. Construction phase

This assessment was carried out on the basis of the results of geological reconnaissance and geophysical surveys of the seabed in the implementation area, which are included in Appendix 1 of this EIA Report (Volume III).

⁶⁴¹ Petersen I.K., Christensen T.K., Kahlet J., Desholm M., Fox A.D., *Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. Report request. Commissioned by DONG energy and Vattenfall A/S. National Environmental Research Institute, Ministry of the Environment, 2006*

The probability of the presence of Stone Age settlement remains in the area of the planned project was assessed. The implementation of the BC-Wind OWF may cause the following types of impacts on hitherto unrecognised objects, which may be discovered and identified, and which may be important for the protection of cultural heritage (archaeological relics dating to the Stone Age):

- damage or complete destruction of archaeological relics by ship anchors;
- damage or complete destruction of archaeological relics during the piling of foundations and the laying of cables;
- ground settlement;
- exposure of archaeological sites;
- settling of disturbed sediment;
- discovery of new objects (positive nature).

During the course of the construction works, new, previously unidentified archaeological sites, objects or artefacts may be discovered, which, due to the lack of knowledge of their existence at this stage, are not considered in the impact assessment presented in this EIA Report. Archaeological monitoring will be conducted during the construction phase, as further described in Chapter 15.

Based on the performed analysis, it was considered that the significance of the impact of the development of the project on prehistoric Stone Age archaeological relics would range from negligible to unimportant.

It was concluded that all potential impacts of the BC-Wind OWF on possible Stone Age relics would be of negligible significance, with the exception of the impact associated with the installation of pile foundations, which was determined to be of low significance. The results of the assessment showed that the BC-Wind OWF project will not have a significant negative impact on heritage assets in the WWR 2024 during the construction phase.

When considering the problem of the presence of Stone Age relics (mainly remains of Late Palaeolithic and Mesolithic settlements) in the area of the planned project, it must be taken into account that the relevant area that was potentially inhabited by Stone Age communities has been irreversibly transformed or destroyed by natural factors. Its identification is not only impossible from the perspective of conventional terrestrial archaeology, but is also extremely complex from the perspective of underwater archaeology methodology.

The scale of the palaeo-landscape transformation from the turn of the Pleistocene and Holocene is confirmed by the results of geophysical surveys carried out in the area of the BC-Wind OWF. Their dynamics led to a complete erosion of the strata, which could contain relics related to human settlement in the area in the mentioned period, i.e. at the end of the Pleistocene and in the early Holocene. Consequently, the chances of accidentally encountering remains of Stone Age relics during the construction phase must be considered to be close to zero in this area.

Although the current state of knowledge on the history of settlement of Pomerania in the Stone Age does not exclude the possibility of the existence of settlements in the Late Palaeolithic and Mesolithic in the areas overlapping with the project area, the possibility of observing and identifying these relics is much more complicated:

- Stone Age archaeological sites (so-called flintstones);
- anthropogenic ground structures;
- individual stone and organic artefacts.

Even if the listed relics potentially exist as a component of the bottom sediments in the BC-Wind OWF area, the possibility of capturing and locating them is extremely low. Furthermore, the Inventory of Underwater Archaeological Sites does not contain information on any Stone Age undersea archaeological sites located in the area of the proposed project.

6 wrecks were identified in the area of the planned project (Appendix 1 to the Report, Volume III), shown by Fig. 7.19. All identified wrecks are located outside the boundaries of the BC-Wind OWF and have been reported to the relevant authorities. Two of the wrecks had been found previously and their positions are included on nautical charts. Wrecks SS001 and SS099 have been reviewed by the Director of the National Maritime Museum in Gdańsk. Three others, i.e. SS070, SS059 and SS066, do not constitute cultural heritage according to information from SIPAM, while the sixth object, SS086, requires verification (no information in SIPAM).

The SS099 wreck is located the closest to the BC-Wind OWF, approx. 314 m east of the boundaries of the planned project. A conservation zone has been set around the wreck, i.e. 25 m from the contour line of the wreck. The historical wreck of SS001 is located ca. 3.1 km to the west of the planned project boundaries. Due to the distance from the planned OWF, no significant impacts on the above wrecks under conservation protection are expected. In order to protect the aforementioned objects, the Investor assumes a precautionary limitation of seabed disturbance activities (installations, anchoring, foundations) within 100 m from the reported wrecks.

In summary, the planned BC-Wind OWF project will not have a negative impact on potential objects of great significance for the protection of cultural heritage from the Stone Age and on the wrecks identified in its vicinity. Surveys carried out in the area in question have not revealed any archaeological sites or strata associated with Stone Age settlement.

9.6.2. Exploitation phase

No negative impacts on cultural heritage are expected during the exploitation phase. The operation of the OWF is a virtually maintenance-free process, limited to conservation and maintenance works. Due to the fact that no risk of impact on objects of significant importance for the protection of the cultural heritage from the Stone Age and wrecks has been identified in the BC-Wind OWF Area, there is no justification for indicating monitoring activities in this respect. Due to the nature of the performed works, impacts during the exploitation phase will be **negligible**.

9.6.3. Decommissioning phase

The presence of anthropogenic objects was recorded in the BC-Wind OWF Area. As of the date of submission of the EIA Report, there is no confirmation that these structures are of cultural value, nor have they been entered into the register of monuments. There are no archaeological sites either.

If it is found that anthropogenic objects present in the BC-Wind OWF area are of cultural value or are monuments, the significance of the impact is assessed to be negligible. This assessment is the result of the assumption that a zone will be designated around the structures in which no activities resulting in the disturbance of the seabed will be carried out.

9.7. IMPACT ON THE LANDSCAPE

9.7.1. Construction phase

The following potential impacts of the project on the landscape, including cultural landscape, were identified for the construction phase of the planned OWF:

- vessel traffic, conducted primarily by construction contractors, as well as associated with surveys, surveillance and other work;
- transport of OWF structural components, including large ones;
- offshore structures under construction, such as offshore wind farms (SHPPs), substations, platforms, and others.

The impact on the landscape will be objective, changing its character from natural to anthropogenic, but also subjective, depending on the individual characteristics of the recipient, and can be perceived as both negative and positive, as well as indifferent.

The impact of the OWF on the landscape during the construction phase is dependent on:

- construction-related vessel traffic, the size of the structures to be transported;
- the size of the structure, the diameter of the rotor and its positioning in relation to the viewer;
- the number and location of SHPPs and facilities;
- meteorological conditions and the state of the sea;
- the location of the observer of the landscape.

People not directly related to the OWF are in the area occasionally and for short periods. These include workers on ships, passengers on tourist ferries and deep-sea fishermen and anglers, tourists on recreational vessels, participants in search and rescue operations, those flying over the sea in planes, scientists, and others. For this group, the planned OWF will be the most visible. During construction, this group will expand to include workers on the OWF construction vessels. Impacts on the landscape will be short-term, temporary, dependent on how long the observer sees the OWF construction and the components being transported.

During the construction phase, the landscape will be altered not only at sea, but also in the ports where offshore structures will be built. Impacts on the landscape in this respect will be short-term, temporary, and will primarily take place in the industrial port areas, depending on the location of the production area more or less visible to the casual observer; these will be medium and large Baltic ports. The landscape of the port-industrial areas is transformed, there are many objects and constructions changing the landscape into an industrial, anthropogenic one; they may partially or even completely obscure the observer's view of the constructions implemented for the OWF.

Offshore structures can be implemented successively, in phases. It is envisaged that the construction phase of the OWF may take 2 to 3 years – a maximum of 5 years. Offshore structures, including blade tips, will be appropriately painted and marked, and illuminated at night to ensure maritime and aviation safety.

The impact of the construction phase was determined to be negligible, although this varies depending on the distance of the observer from the OWF and the type of impacted landscape. In the open sea, the landscape is not immune to disturbance, but its value there is not high, as very few people, and in the short term, will be exposed to the change in the landscape, and some of them (e.g. tourists) may perceive it as beneficial or interesting. The spatial extent of the impact will be large, decreasing with distance from the OWF. There will be periodic increases in vessel traffic, and in the ports, the impact will be localised.

9.7.2. Exploitation phase

The following potential impacts of the project on the landscape, including cultural landscape, were identified for the exploitation phase of the OWF:

- changes in the landscape as a result of the presence of offshore structures, such as wind power stations and export stations;
- the movement of vessels for the purposes of the operation of the OWF.

The offshore structures will operate in the open sea for approx. 35 years.

The impact of the OWF on the landscape during the phase of operation is dependent on:

- the size of the structure, the diameter of the rotor and its positioning in relation to the viewer;
- the number and location of SHPPs and facilities;
- vessel traffic associated with the operation of the OWF;
- meteorological conditions and the state of the sea;
- the location of the observer of the landscape.

People not directly related to the OWF stay in the area of the OWF sporadically and temporarily. In the phase of its operation, there will be workers on ships servicing the OWF, as well as passengers on tourist ferries and deep-sea fishermen and anglers, tourists on recreational ships, participants in

search and rescue operations, people flying over the sea in planes, and scientists. For these groups, the planned OWF will be most visible. Impacts on the landscape will be long-lasting, for approx. 35 years, but temporary, as decommissioning of the OWF is anticipated after its operation.

During this phase it is important how long the observer will see the OWF. It is anticipated that the people mentioned above will be in the area from which the OWF can best be seen, sporadically, some on a one-off basis.

In the visualisation of the view of the BC-Wind OWF included in Appendix 5 to this Report (Volume III) performed for the landscape impact analysis, 41 offshore structures were assumed. Currently, the Investor is planning to place a maximum of 39 wind turbines (and a minimum of 34), which will not be significant for the landscape impact assessment performed in 2021. The visibility analysis of the BC-Wind OWF is presented below.

Meteorological conditions, specifically visibility understood as the weather-dependent range of seeing and distinguishing objects, are the primary factor that will determine whether or not wind turbines will be seen from shore. Fig. 9.23 shows the number of hours per year for a given visibility (how often the visibility is greater than a specific value) based on data from the UMPL atmospheric model (calculated at ICM UW – data from about 5 years). These values are shown for 4 locations - Łeba, Lubiatoń, Dębki and Jastrzębia Góra. The charts clearly show that in the case of Łeba, the OWF will not be visible from this location. In the case of Lubiatoń and Dębki, individual wind turbines may be visible up to 6000 hours per year, but 100% of the wind turbines installed in the BC-Wind OWF may be visible up to 1000 hours per year. In the case of Jastrzębia Góra, individual wind turbines may be visible for more than 4000 hours per year, but all wind turbines installed in the BC-Wind OWF may be visible for up to several hundred hours per year.

In addition, a limitation associated with the visibility of wind turbines from land is the curvature of the Earth and the associated limitation on the height of objects that can be seen from a distance. In practical terms, this limitation manifests itself in the fact that the further away from the observer the SHPPs are, the smaller proportion of them will be seen. However, the planned structures are large enough that the number of power plants/structures seen will be influenced by atmospheric visibility rather than the curvature of the Earth. Fig. 9.24 and Fig 9.25 show visualisations of the view of the BC-Wind OWF from Białogóra and Dębki. Larger scale visualisations are shown in Appendix 5 of the EIA Report.

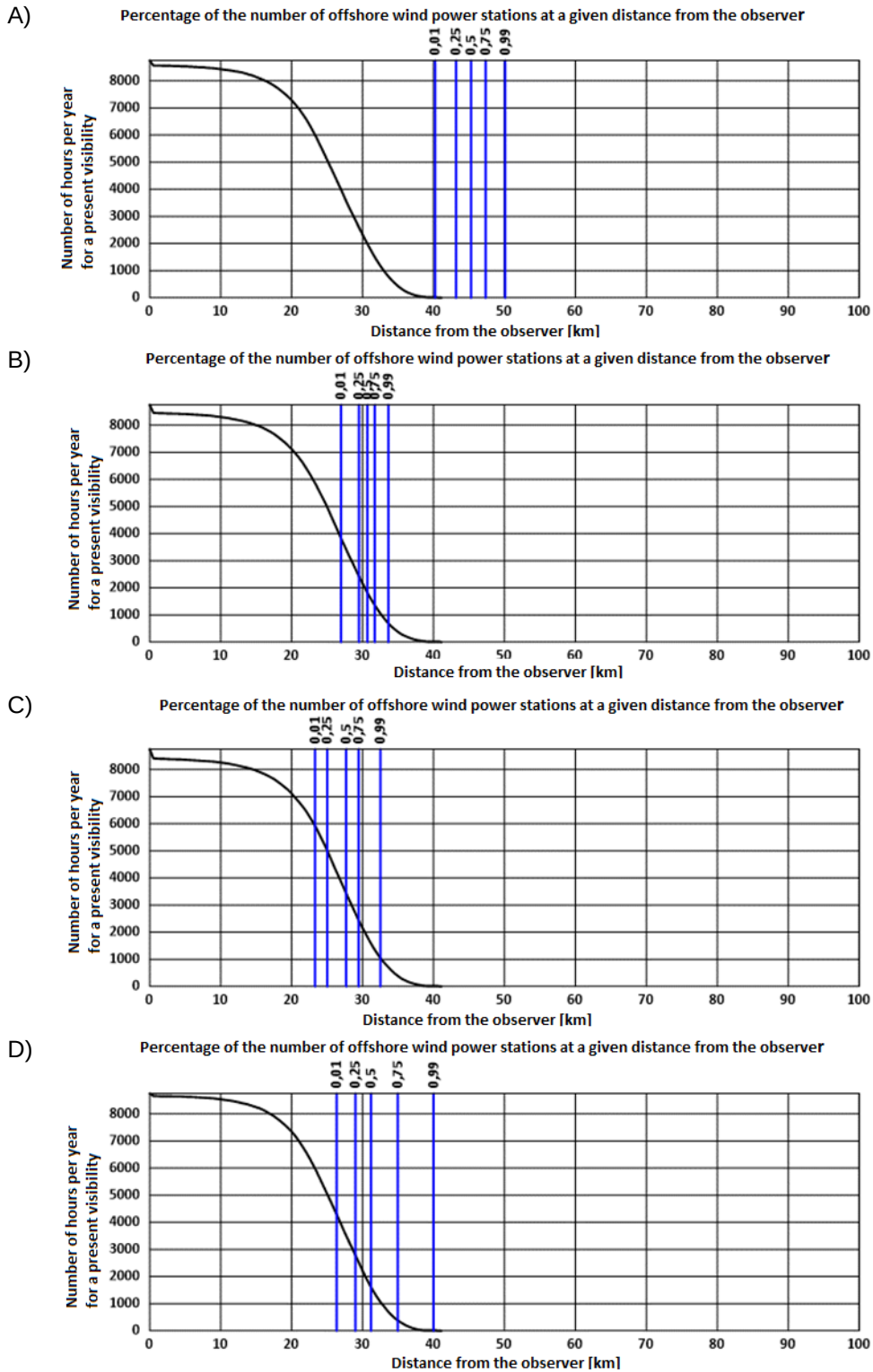


Fig. 9.23. Number of hours per year for a given visibility (distance from the observer) with marked distances of offshore wind turbines in the variant proposed by the Investor (assumed total number of offshore wind turbines and other large-scale structures – 41)

Diagram A – Łeba, B – Lubiatowo, C – Dębki, D – Jastrzębia Góra

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 280



Fig. 9.24. Visualisation of the view of the BC-Wind OWF from Białogóra (summer season)

Source: Appendix 5 to the BC-Wind EIA Report (Volume III)



Fig. 9.25. Visualisation of the view of the BC-Wind OWF from Dębki (autumn season)

Source: Appendix 5 to the BC-Wind EIA Report (Volume III)

For the WWR 2024, the maximum height of the SHPP may be 300 m, and the maximum rotor diameter – 25 m. Both parameters are smaller than those adopted for the APV 2021, but for an observer, for example on a ship, this will not be a noticeable, significant difference. Also, due to the distance of approximately 22.6 km from land, a height of a few tens of metres will not be noted as making a difference.

From land, the highest parts of the OWF structure will be visible at the horizon line when weather conditions are favourable, i.e. with very good visibility. On most days of the year, the OWF will be practically invisible. Within the range of the potential impact zone of the OWF on the landscape is the land area from Łeba in the west to Jastrzębia Góra in the east. Whether the OWF will be visible to people on land depends on the place from which they observe the sea. For those on the beach, the OWF will be less visible than for those at a higher altitude on the coast, at locations such as Rowy, the Człopino lighthouse, dunes in the Słowiński National Park, Łeba, the Stilo lighthouse and Jastrzębia Góra. For each of the observers on land, the OWF will, with good visibility, be located at the horizon line (Fig. 9.24, Fig 9.25). The operational OWF will also not adversely affect onshore forms of nature conservation.

During the exploitation phase of the BC-Wind OWF, which will be located approx. 22.6 km from the shore, there will be no impacts occurring on land, such as the rotor blade rotation effect, flickering light or noise, as these only occur close to the operating structures, and their extent will not reach land. The offshore structures will be painted and marked, and illuminated at night due to the need for maritime and aviation safety.

The significance of the impact was assessed as negligible, although it varies depending on the distance of the observer from the OWF. In the open sea, the landscape is not immune to disturbance, but the value is not high there as very few people, and in the short term, will be exposed to the change in the landscape, and some of them (e.g. tourists) may perceive it as beneficial or interesting. The scale of the impact will be large in spatial extent, and it will decrease with distance from the OWF. It will be a long-term change, but reversible. Onshore, the upper parts of the OWF may be sporadically discernible (Fig. 9.24, Fig 9.25).

A visualisation of the view of the BC-Wind OWF is provided in Appendix 5 of the EIA Report (Volume III).

9.7.3 Decommissioning phase

The impact of the OWF on the landscape in the BC-Wind OWF decommissioning phase will be similar to the impacts in the construction phase, but the order will be reversed. First, the structures and systems will be dismantled, then they will be collected by vessels and transported ashore. Impacts on the landscape during this phase will decrease as the decommissioning works progress.

Depending on the adopted foundation technology, it may be necessary to leave parts of the structures underwater, e.g. due to the fact that they will form an artificial reef. In this case, they will be properly secured and marked for safety reasons. After the completion of the decommissioning of the OWF, the landscape on the sea surface within the OWF area will return to the condition it was in before the implementation of the project, whereas there may be a permanent change in the underwater landscape, which will be available only to divers or underwater vehicles equipped with cameras for ongoing observation or subsequent restoration. Such places may also become tourist attractions.

The significance of the impact of the BC-Wind OWF on the landscape, including cultural landscape, was assessed to be negligible for the decommissioning stage.

9.8. IMPACT ON CLIMATIC CONDITIONS AND AIR QUALITY

9.8.1 Construction phase

As part of the identification of the project's impacts on meteorological conditions, annual meteorological measurements including wind, pressure, humidity and air temperature were analysed, and available literature on air quality and climatic conditions for the Baltic Sea was reviewed.

In the construction phase of the BC-Wind OWF, increased emissions of pollutants introduced into the atmosphere (including greenhouse gases) can be expected, which will be connected with increased traffic of vessels involved in the execution of the investment. Estimation of the amount of this emission to the atmosphere at the present stage is difficult, as the number of working hours of individual vessels cannot be determined. At this stage, it is estimated that there will be approx. 7 transport units at the stage of the transport of turbines, towers and foundations, and approx. 10 installation vessels, including auxiliary vessels. Only the detailed design will determine the exact number and type and duration of specialist vessels to be used. It has been assumed that only vessels meeting national and international emission standards will be used.

Assuming a 48.91% capacity utilisation and 35 years of operation, a 500 MW OWF could produce 84.98 TWh or 302.4 PJ of electricity, which would make it possible to avoid emissions of over 57 million tonnes of CO₂, over 40 thousand tonnes of SO₂, approx. 40 thousand tonnes of nitrogen oxides and approx. 1.7 thousand tonnes of dust. The larger of the quoted values applies if gravity foundations with a high proportion of cement will be used in the construction (the Investor has ruled out the possibility of this type of foundation at this stage). Even in this case, the emissions will be at least 10 times lower than those associated with the production of electricity from other sources based on hard coal or lignite (expected emission reductions are more than 20 million Mg CO₂ – not including the emissions associated with the construction of these sources).

During the construction phase, the significance of the impact of the planned project on the climate and greenhouse gases will be negligible, as there will be no factors that could have a noticeable effect on their change.

The impact during the construction phase of the proposed project on air quality will be temporary and will disappear once the works have ceased. Furthermore, due to the open area without obstructions, potential pollution will quickly dissipate. Therefore, the significance of the impact will be negligible.

9.8.2. Exploitation phase

Wind turbines will locally reduce wind energy and disturb atmospheric pressure directly in the area of rotor operation. Power plant towers may locally disturb water velocities and flow directions and suppress wave energy, as manifested by a decrease in wave height.

Due to the significant distance of the BC-Wind OWF Area from the shore and other potential sources of pollution emissions, it should be assumed that the state of air purity within the area will correspond to the A class. Due to the fact that the emissions generated during the operation of the OWF will be minimal (coming mainly from the emergency generators installed on the substations – if they are installed, and from air-conditioning devices, and to a small extent, from servicing units), it can be practically assumed that there will be no emissions of dust pollutants, and only slight emissions of gaseous pollutants, including carbon dioxide, which is a greenhouse gas. Hence, no deterioration of air purity and no downgrading of air quality is expected.

The planned investment will have both negative and positive impacts on the climate during the exploitation phase. The negative impacts are related to the emission of greenhouse gases due to fuel combustion by service vessels. The positive impact on climate will be the generation of electricity by the BC-Wind OWF from a renewable source at the level of 500 MW, which, with the carbon dioxide emissions of the old-type conventional power industry remaining at the level of 900-960 kg CO₂ per 1 MWh, will allow for a noticeable reduction in the emissions of this gas in the country.

According to the findings of the GP WIND project⁶⁴², the production of electricity from offshore wind farms is associated with emissions of between 6 and 34 kg CO₂ per MWh in all phases of their lifecycle, which, with an expected production of 55.85 TWh over 35 years of operation, means emissions of between 0.48 and 2.60 million Mg CO₂.

During the exploitation phase, there will be a slight increase in local greenhouse gas emissions due to fuel combustion by the service vessels operating the OWF, but their impact will be offset by a reduction in emissions in wind generation.

Climatic conditions in the southern Baltic Sea area related to weather phenomena (mainly temperature, precipitation and wind) are subject to constant changes over the years, which, although related to global climate change, are generally of a regional character. Due to the fact that the predicted scope and scale of these changes over the period of several decades, for which the operation of the BC-Wind OWF is foreseen, is relatively small, the forecasted climatic changes in the Baltic Sea region will have a minor impact on the area of the designed OWF, as well as a minor impact on operating conditions and safety of the wind power plants. However, it should be taken into account that in order to ensure proper functioning of the OWF, it is necessary to take into account the possibility of occurrence of extreme weather conditions on a larger scale than currently observed, as well as the fact that the scope of their variability during the year and in individual years will increase, taking into account the expected trends of changes over several decades.

For areas of the open sea, the shortening and easing of the course of the ice seasons will have a positive impact on navigational conditions and the operation of offshore facilities.

The progressive eutrophication of marine waters may cause some difficulties in the exploitation of the designed OWF, especially in summer. An increase in temperature in winter may cause the disappearance of species typical of cold water and the appearance of species found in warmer waters.

During the exploitation phase, the direct and local impact of the planned project (associated with the use of vessels and their consumption of fuel) will not have a significant impact on the change of climatic conditions. Despite the long-term impact, its range will be local. On the other hand, the operation

⁶⁴² Gill A.B., Desender M., *Risk to Animals from Electromagnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices*, [in:] Copping A.E., Hemery L.G. (eds.), OES-Environmental. 2020 State of the Science Report. Environmental Effects of Marine Renewable Energy Development Around the World. Report for Ocean Energy Systems (OES), 2020: 87-103

of the OWF will indirectly result in the reduction of the emission of greenhouse gases to the atmosphere by other sources, e.g. coal power plants located in other regions of the country. Therefore, despite the high importance of climate and air quality and the small scale of the impact of the BC-Wind OWF in the variant selected for implementation at the stage of operation, it can be considered that the impact in terms of the emission of greenhouse gases to the atmosphere from ships will be negligible. The impact of the reduction of greenhouse gas emissions is positive, but difficult to estimate. This is due to the fact that the emission reduction will be attributed to a completely different space (location of an equivalent conventional fossil fuel power plant).

9.8.3. Decommissioning phase

In the decommissioning phase, the local impact of the planned project (related to the use of vessels and their consumption of fuel) will not have a significant impact on the change of climate conditions. On the other hand, the exploitation of the OWF indirectly causes a reduction of the emissions of greenhouse gases to the atmosphere by other sources, e.g. coal power plants located in other regions of the country. It is difficult to estimate how the decommissioning of offshore wind farms will affect the state of the climate.

9.9. ELECTROMAGNETIC FIELDS

9.9.1. Construction phase

The planned project will not be a source of electromagnetic field emissions during the construction phase.

9.9.2. Exploitation phase

The process of operating the OWF will be a multi-year undertaking. Offshore wind power plants will be connected with the offshore substation with internal power and teletechnical lines. It is assumed that the total length of the cable routes where the cables will be laid in the OWF area will not exceed 100 km.

Internal cables connecting wind turbines to the substation most often operate at 33/66 kV, which is the common standard for offshore wind power. The most commonly used cables are three-core cables, i.e. consisting of three insulated conductors (copper or aluminium). often also fitted with optoelectric cables. Single-core cables are also available. At the current stage of the project, the cable is assumed to be buried at an average depth of approx. 2-3 m below the seabed surface.

Cables buried in the seabed are optimised to emit a residual electric field. The possible magnetic component of an EMF is minimised by running individual conductors as close as possible (for individual phases for AC or flow directions for DC). In the case of DC cables, the range of EMF interactions is reduced the closer the individual conductors of the line are routed (there are virtually no interactions in a composite cable). In the case of AC, the use of a composite cable reduces the magnetic field, but it can remain at levels that generate an electric field in seawater. The remedy for this is to bury the cable in sediment, which in itself does not reduce the effects of EMF interactions, but by separating the cables from the seawater, makes the impact much smaller. According to measurement data of submarine cables, the emission of electromagnetic fields from submarine cables is negligibly small.⁶⁴³

The magnetic field from submarine power cables decreases rapidly with distance from the cable. Burying cables in the seabed significantly reduces the levels of magnetic fields and induced electric fields (iE) in seawater (Fig. 9.26). Cable burial at a depth of 2 m reduces the magnetic field at the bottom surface by about four times. When the cables are covered by a stone cover or a concrete mattress, the

⁶⁴³ Gill A.B., Hutchison Z. L., Desender M., *Electromagnetic fields (EMFs) from subsea power cables in the natural marine environment*, Royal Institution, London 2023

level of magnetic field reduction is less, and is comparable to that for a cable buried in the bottom at a distance of approx. 3 m from the cable axis.⁶⁴⁴

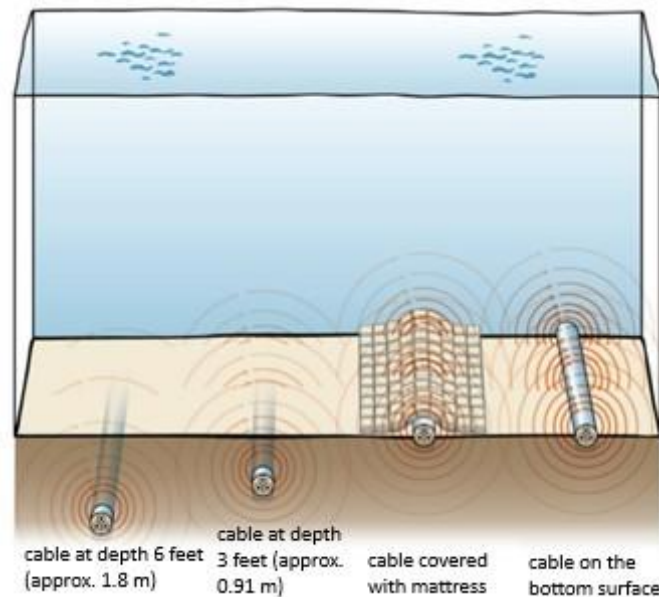


Fig. 9.26. Magnetic field range with different levels of cable burial

Source: *Environmental Studies 2020, Electromagnetic-Fields-Offshore-Wind-Facilities.pdf*

At the present, there are no unambiguous standards in Polish legislation establishing permissible values of magnetic field in the marine environment. Taking into account the values of the electromagnetic field generated by the cables and its spatial variability considered in model tests and in the literature, it should be stated that the emission volumes generated during the exploitation phase of the planned project will not affect abiotic elements of the marine environment. The impact of the planned project on abiotic elements of the marine environment, including the natural magnetic field, will be negligible.

9.9.3. Decommissioning phase

The planned project will not be a source of electromagnetic field emissions during the decommissioning phase.

9.10. THERMAL EFFECTS

9.10.1. Construction phase

The planned project will not be a source of heat emissions caused by power cables during the construction phase.

9.10.2. Exploitation phase

The electric current flowing through the cable during the exploitation phase will cause it to heat up, caused by the power loss across the electrical resistance, according to Joule's law. As the temperature of the cable rises above the ambient temperature, heat dissipation into the surrounding environment begins. Accurate quantification of the transferred heat is difficult, as there are the phenomena of heat conduction, heat dissipation and heat radiation, subject to different physical laws.⁶⁴⁵ The heating of sediments can lead to a change in the taxonomic composition of benthos living on and in the seabed, in the immediate vicinity of the cables.⁶⁴⁶ The minimum burial depth should be determined

⁶⁴⁴ *Environmental Studies, 2020*

⁶⁴⁵ *Rakowska A., Grabowski A., Stiller J., 2006*

⁶⁴⁶ *Regulation of the Minister of the Environment of 11 May 2015 on the recovery of waste outside installations and facilities*

by the type of sediment (its thermal conductivity) and the type of power network (size and type of loads, thermal characteristics).

9.10.3. Decommissioning phase

The planned project will not be a source of heat emissions caused by power cables during the decommissioning phase.

9.11. IMPACT ON MATERIAL ASSETS, FISHING USE OF WATER BODIES, AND MARITIME TRANSPORT

9.11.1. Construction phase

During the construction phase of the BC-Wind OWF, the area will be gradually and temporarily excluded from navigation, fishing, research and tourist cruises for safety reasons. Only the presence of vessels associated with the project will be allowed. The construction of the BC-Wind OWF will not interfere with the use of the MW P-18 and MW P-19 training grounds. The cultural heritage elements identified during the surveys should be protected by establishing exclusion zones at a distance of up to 100 m. Increased vessel traffic resulting from the construction of the OWF may mean difficulties for vessel traffic on the routes to the south and northeast of the OWF.

Restrictions resulting from the gradual removal of the BC-Wind OWF area from existing use will have the greatest impact on fisheries, including in terms of where to fish and the need to extend routes to fisheries located to the north of the BC-Wind OWF area. The impact on fisheries will be negative (resulting from the fact of restrictions) and direct (directly affecting the receptor). Furthermore, due to the assumed duration of the construction phase (2 to 3 years – a maximum 7 years), the impact will be long-term and local (limited to the area of the BC-Wind OWF development).

Taking into account the existing minor use of the BC-Wind OWF area for fishing activities and that the Investor does not plan to apply for a restriction of fishing in the area, it should be assumed that the significance of the impact of the BC-Wind OWF on fishing will be negligible. This impact will not significantly differ between the WWR 2024 and the RAV 2024.

9.11.2. Exploitation phase

During the exploitation phase, the area of the BC-Wind OWF will be excluded from regular shipping for safety reasons. The movement of other vessels (fishing, research and tourist vessels) may be allowed depending on the location of the wind power plants, under the conditions worked out with the Investors. Decisions on allowing vessels other than those supporting the OWF in the BC-Wind OWF area will be made by the maritime administration authorities.

The exclusion of the BC-Wind OWF area from free passage by fishing vessels may result in the lengthening of their routes to and from fishing grounds. However, taking into account the location of the BC-Wind OWF in relation to the shortest routes to fisheries in the Słupsk Channel area from ports in Władysławowo and Łeba, the extension of these routes may occur only after taking into account other areas of planned OWF. In no way will the exclusion from free passage through the BC-Wind OWF area affect fishermen from other ports, fishing in the Słupsk Channel area. This issue is presented in detail in Chapter 10.

As a result of the occupation of the offshore area by the BC-Wind OWF, the area may be excluded from fishing. The BC-Wind OWF area is located within two fishing squares, O8 and P8. The area is characterised by low fishing productivity, and its significance for fisheries is marginal. Consequently, the impact was assessed to be insignificant. This impact will not significantly differ between the WWR 2024 and the RAV 2024.

9.11.3. Decommissioning phase

Currently, the area of the BC-Wind OWF is not intensively used by other users (i.e. fishing, raw materials). Only along the northeastern boundary of the BC-Wind OWF is there ferry traffic. For these

reasons, the release of the area as a result of the decommissioning of the OWF will have little impact on the aforementioned elements. Therefore, the significance of this impact was assessed to be negligible.

9.12. IMPACT ON HUMAN HEALTH AND LIFE

9.12.1. Construction phase

During the construction phase of the OWF, the population will be affected to varying degrees in onshore and offshore areas. In port and shipyard areas, basic components of wind power plants will be stored and assembled: foundations or support structures, towers, nacelles together with rotors. Other sites will be used for the construction of substations, platforms for the infrastructure necessary for the proper functioning of the OWF. These will be manufactured for several years, using various technologies, and then transported to the site of the OWF on ships. The construction phase of the planned project will result in the creation of jobs for many people in the shipbuilding, electricity, electrical machinery and shipping industries. Large factories and ports in the Tricity area, as well as Świnoujście and Szczecin, will potentially be involved in the production and shipping of wind power components for the OWF. The offshore wind farm structures and equipment will be manufactured within the plants and port infrastructure located there, moreover, the components transported from other production plants may be transhipped there. In these centres, there will be impacts on the health and living conditions of the employees due to noise emissions, air pollution, sewage and waste. Smaller ports, such as Władysławowo, Łeba, Ustka, Darłowo, Kołobrzeg and Dziwnów, may also fulfil the role of service or rapid response ports in case of adaptation of the existing infrastructure, in which similar impacts on health and living conditions of employees, related to noise emissions, air pollution, sewage and waste will occur, but on a much smaller scale.

In marine areas, the multi-year construction phase of the OWF will result in significant changes to the shipping routes in the vicinity of the OWF and significant disruption to the navigation of all marine vessels due to the crossing of the main shipping routes of the southern Baltic Sea. This will cause an increased threat to the navigational safety of all types of vessels, including recreational vessels, and to the functioning of fisheries in this area of the sea. Construction of an OWF of the size of the BC-Wind OWF may require several dozen voyages of vessels of various sizes between the OWF and ports in the Gulf of Gdańsk (or other selected ports of construction), and ports in Łeba and Władysławowo. This will have a slight impact on shipping safety. During the construction period, fisheries will have to give up fishing in parts of the fishing squares of O8 and P8 in the areas affected by the construction works.

The current oil and gas production in fields B3 and B8 and the planned production from offshore gas fields B4 and B6 will not be disturbed due to the considerable distance in the amount of several tens of kilometres, separating these fields from the area of the BC-Wind OWF.

The construction process of the BC-Wind OWF will be a constraint for conducting emergency management and response activities at sea. This includes various types of emergency incidents and accidents involving vessels, conducting rescue operations, saving property or combating oil pollution.

In offshore areas, potential impacts on health conditions and human life will be related to the transport and installation of individual wind turbine structures, and possible collisions of vessels with SHPP structures.

In summary, the magnitude of the impact on the population, health and living conditions of people during the construction phase will be low, and by assessing the significance of the receptor as very high, it can be assumed that the significance of the impact will be moderate.

9.12.2. Exploitation phase

The commissioning and operation of subsequent SHPPs requires regular maintenance. During operation, planned inspections and interventions undertaken as a result of observed faulty operation will

include: SHPPs, foundations or support structures of the OWF, the substation, and submarine cables. These activities will be performed using, i.a.: specialised vessels, helicopters, service vessels, workboats and submersible vehicles. During the operation of the BC-Wind OWF, the number of voyages of the vessels servicing the OWF may amount to several dozen voyages per year. These vessels will travel mainly between the central coast ports and the OWF area. Possible voyages in the relation of Władysławowo – BC-Wind OWF – Władysławowo will be much fewer in number in the exploitation phase, in the amount of several dozen per year.

Regular maintenance of the OWF during the exploitation phase will perpetuate changes in seagoing vessel navigation. The intensity of ship traffic between the central coast service ports will be close to the maximum during the construction phase, which will adversely affect the risk of emergency events.

For safety reasons, the access to the area of the BC-Wind OWF may be restricted for fishing vessels and may mean, i.a., limited availability of the currently exploited fishing grounds and extension of the routes of fishing vessels from some ports to the fishing grounds located to the north of the BC-Wind OWF area. The scale of these impacts will affect several dozen fishing vessels, mainly from the ports of Łeba and Władysławowo.

A variant of marine fishing is recreational fishing, practised by both marine fishermen and fishing enthusiasts, as well as by owners of sport and recreational vessels. In these cases, it is a small group of people whose material situation will be worsened by the construction and exploitation of the BC-Wind OWF.

The standard of living of the inhabitants of coastal towns, municipalities and settlements depends to a large extent on the development of coastal tourism and recreation. In some communes, e.g. the town of Łeba, the income of the local government and inhabitants comes mostly from tourism services and qualified tourism and recreation. The tourism and recreation potential of this part of the Baltic coast is one of the highest in the country, and thousands of inhabitants provide a variety of services to visitors, mainly during the summer season, with a tendency to extend the holiday season.

Due to the long distance from the shore (approx. 23 km or more), the noise from the wind turbines and maintenance units will not reach the coastal zone. During most meteorological situations (wind, wave, cloud cover, humidity), the operation of the BC-Wind OWF will not be noticeable from beach or dune level. Only from higher vantage points and under suitable visibility conditions will it be possible to observe more power plants (tower and rotor sections). The number of visible wind turbines will depend on their spacing, positioning and distance from the shoreline.

Weather conditions for such long distances will result in a maximum reduction in the shadow flicker effect on land. In contrast, at night time, elements of OWF lighting along a long stretch of coastline will be clearly visible from the shore.

Human health and life are associated with direct or indirect impacts related to emissions of: noise, air pollutants, electromagnetic fields and radiation, as well as sewage and waste.

For the most part, these impacts will not cause significant impacts on human health and living conditions due to isolation from facilities and installations. Due to the occurrence of electromagnetic fields from equipment at offshore substations and the transmitting power of radiolocation and radiocommunication equipment, the potential danger will occur throughout the operation of the substations for employees servicing this equipment. The public will never be within the range of electromagnetic impacts of these devices. Individuals present within the BC-Wind OWF area in connection with the performance of their duties will be subject to labour and occupational health and safety legislation. Therefore, in the event that there is a risk of the emissions mentioned above, they will be provided with personal protective equipment or their working time in these conditions will be

optimised accordingly so that they are not subjected to exposures beyond the time allowed by health and safety regulations.

Other types of events that may affect health and living conditions may be the various collisions of vessels at sea. Events of this type are random in nature and the operation of the OWF can impede rescue operations at sea.

Another aspect that has been considered in terms of impacts is the scattering of ice accumulated on the blades. The extent of ice scattering is usually in the range of a few metres within the farm, however, in exceptionally adverse meteorological conditions, it can reach up to approx. 500m. This issue is of potential importance for turbines located on land, where the likelihood of impacts on human health and life and property (damage to property) is generally low, but higher than for offshore farms. This is for fairly obvious reasons, i.e. the lack of potential receptors around an offshore farm. Possible ice impacts on bystanders or operators are very unlikely. Furthermore, due to the quite likely safety zone around the farm, access to the farm may be restricted, only for selected offshore users. Thus, impacts in this respect should be described as negligible.

Although the resource of people's population, health and living conditions is of high value, due to the distance of the BC-Wind OWF from people's permanent places of residence and work, the significance of the impact of the BC-Wind OWF in this case was considered negligible.

9.12.3. Decommissioning phase

The decommissioning of the OWF in marine conditions will be a very complex, long-term task with increased risk for the vessels disassembling wind turbines and for other users of the water areas. It should be expected that in the period when it will be necessary to decommission the OWF, the intensity of navigation on the shipping routes in the OWF area will be much higher than it is currently, and the number of additional cruises of technical vessels of various sizes, involved in the dismantling of wind turbines and other structures of the BC-Wind OWF, will be close to those involved in the construction, i.e. there will be approx. 400 cruises.

At the same time, it should be emphasised that the routes of these additional cruises of technical vessels dedicated to the decommissioning of the OWF, moving between the BC-Wind OWF and small ports of the central coast and deep-water ports of, for example, Tricity, will cross the routes of vessels cruising along the navigation routes of the southern Baltic.

Similarly to the construction phase, fishing activities in the parts of the fishing squares of O8 and P8 will be limited.

At the same time, emergency response in case of emergency events involving vessels will be limited to conducting rescue operations or combating oil spills.

The significance of the impact of the BC-Wind OWF during the decommissioning phase on the population, health and living conditions of people was estimated to be negligible, despite the high significance of the resource itself. This results from the fact that, during the decommissioning phase, all users of the sea will be already familiar with the restrictions related to the existence of the BC-Wind OWF, and its gradual decommissioning will only increase the availability of the BC-Wind OWF sea area for other forms of use.

9.13. WASTE MANAGEMENT

9.13.1. Construction phase

The predicted types and quantities of waste generated during the construction phase of the BC-Wind OWF are presented in a breakdown in accordance with the Regulation of the Minister of Climate of 2 January 2020 on the waste catalogue (Journal of Laws of 2020, item 10, consol.) in the table below (Tab. 9.43). Waste is expected to arise from the normal operation of the various types of vessels involved in this phase of the project, as well as during the filling of foundations or support structures with cement

or sludge, the joining of structural elements (e.g. in the welding process), the driving or drilling of piles (e.g. borings), the installation of corrosion protection elements, and the possible abrasion of protective coatings (e.g. during piling).

Tab. 9.43. Summary of estimated amounts of waste generated during the construction phase of the BC-Wind OWF on an annual basis

Waste code (*hazardous waste)	Type of waste	Estimated quantity [Mg/year]
04 01 08	Gravel waste or crushed rock other than those listed in 01 04 07	753
08 01 11*	Waste paint and varnish containing organic solvents or other dangerous substances	0.05
08 01 12	Paints and varnish waste other than those mentioned in 08 01 11	0.05
12 01 13	Welding waste	0.10
13 01 09*	Mineral hydraulic oils containing halogenated compounds	0.05
13 01 10*	Halogen-free mineral-based hydraulic oils	0.05
13 01 11*	Synthetic hydraulic oils	0.05
13 02 04*	Mineral-based chlorinated engine, gear and lubricating oils	0.05
13 02 05*	Halogen-free mineral-based engine, gear and lubricating oils	0.05
13 02 06*	Synthetic engine, gear and lubricating oils	0.05
13 02 07*	Readily biodegradable engine, gear and lubricating oils	0.05
13 02 08*	Other engine, gear and lubricating oils	0.05
13 03 01*	Oils and liquids used as electrical insulators and heat carriers containing PCBs	0.20
13 04 03*	Bilge oils from marine vessels	0.10
13 05 02*	Sludges from oil dehydration in oil separators	0.50
13 05 06*	Oil from oil dehydration in separators	0.50
13 05 07*	Oily water from oil dehydration in separators	0.50
13 07 01*	Heating oil and diesel	0.05
13 07 02*	Petrol	0.05
13 08 80	Oily solid waste from ships	0.10
14 06 01*	Freons, HCFCs, HFCs	0.05
14 06 02*	Other halogenated solvents and solvent mixtures	0.05
14 06 03*	Other solvents and solvent mixtures	0.05
15 01 01	Paper and cardboard packaging	2.00
15 01 02	Plastic packaging	2.00
15 01 03	Wood packaging	2.00
15 01 04	Metal packaging	2.00
15 01 05	Multi-material packaging	2.00
15 01 06	Mixed packaging waste	2.00
15 01 07	Glass packaging	0.10
15 01 09	Textile packaging	0.10
15 02 02*	Sorbents, filter materials (including oil filters not otherwise specified), wiping cloths (e.g. rags, cloths) and protective clothing contaminated by hazardous substances (e.g. PCBs)	1.00
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, cloths) and protective clothing other than those mentioned in 15 02 02	1.00
16 06 01*	Lead batteries and accumulators	0.10

Waste code (*hazardous waste)	Type of waste	Estimated quantity [Mg/year]
16 06 02*	Nickel-cadmium batteries and accumulators	0.10
16 06 03*	Batteries containing mercury	0.01
16 06 04	Alkaline batteries (except 16 06 03)	0.01
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Waste exhibiting hazardous properties	1.00
16 81 02	Waste other than those mentioned in 16 81 01	1.00
17 01 01	Concrete wastes and concrete rubble from demolition and renovation	50.00
17 01 03	Waste from other ceramic materials and fittings	10.00
17 01 82	Waste not otherwise specified	50.00
17 02 01	Wood	2.00
17 02 02	Glass	0.10
17 02 03	Plastics	5.00
17 04 01	Copper, bronze, brass	0.05
17 04 02	Aluminium	0.05
17 04 04	Zinc	0.05
17 04 05	Iron and steel	1.00
17 04 07	Metal mixtures	0.05
17 04 11	Cables other than those mentioned in 17 04 10	5.00
17 09 03*	Other construction, renovation and dismantling waste (including mixed waste) containing dangerous substances	20.00
17 09 04	Mixed construction, renovation and dismantling waste other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	20.00
19 08 05	Stabilised municipal sewage sludge	1.00
20 01 01	Paper and cardboard	1.00
20 01 02	Glass	1.00
20 01 08	Biodegradable kitchen waste	1.00
20 01 10	Clothing	1.00
20 01 21*	Fluorescent tubes and other mercury-containing waste	0.05
20 01 23*	Equipment containing CFCs	0.05
20 01 29*	Detergents containing hazardous substances	0.05
20 01 30	Detergents other than those mentioned in 20 01 29	0.05
20 01 33*	Batteries and accumulators including batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	0.05
20 01 34	Batteries and accumulators other than those mentioned in 20 01 33	0.05
20 01 35*	Electrical waste and electronic equipment other than those mentioned in 20 01 21 and 20 01 23, containing hazardous components (1)	0.05
20 01 36	Electrical waste and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	0.05
20 03 01	Non-segregated (mixed) municipal waste	20.00

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 83-85

9.13.2. Exploitation phase

The predicted types and quantities of waste generated during the exploitation phase of the BC-Wind OWF are presented in a breakdown in accordance with the Regulation of the Minister of Climate of 2 January 2020 on the waste catalogue (Journal of Laws of 2020, item 10, consol.) in the table below (Tab. 9.44). The waste quantities shown are for a single SHPP or offshore substation. It should therefore be assumed that the waste and effluent quantities will be significantly higher for the RAV 2024 than for the WWR 2024.

The main drivers of waste and wastewater during the exploitation phase of the BC-Wind OWF are the use of the vessels and the execution of repairs.

Tab. 9.44. Summary of waste generated during the exploitation phase of the BC-Wind OWF on an annual basis

Waste code (*hazardous waste)	Type of waste	Estimated quantity [Mg/year]
08 01 11*	Waste paint and varnish containing organic solvents or other dangerous substances	0.21
08 01 12	Paints and varnish waste other than those mentioned in 08 01 11	0.21
12 01 13	Welding waste	0.04
13 01 09*	Mineral hydraulic oils containing halogenated compounds	0.01
13 01 10*	Halogen-free mineral-based hydraulic oils	0.01
13 01 11*	Synthetic hydraulic oils	0.01
13 01 12*	Readily biodegradable hydraulic oils	0.01
13 01 13*	Other hydraulic oils	0.01
13 02 04*	Mineral-based chlorinated engine, gear and lubricating oils	0.01
13 02 05*	Halogen-free mineral-based engine, gear and lubricating oils	0.01
13 02 06*	Synthetic engine, gear and lubricating oils	0.01
13 02 07*	Readily biodegradable engine, gear and lubricating oils	0.01
13 02 08*	Other engine, gear and lubricating oils	0.01
13 03 01*	Oils and liquids used as electrical insulators and heat carriers containing PCBs	0.42
13 04 03*	Bilge oils from marine vessels	0.04
13 05 02*	Sludges from oil dehydration in separators	0.21
13 05 06*	Oil from oil dehydration in separators	0.21
13 05 07*	Oily water from oil dehydration in separators	0.21
13 07 01*	Heating oil and diesel	0.04
13 07 02*	Petrol	0.02
13 08 80	Oily solid waste from ships	0.04
14 06 01*	Freons, HCFCs, HFCs	0.02
14 06 02*	Other halogenated solvents and solvent mixtures	0.02
14 06 03*	Other solvents and solvent mixtures	0.02
15 01 01	Paper and cardboard packaging	0.04
15 01 02	Plastic packaging	0.04
15 01 03	Wood packaging	0.04
15 01 04	Metal packaging	0.04
15 01 05	Multi-material packaging	0.04
15 01 06	Mixed packaging waste	0.04

Waste code (*hazardous waste)	Type of waste	Estimated quantity [Mg/year]
15 01 07	Glass packaging	0.04
15 01 09	Textile packaging	0.04
15 02 02*	Sorbents, filter materials (including oil filters not otherwise specified), wiping cloths (e.g. rags, cloths) and protective clothing contaminated by hazardous substances (e.g. PCBs)	0.12
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, cloths) and protective clothing other than those mentioned in 15 02 02	0.12
16 06 01*	Lead batteries and accumulators	0.04
16 06 02*	Nickel-cadmium batteries and accumulators	0.04
16 06 03*	Batteries containing mercury	0.04
16 06 04	Alkaline batteries (except 16 06 03)	0.04
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Waste exhibiting hazardous properties	0.12
16 81 02	Waste other than those mentioned in 16 81 01	0.12
17 01 01	Concrete waste and concrete rubble from demolition and renovation	2.10
17 01 03	Waste from other ceramic materials and fittings	0.41
17 01 82	Waste not otherwise specified	2.10
17 02 01	Wood	0.08
17 02 02	Glass	0.04
17 02 03	Plastics	0.21
17 04 01	Copper, bronze, brass	0.02
17 04 02	Aluminium	0.02
17 04 04	Zinc	0.02
17 04 05	Iron and steel	0.41
17 04 07	Metal mixtures	0.02
17 04 11	Cables other than those mentioned in 17 04 10	2.10
17 09 03*	Other construction, renovation and dismantling waste (including mixed waste) containing dangerous substances	0.82
17 09 04	Mixed construction, renovation and dismantling waste other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	0.82
19 08 05	Stabilised municipal sewage sludge	1.230
20 01 01	Paper and cardboard	0.82
20 01 02	Glass	0.82
20 01 08	Biodegradable kitchen waste	0.82
20 01 10	Clothing	0.82
20 01 21*	Fluorescent tubes and other mercury-containing waste	0.04
20 01 23*	Equipment containing CFCs	0.04
20 01 29*	Detergents containing hazardous substances	0.04
20 01 30	Detergents other than those mentioned in 20 01 29	0.04
20 01 33*	Batteries and accumulators including batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	0.04
20 01 34	Batteries and accumulators other than those mentioned in 20 01 33	0.04

Waste code (*hazardous waste)	Type of waste	Estimated quantity [Mg/year]
20 01 35*	Electrical waste and electronic equipment other than those mentioned in 20 01 21 and 20 01 23, containing hazardous components (1)	0.04
20 01 36	Electrical waste and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	0.04
20 03 01	Non-segregated (mixed) municipal waste	12.30

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 87-89

9.13.3. Decommissioning phase

The predicted types and quantities of waste generated during the decommissioning phase of the BC-Wind OWF are presented in a breakdown in accordance with the Regulation of the Minister of Climate of 2 January 2020 on the waste catalogue (Journal of Laws 2020, item 10, consol.) in the table below (Tab. 9.45). The waste quantities shown are for a single SHPP or offshore substation or 1 km of cable. The higher value resulting from the comparison for these two types of construction has been assumed in the compilation. Therefore, it should be assumed that the waste and effluent quantities will be significantly higher for the RAV 2024 than for the WWR 2024.

It is expected that decommissioning of the structures in the BC-Wind OWF Aarea will take place up to the seabed level (driven piles, after being cut or stoned at an appropriate depth, will be left in the seabed, as they do not cause impacts on the environment, while their removal may cause impacts on the environment – e.g. if explosives are used as the method of removal). In the case of the decommissioning of the BC-Wind OWF, the generation of waste is mainly associated with the physical disposal of the used elements of the BC-Wind OWF, and the operation of the vessels used during decommissioning.

Tab. 9.45. Summary of waste generated during the decommissioning phase of the BC-Wind OWF for a single structure

Waste code (*hazardous waste)	Type of waste	Estimated quantity [Mg/structure]
13 01 09*	Mineral hydraulic oils containing halogenated compounds	0.05
13 01 10*	Halogen-free mineral-based hydraulic oils	0.05
13 01 11*	Synthetic hydraulic oils	0.05
13 01 12*	Readily biodegradable hydraulic oils	0.05
13 01 13*	Other hydraulic oils	0.05
13 02 05*	Halogen-free mineral-based engine, gear and lubricating oils	0.01
13 02 05*	Halogen-free mineral-based engine, gear and lubricating oils	0.01
13 02 06*	Synthetic engine, gear and lubricating oils	0.01
13 02 07*	Readily biodegradable engine, gear and lubricating oils	0.01
13 02 08*	Other engine, gear and lubricating oils	0.01
13 03 01*	Oils and liquids used as electrical insulators and heat transfer media containing PCBs	82.5
13 04 03*	Bilge oils from marine vessels	0.1
13 07 01*	Heating oil and diesel	0.05
13 07 02*	Petrol	0.05
13 08 80	Oily solid waste from ships	0.1
14 06 01*	Freons, HCFCs, HFCs	0.1
14 06 02*	Other halogenated solvents and solvent mixtures	0.1

Waste code (*hazardous waste)	Type of waste	Estimated quantity [Mg/structure]
14 06 03*	Other solvents and solvent mixtures	0.1
15 01 01	Paper and cardboard packaging	0.1
15 01 02	Plastic packaging	0.1
15 01 03	Wood packaging	0.1
15 01 04	Metal packaging	0.1
15 01 05	Multi-material packaging	0.1
15 01 06	Mixed packaging waste	0.1
15 01 07	Glass packaging	0.1
15 01 09	Textile packaging	0.1
15 02 02*	Sorbents, filter materials (including oil filters not otherwise specified), wiping cloths (e.g. rags, cloths) and protective clothing contaminated by hazardous substances (e.g. PCBs)	1
15 02 03*	Sorbents, filter materials, wiping cloths (e.g. rags, cloths) and protective clothing other than those mentioned in 15 02 02	1
16 06 01*	Lead batteries and accumulators	0.1
16 06 02*	Nickel-cadmium batteries and accumulators	0.1
16 06 03*	Batteries containing mercury	0.01
16 06 04	Alkaline batteries (except 16 06 03)	0.01
16 06 05	Other batteries and accumulators	0.01
16 81 01*	Waste exhibiting hazardous properties	1
16 81 02	Waste other than those mentioned in 16 81 01	1
17 01 01	Concrete waste and concrete rubble from demolition and renovation	7000
17 01 03	Waste from other ceramic materials and fittings	50
17 01 07	Mixed concrete, bricks, tiles and ceramics waste other than those mentioned in 17 01 06	50
17 01 82	Waste not otherwise specified	50
17 02 01	Wood	0.1
17 02 02	Glass	2
17 02 03	Plastics	1000
17 04 01	Copper, bronze, brass	1
17 04 02	Aluminium	1
17 04 04	Zinc	1
17 04 05	Iron and steel	4000
17 04 07	Metal mixtures	1
17 04 11	Cables other than those mentioned in 17 04 10	71
17 09 03*	Other construction, renovation and dismantling waste (including mixed waste) containing dangerous substances	50
17 09 04	Mixed construction, renovation and dismantling waste other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	50
19 08 05	Stabilised municipal sewage sludge	1
20 01 01	Paper and cardboard	1
20 01 02	Glass	1

Waste code (*hazardous waste)	Type of waste	Estimated quantity [Mg/structure]
20 01 08	Biodegradable kitchen waste	1
20 01 10	Clothing	1
20 01 21*	Fluorescent tubes and other mercury-containing waste	0.05
20 01 23*	Equipment containing CFCs	0.05
20 01 29*	Detergents containing hazardous substances	0.05
20 01 30	Detergents other than those mentioned in 20 01 29	0.05
20 01 33*	Batteries and accumulators including batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	0.05
20 01 34	Batteries and accumulators other than those mentioned in 20 01 33	0.05
20 01 35*	Electrical waste and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components (1)	0.05
20 01 36	Electrical waste and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	0.05
20 03 01	Non-segregated (mixed) municipal waste	20

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 90-92

10. IDENTIFICATION OF THE ENVIRONMENTAL IMPACTS OF THE RATIONAL ALTERNATIVE VARIANT (RAV 2024)

A rational alternative to the assessed variant selected for implementation (WWR 2024) is the variant for which the Investor obtained the decision on environmental conditions and which was assessed in the EIA Report of 2021 (the RAV 2024). In the 2021 Report, it was the so-called Applicant Proposed Variant (APV 2021), for which the Regional Director for Environmental Protection in Gdańsk issued a decision on environmental conditions in 2022. In this Report, it is the Rational Alternative Variant 2024 (RAV 2024). The addition of the year to the RAV abbreviation was introduced to avoid confusion between what constituted the RAV in the previous Report and what constitutes the RAV now.

Both variants, the WWR 2024 and the RAV 2024, result in environmental impacts of the same nature, however the RAV 2024 would result in impacts of a greater magnitude due to the project parameters adopted in the DEC, i.e.:

- the greater number of turbines – 41 (39 in the WWR 2024, of which 34 will be implemented and 5 constitute backup locations),
- the larger rotor diameter – 280 m (250 m in the WWR 2024),
- the greater height of the entire structure – 330 m (300 m in the WWR 2024),
- the significantly greater length of the cables inside the farm – approx. 188 km (approx. 100 km in the WWR 2024).

The construction and operation of a larger number of wind power plants under the RAV 2024 compared to the WWR 2024 consequently implies a greater environmental impact, as a result of:

- the longer duration of the construction and decommissioning phases,
- the greater risk during crane and marine operations,
- the greater consumption of construction and operational materials.

A significant difference in the construction phase relates to the greater amount of analysed suspended solids, which is related to the fact that the RAV 2024 included the possibility of using gravity foundations, which require a large amount of dredging. Gravity foundations have been completely ruled out at this stage. The second factor that causes significant differences in the projected scale of impact of the suspended solids is the determination of the actual length of cable routes between the power

stations and the OSS. At the stage in which the DEC was obtained, the location of the power plants and OSS was not known, therefore the length of the cable routes was assumed, with some margin, to be approx. 188 km (for the WWR 2024, this is currently approx. 100 km).

During the exploitation phase, the greater number of wind turbines under the RAV 2024 will require more maintenance and operation works compared to the WWR 2024, which will result in greater environmental impacts. The RAV 2024 will result in greater environmental impacts in terms of collision risk between migratory birds and wind turbine structures compared to the WWR 2024. The results of the collision modelling indicate that in most cases, this risk is higher for the RAV 2024, and in no case is it lower. With that said, it is worth noting that the lower collision rate did not change the significance of the impact – it remains at the same level for both the WWR 2024 and the RAV 2024, despite the lower collision rate shown in the modelling.

In summary, the main parameters differentiating the RAV 2024 from the WWR 2024 are the number of wind turbines, the rotor diameter, the foundation type, and the length of cable routes. They consequently determine the larger scale of impacts on selected environmental components, such as:

- the shape of the basin bottom,
- the geological structure, bottom sediments and availability of raw materials,
- the good condition of marine waters,
- benthic organisms, ichthyofauna, marine mammals, birds, and bats.

For the other environmental components, the specification of the project parameters defined as WWR 2024 did not change the impacts assessed in this EIA Report.

Therefore, the following chapters assess the most relevant components that will be most affected by the change in parameters of the project in relation to the WWR 2024. The assessment of the other components is the same as for the WWR 2024.

10.1. SHAPE OF THE BASIN BOTTOM

The following chapter outlines the differences in the impacts of the RAV 2024 compared to the WWR 2024. A detailed description of the mechanisms of impacts on the shape of the basin bottom is provided in the impact assessment section for the WWR 2024 (Chapter 9.1 of this Report).

10.1.1. Construction phase

The works associated with the construction of the planned project may cause the following types of impacts on the seabed:

- changes in the shape of the bottom in connection with: the preparation of the bottom for the foundation or support structure, cable burial, or the levelling of the bottom along the cable route;
- changes in the level of the seabed in connection with the deposition of rock material disturbed and moved during preparatory and construction works – the average thickness of the newly formed sediment layer after the completion of the works will not exceed 4 mm within the distance of 1000 m from the place of works – in the remaining area it will reach the thickness of no more than 0.2 mm, which is comparable to the amount of suspended solids deposited in natural processes throughout the year;
- pits forming in the seabed at the anchoring locations of vessels installing elements of the OWF infrastructure.

The overall impact of the project during the construction phase on the overall character of the seabed and its structure, as in the WWR 2024 variant, was assessed as negligible – the changes will be minor, occur on a small area of the seabed, local (foundations or support structures of wind turbines), or linear (in a strip along the cable route).

Although there are no differences in the final assessment of the impacts on the basin, it should be pointed out that the RAV 2024 is environmentally less favourable than the WWR 2024 due to the greater extent of bottom disturbance during construction works.

10.1.2. Exploitation phase

During the exploitation phase, the planned project may cause different types of impacts on the seabed, i.e.:

- local changes in bottom relief associated with the presence of the infrastructure elements of the BC-Wind OWF and their impact on sediment transport and sedimentation processes: scouring of the bottom in front of/behind BC-Wind infrastructure elements, formation of sediment accumulations in front of/behind infrastructure elements (sand drifts),
- pits forming in the seabed at the anchoring locations of vessels servicing the OWF.

The resulting changes will be of a local nature, directly related to the immediate surroundings of the infrastructure elements. The significance of this impact during the exploitation phase for the RAV, as in the case of the WWR 2024, was determined to be insignificant.

10.1.3. Decommissioning phase

The impacts to occur during the closure and decommissioning phase of the project will be similar to those in the construction phase, but of lower intensity. Seabed intervention works will not be as extensive as for the driving/setting of foundations and/or support structures. Some structural elements may be left on and in the seabed. Transmission cables may be completely or only partially removed or left in the seabed.

Changes to the seabed associated with the impact of the project will be local and, at the scale of the entire area occupied by the project, insignificant for the overall character of the seabed and its structure.

The overall impact of the project during the closure and decommissioning phase in the RAV 2024, as in the WWR 2024, can be tentatively assessed as negligible.

10.2. GEOLOGICAL STRUCTURE, BOTTOMS SEDIMENTS AND AVAILABILITY OF RAW MATERIALS

The following chapter outlines the differences in the impacts of the RAV 2024 compared to the WWR 2024. A detailed description of the mechanisms of impacts on geological structure, bottom sediments and access to raw materials and deposits is provided in the impact assessment section for the WWR 2024 (Chapter 9.1 of this Report).

10.2.1. Construction phase

The works related to the construction of the planned project may cause the following types of impacts on the geological structure and bottom sediments:

- a spot disturbance of the geological structure due to embedding elements of foundations or support structures of the power station (drilling or pile-driving of foundations or support structures, erection of support structures, laying or possible burial of cables);
- local spot changes in the structure of the seabed where foundations are to be located, around their bases (placement of protective layers to prevent washout; for this purpose, crushed stone, stones and boulders are most often used; these actions cause a change in the subtractive composition of seabed sediments);
- pits forming in the seabed at the anchoring locations of vessels installing elements of the OWF infrastructure;
- the disturbance and sedimentation of suspended solids – during construction works, suspended solids will be disturbed locally, which will result in water turbidity. Suspended solids generated as a result of sediment disturbance during dredging works are deposited at the seabed depending on the water dynamics in the area. The disturbed sediment will move mainly within the area of the OWF and no further than a dozen kilometres from its boundaries (in trace amounts), and, during the deposition, it will cover the seabed with an average thickness of no more than 0.2-0.5 mm, which is comparable to the amount of suspended solids deposited as part of natural processes during the year.

Bottom sediments and geological structure

Taking into account the characteristics of the sediments building up the surface of the bottom within the OWF area, no significant changes in their character are expected geologically. Changes and

disturbances of their structure will be of a spot character, where gravity foundations are applied (and additionally, where soil replacement is necessary), and of a linear character – along the cable routes.

The impact of the RAV 2024 on bottom sediments in the context of foundation placement and the laying of cables/cable burial, as in the WWR 2024, will be negligible.

Despite the lack of difference in assessment, however, it should be pointed out that the seabed intervention works and associated sediment disturbance in the RAV 2024 will be greater than in the WWR 2024 due to the greater length of the cable routes, as well as the type of foundations and the associated need for bottom preparation and soil replacement (Tab. 10.1). The level of seabed disturbance in the RAV 2024 during gravity foundation placement and the laying of cables will cover a much larger area of the seabed with a total area of 2.32 km² (for a gravity foundation with a protective layer and dredging works), which constitutes 3.03% of the BC-Wind OWF Development Area, compared to only 0.854 km² for the WWR 2024 variant (for monopiles with a protective layer and excavation through the ploughing method), which constitutes 1.08% of the development area.

Tab. 10.1. Comparison of parameters of the planned project for the RAV 2024 and the WWR 2024

Parameter		RAV 2024	WWR 2024
Cable routes	Length of cable routes	188 km	100 km
	Seabed disturbance – area	0.282 km ² (jetting) 2.060 km ² (dredging)	0.20 km ² (jetting) 0.75 m ² (ploughing)
	Volume of the sediment disturbed during excavation works	470000 m ³ (jetting) 2632000 m ³ (dredging)	260000 m ³ (jetting) 800000 m ³ (ploughing)
Foundations/support structures	Number of foundations	41	40**
	Seabed area occupied by one foundation	2826 m ²	103.8 m ²
	Seabed area occupied by one foundation with a protective layer	6360 m ² *	2600 m ²
	Seabed area occupied by foundations with protective layers	260760 m ²	104000 m ²
	Volume of the sediment disturbed for the placement of one foundation	11280 m ³	64 m ³
	Volume of the sediment disturbed for the placement of all foundations	462480 m ³ (41 foundations)	2560 m ³ (40 foundations)

Source: own elaboration

* calculations for the protective layer diameter equal to 90 m, adopted in the assumptions for dredging works for a gravity support structure (Marcinkowski T., Olszewski T., 2021, Environmental impact assessment of the BC-Wind OWF, Appendix 2 – Results of model calculations. Dispersion of suspended solids in the BC-Wind OWF Area, October 2021)

** with the OSS foundation taken into account

This allows for the conclusion that the WWR 2024 is more environmentally favourable than the RAV 2024 in the context of seabed intervention. **Impact on the quality of bottom sediments and seawater**

During their construction, offshore wind farms may cause various types of impacts on the discussed receptors (seawater and bottom sediments), including:

- the release of pollutants and nutrients from sediments to water,
- the increase in water turbidity and the spread of suspended solids,
- the contamination of water and seabed sediments with oil derivatives,
- the contamination of water and seabed sediments with antifouling agents,
- the contamination of water and seabed sediments with accidentally released municipal waste or domestic sewage,
- the contamination of water and seabed sediments with accidentally released chemicals and waste originating from the construction of the BC-Wind OWF.

Release of pollutants and nutrients from sediments into water

The release of pollutants and nutrients from benthic sediments in the construction phase is a direct, negative impact of a regional scale, short-term, reversible or irreversible, repeatable during the construction period, and of low intensity. The significance of this impact during the construction phase in the RAV 2024, as for the WWR 2024, was determined to be low for marine waters and negligible for bottom sediments.

However, despite the lack of difference in assessment, it should be pointed out that the impacts associated with the release of pollutants and nutrients in the RAV 2024 will be greater than in the WWR 2024.

The significantly higher volume of disturbed sediment during construction works in the RAV 2024 – 2632000 m³ (for dredging) and 462480 m³ (for gravity foundations) – compared to the WWR 2024 – 800000 m³ (for ploughing) and 2560 m³ (for monopile driving) (Tab. 10.1) – will translate into significantly higher concentrations of nutrients, heavy metals and pollutants released into the basin. Despite the higher load of the aforementioned substances, their total input will be insignificant in comparison to the load contributed annually to the Baltic Sea by Polish rivers and precipitation, so the impact was determined to be negligible. ***Water turbidity and spread of suspended solids***

Water turbidity will occur during construction works. The degree of turbidity will depend on the type of sediment building up the bottom. In the case of clay and silt fractions (cohesive sediments), turbidity is expected to be more widespread and longer-lasting than in the case of sandy sediments (non-cohesive sediments).

Turbidity is a direct, negative, regional, short-term, reversible impact of low intensity. The significance of this impact during the construction phase in the RAV 2024, as in the WWR 2024, was determined to be low for both the bottom sediments and marine waters.

However, despite the lack of difference in assessment, it is important to point out that turbidity levels in the RAV 2024 will be higher than in the WWR 2024 due to the greater disturbance of the seabed during preparatory works for gravity foundations and excavating an almost twice as long cable route as in the WWR 2024. The maximum extent of suspended solids with concentrations exceeding the background concentration of 4 mg/l will be approx. 6.5 km, while the same level in the case of WWR 2024 will be reached already at a distance of approx. 2.5 km from the works. This leads to the conclusion that the WWR 2024 is environmentally preferable to the RAV 2024 in terms of water turbidity.

The remaining impacts:

- the contamination of water and seabed sediments with oil derivatives,
- the contamination of water and seabed sediments with antifouling agents,
- the contamination of water and seabed sediments with accidentally released municipal waste or domestic sewage,
- the contamination of water and seabed sediments with accidentally released chemicals and waste originating from the construction of the BC-Wind OWF.

The impacts associated with the release of the aforementioned pollutants to the water will be negative, direct, of a local or regional range, short-term, reversible, repeatable and of low/medium intensity (high in the case of emergencies or collisions), and the significance of these impacts for bottom sediments and water quality in the RAV 2024 is the same as for the WWR 2024 (negligible or minor).

Access to raw materials and deposits

In the case of access to crumbstone raw materials in area II – the Baltic seabed coastal zone, within which the planned project is located, an area of 79.05 km² will be excluded from use during the construction phase in the RAV 2024, representing 2.2% of its total area (for WWR 2024, this area represents 2.2%).

Taking into account the small area occupied by the BC-Wind OWF within area II in the RAV 2024, this impact was assessed as negligible.

10.2.2. Exploitation phase

Impact on geological structure and bottom sediments

Changes to the seabed associated with the impact of the RAV 2024 will be of local range and, at the scale of the entire area occupied by the project, insignificant to the overall character of the seabed and its structure.

No changes to the geological structure of the seabed are anticipated during the exploitation phase of the project. The overall impact of the project in the exploitation phase of the RAV 2024, as in the WWR 2024, can be assessed as negligible.

Impact on the quality of bottom sediments and seawater

During the exploitation phase of the BC-Wind OWF, works affecting the quality of seawater and bottom sediments will be carried out in the area. These will be mainly maintenance works and emergency interventions.

During their operation, offshore wind farms may cause various types of impacts on seawater and bottom sediments, including:

- the release of pollutants and nutrients from sediments to water, water turbidity,
- contamination with oil derivatives,
- contamination with antifouling agents,
- contamination with accidentally released municipal waste or domestic sewage,
- contamination with accidentally released chemicals and waste originating from the operation or servicing of the OWF;
- contamination with compounds from anti-corrosion agents,
- temperature change of seabed sediments and seawater through the reception of heat from transmission cables.

The impacts caused by the release of these pollutants to the water, water turbidity and other emissions will be negative, direct, local, short-term or long-term (in the case of anti-corrosion agents and thermal emissions), reversible or irreversible (in the case of anti-corrosion agents and thermal emissions), repeatable or permanent (in the case of anti-corrosion agents and thermal emissions), low/medium in intensity, and the significance of these impacts in the RAV 2024 for the quality of bottom sediments and seawater will be the same as for the WWR 2024 (negligible or minor).

Access to raw materials and deposits

In the case of access to crumbstone raw materials in area II – the Baltic seabed coastal zone, within which the planned project is located, an area of 79.05 km² will be excluded from use during the exploitation phase in the RAV 2024, representing 2.2% of its total area (for WWR 2024, this area represents 2.2%).

Taking into account the small area occupied by the BC-Wind OWF within area II in the RAV 2024, this impact was assessed as negligible.

10.2.3. Decommissioning phase

The impacts to occur during the closure and decommissioning phase of the project will be similar to those in the construction phase, but of lower intensity. Seabed intervention works will not be as extensive as for the driving/setting of foundations and/or support structures. Some structural elements may be left on and in the seabed. Transmission cables may be completely or only partially removed or left in the seabed.

Changes to the seabed associated with the impact of the project will be local and, at the scale of the entire area occupied by the project, insignificant for the overall character of the seabed and its structure.

The overall impact of the project during the closure and decommissioning phase in the RAV 2024, as in the WWR 2024, can be tentatively assessed as negligible.

10.3. IMPACT ON MARINE WATERS, INCLUDING THE QUALITY OF MARINE WATERS

The following chapter outlines the differences in impacts of the RAV 2024 and the WWR 2024. A detailed description of the mechanisms of impacts on marine water quality is provided in the impact assessment section for the WWR 2024 (Chapter 9.3 in this EIA Report).

10.3.1. Construction phase

Construction works undertaken during the construction phase may cause various types of impacts on water and its quality, such as:

- the release of pollutants and nutrients from sediments to water,
- the increase in water turbidity and the spread of suspended solids,
- the contamination of water with oil derivatives,
- the contamination of water with antifouling agents,
- the contamination of water with accidentally released municipal waste or domestic sewage,
- the contamination of water with accidentally released chemicals and waste originating from the construction of the BC-Wind OWF.

Release of pollutants and nutrients from sediments into water

The release of pollutants and nutrients from bottom sediments in the construction phase is a direct, negative impact of a regional scale, short-term, reversible or irreversible, repeatable during the construction period, and of low intensity. The significance of this impact during the construction phase in the RAV 2024, as for the WWR 2024, was determined to be low for marine waters.

However, despite the lack of difference in assessment, it should be pointed out that the impacts associated with the release of pollutants and nutrients in the RAV 2024 will be greater than in the WWR 2024.

The significantly higher volume of disturbed sediment during construction works in the RAV 2024 compared to the WWR 2024 (Tab. 10.1) will translate into significantly higher concentrations of nutrients, heavy metals and pollutants released into the basin. Despite the higher load of the aforementioned substances, their total input will be insignificant in comparison to the load contributed annually to the Baltic Sea by Polish rivers and precipitation, so the impact was determined to be negligible.

Water turbidity and spread of suspended solids

Water turbidity will occur during construction works. It is a direct, negative, regional, short-term, reversible impact of low intensity. The significance of this impact during the construction phase in the RAV 2024, as in the WWR 2024, was determined to be low for marine waters.

However, despite the lack of difference in assessment, it is important to point out that turbidity levels in the RAV 2024 will be higher than in the WWR 2024 due to the greater disturbance of the seabed during preparatory works for gravity foundations and excavating an almost twice as long cable route as in the WWR 2024. The maximum extent of suspended solids with concentrations exceeding the background concentration of 4 mg/l will be approx. 6.5 km, while the same level in the case of WWR 2024 will be reached already at a distance of approx. 2.5 km from the works. This leads to the conclusion that the WWR 2024 is environmentally preferable to the RAV 2024 in terms of water turbidity.

The remaining impacts:

- the contamination of water and seabed sediments with oil derivatives,
- the contamination of water and seabed sediments with antifouling agents,
- the contamination of water and seabed sediments with accidentally released municipal waste or domestic sewage,
- the contamination of water and seabed sediments with accidentally released chemicals and waste originating from the construction of the BC-Wind OWF.

The impacts associated with the release of the aforementioned pollutants to the water will be negative, direct, of a local or regional range, short-term, reversible, repeatable and of low/medium intensity (high in the case of emergencies or collisions), and the significance of these impacts for water quality in the RAV 2024 is the same as for the WWR 2024 (negligible or minor).

10.3.2. Exploitation phase

During the exploitation phase of the BC-Wind OWF, works affecting the quality of seawater will be carried out in the area. These will be mainly maintenance works and emergency interventions.

During their operation, offshore wind farms may cause various types of impacts on seawater, including:

- the release of pollutants and nutrients from sediments to water, water turbidity,
- contamination with oil derivatives,
- contamination with antifouling agents,
- contamination with accidentally released municipal waste or domestic sewage,
- contamination with accidentally released chemicals and waste originating from the operation or servicing of the OWF;
- contamination with compounds from anti-corrosion agents,
- temperature change of seabed sediments and seawater through the reception of heat from transmission cables,
- modification of water velocity, flow directions and water pressure in the immediate vicinity of the OWF structures.

The impacts caused by the release of these pollutants to the water, water turbidity and other emissions will be negative, direct, local, short-term or long-term (in the case of anti-corrosion agents and thermal emissions), reversible or irreversible (in the case of anti-corrosion agents and thermal emissions), repeatable or permanent (in the case of anti-corrosion agents and thermal emissions), low/medium in intensity, and the significance of these impacts in the RAV 2024 for the quality of seawater will be the same as for the WWR 2024 (negligible or minor).

The significance of the impact of the OWF on marine water dynamics in the RAV 2024 (as in the WWR 2024) was assessed as negligible.

10.3.3. Decommissioning phase

During the decommissioning of the BC-Wind OWF, identical impacts on marine waters and their quality are expected to occur as during the construction phase of the OWF.

Impacts during the decommissioning phase were assessed to be direct, negative, of a regional/local range, short-term, reversible, repeatable and low to medium in intensity (except for accidents and collisions, for which the intensity was assessed as high).

The significance of the impacts on marine water quality during the decommissioning phase in the RAV 2024 were assessed as negligible/low.

10.3.4. Impact on the state of the marine environment of the construction and exploitation phases according to the MSFD

The impacts of the planned project in the RAV 2024 on the current water status defined by individual marine ecosystem features (D1-D11) will be the same as in the WWR 2024 during the construction, operation and decommissioning phases (minor, insignificant or negligible).

However, when considering the impacts in the individual state and pressure features, it is important to point out that the RAV 2024 is more environmentally unfavourable than the WWR 2024 in the construction phase, particularly in terms of benthic habitat loss, the scale of which is considered in features: D1 (criterion D6C4), D4 and D6. For the RAV 2024, the permanent loss of benthic habitat, due to the use of gravity foundations, will cover a slightly larger area, with a total area of 0.122 km² without the use of a protective layer and 0.26 km² with the use of a protective layer; while for the WWR 2024,

that area will amount to 0.004 km² and 0.104 km², respectively. Despite the aforementioned differences, given the scale of disturbance within the sub-area 27 and the moderate sensitivity of benthic organisms to seabed and sediment structure intervention, the significance of the impact in the RAV 2024 was assessed as low.

In summary, there will be no deterioration in the current water status of the Eastern Gotland Basin sub-area 27 during the construction, operation and decommissioning phases of the proposed project in the RAV 2024.

10.4. IMPACT ON ANIMATE NATURE

10.4.1 Macrozoobenthos

This subchapter summarises and discusses the differences between the impacts of the variant selected for implementation (WWR 2024) and the Rational Alternative Variant (RAV 2024) on macrozoobenthos. Information on the mechanisms of impacts on macrozoobenthos is detailed in Subchapter 9.4.2 of this Report, dedicated to the WWR 2024.

Construction phase

The works carried out during the construction phase will cause, analogous to the WWR 2024, the following impacts affecting the condition of the macrozoobenthos inhabiting the area of the planned project:

- a disturbance of the seabed sediment structure;
- an increased concentration of suspended solids in the water;
- a sedimentation of suspended solids on the seabed;
- a redistribution of pollutants from sediments into water.

Of the impacts listed above, the disturbance of the sediment structure constitutes the strongest negative impact on macrozoobenthos, especially in the case of a hard bottom. The RAV 2024 is expected to have a greater impact on macrozoobenthos compared to the WWR 2024 due to the larger parameters of the project and the use of gravity foundations. The assessment of bottom occupancy carried out for the RAV 2024 for a gravity foundation showed that the impact of this structure is the strongest of the considered methods, as the bottom occupation for it amounts to 2826 m² (and with the protective layer – 6360 m² ⁶⁴⁷), while for the monopile foundation adopted in WWR 2024, including the protective layer, it is 2600 m². Consequently, the total bottom occupation for all wind turbines including cables inside the farm will be 3.03% of the development area in the RAV 2024 and 1.08% of the development area in the WWR 2024 (Tab. 10.1). For both soft-bottom and hard-bottom macrozoobenthos, the impact associated with the disturbance of bottom sediment structures for the RAV 2024 is negative, direct, local and medium-term. The sensitivity of benthic communities and the magnitude of the impact on macrozoobenthos were determined to be moderate. The significance of the impact for both communities was assessed to be low, which is consistent with the assessment of the WWR 2024. However, the reduced interference with bottom sediment structures results in the WWR 2024 being considered environmentally preferable to the RAV 2024.

The increase in the concentration of suspended solids in the water and the increased sedimentation of suspended solids on the bottom in the RAV 2024 were assessed for gravity foundations, generating the strongest impact among the considered construction solutions analysed at the stage of obtaining the DEC. The RAV 2024 is characterised by a higher total number of structures compared to the WWR 2024, as 41 power plants, 2 OSS and 4 additional structures were assumed, for a total of 47 structures in the RAV 2024. Currently, the WWR 2024 has a maximum of 42 structures (39 power plants, 1 OSS and 2 additional structures). In addition, as previously mentioned, the RAV 2024

⁶⁴⁷ calculations for the protective layer diameter equal to 90 m, adopted in the assumptions for dredging works for a gravity support structure (Marcinkowski T., Olszewski T., 2021, *Environmental impact assessment of the BC-Wind OWF*, Appendix 2 – Results of model calculations. Dispersion of suspended solids in the BC-Wind OWF area, October 2021

assumes a total cable route length inside the OWF of 188 km compared to the 100 km in the WWR 2024. The presented parameters clearly indicate a higher resuspension and redeposition of suspended solids in the RAV 2024 compared to the WWR 2024, and thus a stronger negative impact on macrozoobenthos. For both the soft-bottom and hard-bottom macrozoobenthos, the impacts associated with the increase of suspended solids in the water and sedimentation on the bottom for the RAV 2024 were assessed as negative, direct, local and temporary. The sensitivity to impact and the magnitude of impact on soft-bottom macrozoobenthos were assessed as negligible for the increased turbidity in the water and low for the sedimentation of suspended solids on the bottom. In the case of hard-bottom macrozoobenthos communities, composed mainly of filter-feeding organisms, the sensitivity of the macrozoobenthos and the magnitude of the impact related to the increase in the suspended solids concentration in the water, as well as sedimentation on the seabed, were assessed to be low. The significance of the impact on both communities was assessed as negligible, both for the increase in the concentration of suspended solids in the water and their sedimentation on the bottom. Assessment results obtained for the RAV 2024 are the same as those for the WWR 2024. Despite the same impact significance assessment for both variants, the reduced interference with bottom sediment structures indicates that the WWR 2024 should be regarded as environmentally preferable.

The potential redistribution of pollutants from sediment into water as a result of the works under the RAV 2024 would impact hard- and soft-bottom macrozoobenthos communities in a negative, direct, localised and short-term manner. The sensitivity of the macrozoobenthos and the magnitude of the impact was assessed as negligible for both communities, which is the same as in the WWR 2024. The significance of the impact for both communities was assessed as negligible in both the RAV 2024 and the WWR 2024. However, it should be noted that the reduced number of structures and their smaller size in the WWR 2024 are associated with reduced seabed interference, and therefore the resuspension of sediment and redistribution of pollutants from sediment to the water would be limited, which is more beneficial to the environment.

In summary, the significance of the impacts of the RAV 2024 during the construction phase of the BC-Wind OWF is the same as in the WWR 2024 and does not show significant differences. However, due to the reduced number of structures, the exclusion of gravity foundations, and the shorter cable routes inside the farm in the WWR 2024, it is more favourable for the environment compared to the RAV 2024.

Exploitation phase

The operation of the BC-Wind OWF will result in the following impacts on the macrozoobenthos inhabiting the area:

- partial loss of a macrozoobenthos habitat;
- an 'artificial reef' effect.

The impact associated with the loss of a part of a habitat is negative, direct, localised and long-term for soft- and hard-bottom macrozoobenthos, with the magnitude of the impact determined to be low. The sensitivity of both macrozoobenthos communities to this impact was determined to be high. The significance of the impact was assessed as low for the soft-bottom macrozoobenthos and negligible for the hard-bottom macrozoobenthos. The results of the assessment are the same as for the WWR 2024, however, due to the smaller number of structures in the WWR 2024, it should be considered as environmentally preferable.

The loss of macrozoobenthos habitat in the project area during the exploitation phase may be compensated to some extent by the artificial reef effect resulting in the colonisation of introduced structures by epiphytic organisms and mobile epifauna. This impact therefore appears to be positive; however, it may also be negative due to the establishment of non-native invasive species undesirable in the ecosystem. For other aspects, the impact of the RAV 2024 was assessed as direct, local and long-term, with the magnitude of the impact determined as high. The significance of the impact on

macrozoobenthos was assessed as moderate, similar to the WWR 2024. The higher number of structures in the RAV 2024, relative to the WWR 2024, may suggest stronger positive environmental impacts and contribution to biodiversity in the OWF area. However, it is also associated with a higher risk of negative impacts associated with the spread of invasive species. Therefore, the WWR 2024 is more favourable for the environment.

In summary, the significance of the impacts of the RAV 2024 during the exploitation phase of the BC-Wind OWF does not show significant differences to the one of WWR 2024. However, due to the reduced number of structures in the OWF area, the WWR 2024 is more favourable for the environment compared to the RAV 2024.

Decommissioning phase

The decommissioning of the BC-Wind OWF will cause the following impacts on macrozoobenthos inhabiting the area of the project:

- disturbance of the seabed sediment structure;
- increased concentration of suspended solids in the water;
- sedimentation of suspended solids on the seabed;
- redistribution of pollutants from sediment into water;
- removal of artificial substrates of underwater wind turbine systems, forming an 'artificial reef', from the marine environment.

The disturbance of seabed sediment structures associated with the decommissioning of constructions placed in the OWF area will be a negative, direct, local and medium-term impact for both soft- and hard-bottom macrozoobenthos.

The decommissioning works will result in an increase in the concentration of suspended solids in the water, as well as their subsequent sedimentation on the bottom. For both soft-bottom and hard-bottom macrozoobenthos, the impacts associated with the increase of suspended solids in the water and their sedimentation on the bottom are negative, direct, local and temporary.

With the commencement of decommissioning works, there may be a redistribution of pollutants from the sediment to the water. This impact was assessed to be negative, direct, local and short-term for both hard- and soft-bottom macrozoobenthos.

Decommissioning of an artificial reef may cause irreversible, permanent destruction of the epiphytic fauna communities gathered on anthropogenic substrates within the area of the BC-Wind OWF, as well as the destruction of the macrozoobenthos community around the foundations of the structure, which will mean the reconstruction of its qualitative and quantitative structure. This is a negative phenomenon that may contribute to a decrease in the biodiversity of the ecosystem. On the other hand, the decommissioning phase means a return to the natural character of the area, which is a positive phenomenon.

In summary, the significance of the impacts of the RAV 2024 during the decommissioning phase of the BC-Wind OWF is the same as in the WWR 2024 and does not show significant differences. However, due to the reduced number of structures to be dismantled in the WWR 2024, it is more favourable for the environment compared to the RAV 2024.

10.4.2. Ichthyofauna

Construction phase

The main impacts on ichthyofauna in the construction phase in the alternative variant of RAV 2024 will be, as in the WWR 2024:

- emission of noise and vibration;
- increased suspended solids concentration;
- release of pollutants and nutrients from sediments into water;
- habitat change;

- barrier creation.

The impact of noise associated with driving monopiles on fish in the RAV 2024 was assessed in the 2021 Report through the use of a modelling of underwater noise propagation based on data available at that time on monopile parameters, hammer power, number of strikes, etc., as well as the knowledge on the subject that was available at the time. The 2021 modelling assumed a more favourable location of the sound source, i.e. in the centre of the BC-Wind OWF, and cumulative noise from 1 hour, meanwhile the 2024 remodelling covers 24-hour cumulative noise and was performed for a location in the extreme east of the area, i.e. the most unfavourable when it comes to noise propagation. These differences mean that the results of the original modelling are not comparable with the results of the 2024 remodelling.

The impact of noise on fish was assessed as the same for both variants, with mitigation measures, i.e. the Noise Reduction System (NRS), also required for both. The purpose of the mitigation measures is to limit the extent of TTS, PTS and reversible hearing damage to fish with swim bladders to less than 11 km from the sound source, as required by the DEC. **The significance of the impact of underwater noise with the use of the planned mitigation measures was assessed as moderate for the RAV 2024 for all the surveyed fish species, similar to the WWR 2024.**

The impact associated with the increase in the concentration of suspended solids was assessed in the RAV 2024 for gravity foundation structures, which generate the greatest impact due to the requirement of seabed cleaning works. Gravity foundation structures have since been excluded, making the WWR 2024 variant more favourable in terms of the amount of suspended solids generated during the construction phase. This results in a significantly greater impact of the suspended solids inflow on ichthyofauna in the RAV 2024 variant.

The impact associated with the increase in suspended solids will be negative, direct, localised and short-term. The significance of the impact in the RAV 2024 was assessed, as for the WWR 2024, to be **insignificant** for all the surveyed fish species due to the limited spatial scale. However, it should be pointed out that the sensitivity of fish to this impact will be the same in both variants, so the RAV 2024 should be indicated as environmentally less favourable than the WWR 2024 despite the lack of differences in the final impact assessment.

The impact associated with the release of pollutants and nutrients from the sediment to the water will be negative, direct, temporary and localised, and the sensitivity of fish species will be the same as in the WWR 2024. This impact would be greater in the RAV 2024 than the WWR 2024 as the volume of disturbed sediment would be greater with the use of gravity foundation technology, as well as due to the greater maximum length of the internal cable routes. However, due to the generally low level of their contamination in the PMA, the impact for the RAV 2024 was assessed the same as for the WWR 2024, as **negligible**.

The impact associated with habitat change results from the permanent occupation of the bottom surface by OWF structures, the change in the nature of the bottom in the area foundations will be placed, and the temporary disturbance of habitat conditions due to bottom clearance works along the cable line routes and cable-laying/burial works. In the RAV 2024, the assessment was carried out for the gravity foundation as it is the permitted construction method with the highest level of impact. The permanent occupation of the seabed area for a single gravity foundation will be 2826 m², so the total estimated for 41 wind power plants and 2 OSS stations (43 facilities) is 0.122 km², compared to only 0.004 km² for the WWR 2024, which assumes the use of monopile foundations and a smaller number of facilities (40 in total). This value is even higher than the size of the area of the seabed transformed by a stone cover reinforcement, which was estimated at 0.104 km² in the WWR 2024. The area of permanently lost seabed in the RAV 2024 will therefore reach almost 0.155% of the development area of the BC Wind OWF.

The impact associated with permanent habitat alteration in the RAV 2024 will affect a small area of the seabed relative to the development area of the BC-Wind OWF (0.155%) and to the total area of fish spawning and feeding grounds, but will be significantly greater than in the WWR 2024. The impact associated with temporary habitat alteration due to the disturbance of the structure of the seabed and the sedimentation of suspended solids will have a wider spatial extent, but will be a negative, direct, temporary and local impact. The significance of the impact was assessed to be **negligible** for all surveyed fish species, due to the limited spatial scale. However, it should be noted that the sensitivity of fish to this impact will be the same for both variants, and therefore the RAV 2024 should be identified as environmentally less favourable than the WWR 2024, despite there being no differences in the final impact assessment.

The impact on ichthyofauna associated with barrier creation will be similar in both variants, but will be slightly greater in the RAV 2024 due to the higher total number of structures to be constructed (47 versus 42 in the WWR 2024), and the larger diameter of a gravity foundation relative to a monopile foundation. However, the density of the wind turbines is low enough that there will be no impact on the migration opportunities of ichthyofauna. The impact associated with the barrier creation will be negative, direct, local and temporary for all species. The significance of the impact in the RAV 2024 was assessed to be **negligible** for all the surveyed fish species.

In summary, there are no significant differences in the assessment of the final impact on ichthyofauna of the compared variants, however, taking individual impacts into account, it should be noted that the WWR 2024 is more favourable for the environment in the construction phase than the RAV 2024.

Exploitation phase

The main impacts on ichthyofauna in the exploitation phase will be, as in the WWR 2024:

- emissions of noise and vibration;
- habitat changes;
- the creation of a barrier;
- EMF emissions.

There are no significant differences in the assessment of the final impact on ichthyofauna of the compared variants in the exploitation phase, however, taking the differences in OWF parameters into account, it should be noted that the WWR 2024 is more favourable for the environment than the RAV 2024.

Decommissioning phase

The following types of impacts are forecast for the decommissioning phase, as in the WWR 2024:

- emission of noise and vibrations;
- an increase in suspended solids content;
- a release of pollutants and nutrients from sediments;
- habitat change.

There are no significant differences in the assessment of the final impact on ichthyofauna of the compared variants in the decommissioning phase, however, taking individual impacts into account, it should be noted that the WWR 2024 is more favourable for the environment than the RAV 2024.

10.4.3. Marine mammals

Construction phase

During the construction phase of the OWF, the greatest impact on marine mammals is associated with noise generated during piling. For both the RAV 2024 and the WWR 2024, construction works in the BC Wind OWF Area may significantly impact harbour porpoises and seals and will require mitigation measures. Analyses conducted for the RAV 2024 (i.e. noise propagation modelling

undertaken for the 2021 EIA Report for the central point of the BC Wind OWF) indicated that following the application of the NRS, all impacts on the harbour porpoise, the grey seal and the common seal were assessed to be of low or moderate significance.

Tab. 10.2. Significance of the impact on marine mammals resulting from piling during the construction phase after the application of a Noise Reduction System (NRS)

Species	Impact	Impact description	Impact significance
Harbour porpoise <i>Phocoena phocoena</i>	PTS (single strike)	Permanent threshold shift as a result of a single pile driver strike	Low
	PTS (1h cum.)	Permanent threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	TTS (single strike)	Temporary threshold shift as a result of a single pile driver strike	Low
	TTS (1h cum.)	Temporary threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	Behavioural response	Behavioural responses to pile drilling (moving away from the construction site)	Moderate
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of construction operations)	Low
	Suspended solids	Behavioural changes caused by the suspension of sediments released during construction	Low
	Changes in the habitat	Behavioural changes caused by the habitat changes resulting from the construction operations	Low
	Vessel collisions and breakdowns	Pollution caused by the collision of vessels used for construction purposes (e.g. fuel leak)	Moderate
Grey seal <i>Halichoerus grypus</i>	PTS (single strike)	Permanent threshold shift as a result of a single pile driver strike	Low
	PTS (1h cum.)	Permanent threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	TTS (single strike)	Temporary threshold shift as a result of a single pile driver strike	Low
	TTS (1h cum.)	Temporary threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	Behavioural response	Behavioural responses to pile drilling (moving away from the construction site)	Moderate
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of construction operations)	Low
	Suspended solids	Behavioural changes caused by the suspension of sediments released during construction	Low
	Changes in the habitat	Behavioural changes caused by the habitat changes resulting from the construction operations	Low
	Vessel collisions and breakdowns	Pollution caused by the collision of vessels used for construction purposes (e.g. fuel leak)	Moderate
Harbour seal <i>Phoca vitulina</i>	PTS (single strike)	Permanent threshold shift as a result of a single pile driver strike	Low
	PTS (1h cum.)	Permanent threshold shift as a result of a cumulative noise dose from one-hour piling	Moderate
	TTS (single strike)	Temporary threshold shift as a result of a single pile driver strike	Low
	TTS (1h cum.)	Temporary threshold shift as a result of a cumulative noise dose from one-hour piling	Low
	Behavioural response	Behavioural responses to pile drilling (moving away from the construction site)	Low

Species	Impact	Impact description	Impact significance
	Noise related to navigation	Behavioural responses to the noise related to navigation (moving away from the location of construction operations)	Low
	Suspended solids	Behavioural changes caused by the suspension of sediments released during construction	Low
	Changes in the habitat	Behavioural changes caused by the habitat changes resulting from the construction operations	Low
	Vessel collisions and breakdowns	Pollution caused by the collision of vessels used for construction purposes (e.g. fuel leak)	Moderate

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 220-221

The assessment of impact on marine mammals carried out after the change of project parameters, i.e. for the WWR 2024, was based on new noise propagation modelling performed for the purpose of this Report (presented in Appendix 3 Volume III), in which a less favourable location for sound propagation was assumed, i.e. great depths.

In relation to the WWR 2024, there is a difference relating to the assessment of the impact on harbour porpoise, harbour seal and grey seal in the form of a permanent and temporary shift in hearing threshold (PTS and TTS) due to a cumulative noise dose from 1 hour of piling, which was considered to be a moderate impact in the RAV 2024 (Tab. 10.2), while the cumulative 24-hour noise dose assessed for the WWR 2024 (Tab. 9.24) was deemed to be of minor importance.

It should be noted that the numerical modelling of noise propagation and potential ranges of impacts from piling noise on marine mammals was carried out with different assumptions for the two analysed variants. The WWR 2024 includes the soft-start method, an animal movement model, and a 24-hour prior exposure to sound generated during pile driving. The RAV 2024 assumed a 1-hour exposure, a static nature of the exposed organisms, and no gradual increase in sound levels.

The use of a different type of mitigation measures, the different technical parameters of the pile and the different assumptions adopted in the numerical modelling (including the different location of the modelling point) affect the outcome of the impact assessment carried out for the analysed variants. As a result, the modelling results from 2021 (for the RAV 2024) and 2024 (for the WWR 2024) are difficult to compare.

Based on the modelling results for both the RAV 2024 and the WWR 2024, all impacts on harbour porpoise, grey seal and common seal were assessed to be moderate or minor following the application of an NRS. For the RAV 2024, moderate impacts were found in ten cases (Tab. 10.2), and for the WWR 2024, moderate impacts were only found in the case of behavioural response of harbour porpoise and grey seal (Table 9.26).

Exploitation phase

The significance of the impact of the OWF on marine mammals in the exploitation phase was assessed for the RAV 2024 as analogous to the WWR 2024 variant, as the proposed changes to the project parameters do not affect marine mammals during the exploitation phase.

Decommissioning phase

Similarly to the exploitation phase, the same impacts on marine mammals are predicted during the decommissioning phase of the BC-Wind OWF for both the RAV 2024 and the WWR 2024.

10.4.4. Seabirds

The impact of the construction, exploitation and decommissioning phases of the BC-Wind OWF on seabirds in the RAV 2024 will be the same as for the WWR 2024, which is described in detail in Subchapter 9.4.4. This is mainly due to the fact that the nature of impacts and parameters of the farm affecting the assessment of impacts on wintering birds remain the same. WWR 2024 is slightly more

environmentally favourable due to the reduced impact associated with water turbidity during the construction phase (because of the exclusion of gravity foundations), and a lower total number of structures planned within the farm, i.e. 39 wind turbines (of which approx. 34 will be implemented, with the remaining being backup locations) in comparison to the 41 planned in the RAV 2024, and 1 OSS, in comparison to the 2 analysed in the RAV 2024.

10.4.5. Migratory birds

During the assessment of impacts on individual environmental components in all phases of the project, no differences in the significance of impacts between the analysed variants were found. Only in the case of the assessment of collision risk for migratory birds during the exploitation phase is there a significant change worth noting, in the size of the so-called swept area, i.e. the area enclosed within a circle subtended by the blades of the rotor, counted for all the rotors of the wind farm. In the case of the RAV 2024 variant, this area is more than 10 million m², and in the case of the WWR 2024 variant, it will be approx. 7.6 million m² (for 39 wind turbines); assuming a planned target quantity of 34 wind turbines, it will be approx. 6.6 million m².

In reference to the obtained collision modelling results for both variants, they indicated the same or higher risk of collision of migratory birds for the RAV 2024. Nevertheless, higher values of collision risk for the RAV 2024 did not result in an increased impact significance. A detailed impact assessment of the BC-Wind OWF on migratory birds for the variants of WWR 2024 and RAV 2024 is presented in Appendix 4 to the EIA Report, Volume III.

Construction phase

Activities associated with the construction of the BC-Wind OWF in the alternative variant will result in impacts on chiropterofauna which were assessed, as for the WWR 2024, as **negligible**.

Exploitation phase

Low bat activity was found in the OWF area. At the same time, the operation of offshore wind farms and the associated collision risk remains an insufficiently researched topic to clearly assess the collision risk. However, no clear differences were found in the assessment of impacts on chiropterofauna between the alternative variant and the WWR 2024, except for the smaller risk of collision for the WWR 2024 due to the reduction in the number of turbines from 41 to 34.

Decommissioning phase

The decommissioning of the BC-Wind OWF in the RAV 2024 variant would cause negligible impacts on chiropterofauna, same as in the WWR 2024 variant.

11. CUMULATIVE IMPACTS

The assessment of the cumulative impact of the implementation of the BC-Wind OWF in connection with other projects took into account the existing, implemented and planned projects. In the case of the planned projects, only those for which decisions on environmental conditions had been issued were taken into account. This enabled the comparison of the impact assessment conducted for the BC-Wind OWF with the results of assessments carried out for the remaining projects in terms of the possible cumulative effect of these impacts.

No other projects that may cause cumulative impacts are being implemented nor will be implemented in the area of the BC-Wind OWF. The implementation of the OWF in all its phases, due to the correct and safe functioning of this project, prevents carrying out other activities in the same area. Therefore, the impacts that may possibly accumulate with the impacts of the BC-Wind OWF will have their sources outside its area.

11.1. EXISTING, IMPLEMENTED AND PLANNED PROJECTS WITH ISSUED DECISIONS ON ENVIRONMENTAL CONDITIONS

Within the PMA, the following projects connected to hydrocarbon and gas extractions (Fig. 11.1), for which decisions on environmental conditions have been issued, are being implemented or planned:

- Re-injecting water into deposit through selected existing boreholes to the crude oil Deposit B3, located in the Polish EEZ of the Baltic Sea – the existing license no. 108/94 issued by the Minister of Environmental Protection, Natural Resources and Forestry on 29 July 1994 and the 'Łeba' mining area with an area of 31.168 km², which coincides with the mining area (decision no.: RDOŚ-22-WOO.6670/62-5/09/AT of 19 October 2009) (hereinafter referred to as: Deposit B3);
- The extraction of natural gas from subsea hydrocarbon Deposits B4 and B6 and its transmission to the installations of the electrical and heating power station in Władysławowo (decision no.: RDOŚ-Gd-WOO.4211.12.2014.ER.8 of 16 May 2014 (hereinafter referred to as: Deposits B4 and B6);
- The extraction of crude oil and co-occurring natural gas from Deposit B8 located in the Polish EEZ of the Baltic Sea using an offshore platform with the ability to inject water into the bedrock (decision no.: RDOŚ-Gd-WOO.4211.16.2015.ER.6 of 11 August 2015 (hereinafter referred to as: Deposit B8).

Moreover, all offshore wind farms from phase I along with the connection infrastructure in the PMA (Fig. 11.1) have decisions on environmental conditions issued for them, i.e.:

- Bałtyk Środkowy III OWF (decision no.: RDOŚ-Gd-WOO.4211.12.2015.KP.22 of 7 July 2016, modified on 8 November 2022, decision no.: RDOŚ-Gd-WOO.420.41.2022.AM.6);
- Polenergia Bałtyk II OWF (decision no.: RDOŚ-Gd-WOO.4211.26.2015.KSZ of 27 March 2017, modified on 26 October 2021, decision no.: RDOŚ-Gd-WOO.420.3.2021.KSZ.14);
- connection infrastructure for Bałtyk II OWF and Bałtyk III OWF (decision no.: RDOŚ-Gd-WOO.420.40.2022.AM.32 of 29 November 2023);
- Baltica 2 OWF and Baltica 3 OWF (decision no.: RDOŚ-Gd-WOO.4211.21.2017.MJ.PW.AJ.37 of 24 January 2020, modified on 21 August 2023, decision no.: RDOŚ-Gd-WOO.420.29.2023.AJ.8);
- connection infrastructure for Baltica B-2/B-3 OWF (decision no.: RDOŚ-Gd-WOO.420.47.2021.AJ.31 of 11 August 2022);
- Baltic Power OWF (decision no.: RDOŚ-Gd-WOO.420.42.2020.AJ.21, modified on 1 March 2023, decision no.: DOOŚ-WDŚZOO.420.32.2022.SP.12);
- connection infrastructure for Baltic Power OWF (decision no.: RDOŚ-Gd-WOO.420.16.2021.AJ.36 of 6 September 2022).

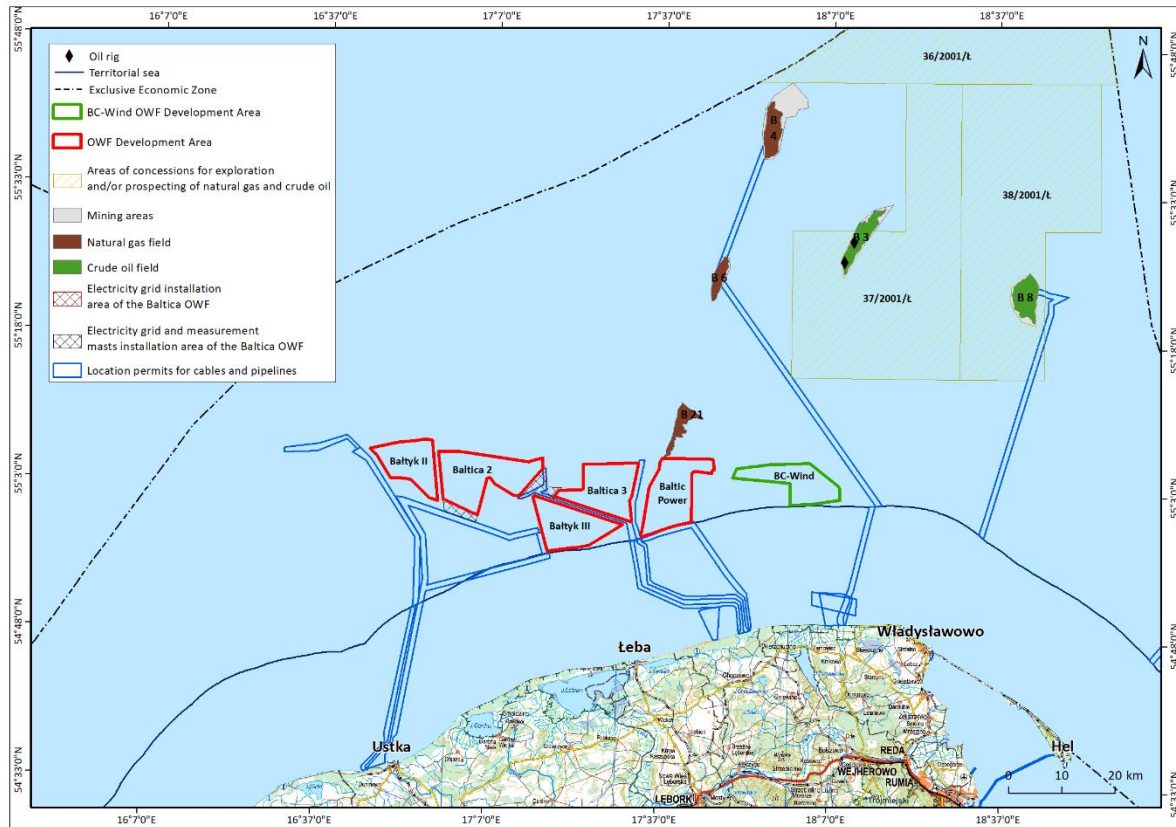


Fig 11.1. Location of the BC-Wind OWF Area among the other projects located in the PMA which had been issued with decisions on environmental conditions

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 315

At the present, preparatory works are being carried out before the construction phases of the offshore wind farms commence. The projects of various Investors are at different stages of progress, therefore the dates of the commencement of construction works and their detailed schedules are unknown. The possibility of the occurrence of cumulative impact at the construction phase, due to the time limitations of the impacts themselves, may take place only when works of the same nature are carried out simultaneously or after a short time interval. With the general assumption of all Investors that the construction phase of their OWF will last several years, it cannot be clearly indicated which activities will be performed simultaneously or within a short period of time. Nevertheless, taking into account that the OWF projects of various Investors will be implemented independently, it cannot be ruled out, guided by the precautionary principle, that these impacts will not occur.

Currently, the most advanced OWF project in the PMA is the Orlen Baltic Power OWF project adjacent to the west. This farm is approx. 4 km away from the BC-Wind OWF (Tab. 11.1). According to the Baltic Power website, construction is expected to start in 2024.⁶⁴⁸ Other farms, located further away, are the Baltica 3, implemented by PGE at a distance of approx. 17 km (construction is to commence at the beginning of 2025), and the Baltica 2 (at a distance of approx. 35.3 km), the works on which are also likely to start soon as the construction permit for this farm is currently being obtained.

Tab. 11.1. Planned offshore wind farms of phase I in relation to the BC-Wind OWF

Name of the OWF	Distance from the BC-Wind OWF [km]	Status	Maximum power [MW]
Bałtyk III	21	Obtained the DEC	1200

⁶⁴⁸ balticpower.pl

Bałyk II	55	Obtained the DEC Construction permit obtained, offshore works to commence in 2026/2027	1200
Baltica 2	35.5	Obtained the DEC Construction permit obtained, offshore works to commence in 2025	1498
Baltica 3	17	Obtained the DEC	1045
FEW Baltic II	70	Obtained the DEC	350
Baltic Power	4	Obtained the DEC Construction permit obtained, offshore works to commence in 2024/2025	1200

Source: own elaboration

Construction of the BC-Wind OWF is planned between 2027 and 2028, therefore it is unlikely to be cumulative with the impacts of the construction phase of the Baltic Power OWF, which is assumed to last up to approx. 2 years.

The second farm that has a high chance of being implemented in the near future is Bałyk III (Polenergia/Equinor), however forecasting the accumulation of individual construction phases is subject to a large error, as Investors do not provide information on construction schedules in advance.

On the other hand, Baltica 2 (PGE) and Bałyk II (Polenergia/Equinor) are very advanced projects, but are located at a considerable distance from the BC-Wind OWF, i.e. 35.5 km and 55 km, respectively.

After the completion of the construction phases, the exploitation phases of individual projects will begin. The beginning of the exploitation phase of the projects of the last of the Investors mentioned above could ultimately generate the greatest possible cumulative impact, resulting from the cumulation of individual impacts indicated for this phase of the project.

Assessing the cumulative impacts of the decommissioning phases of these projects is difficult at this stage, as both the timing and scale of their decommissioning are unknown. Taking into account the assumed OWF lifespan (currently assumed to be approx. 35 years), the impacts should be significantly smaller than for the construction and exploitation phases. As a result of the commencement of the removal of the structures above water, the space will be gradually reclaimed until the original condition is restored. Also, the removal of underwater structures will be a process of gradual restoration of the state before the OWF construction phase. Assuming that the OWF decommissioning process will be a long-term process, carried out in accordance with the applicable regulations and safety standards in terms of the vessels used, and that all structural elements dismantled will be transported to land and disposed of there, it can be indicated that even in the case of decommissioning occurring at the same time in several places within one or more projects, significant cumulative impacts will not occur.

11.2. IDENTIFICATION OF PROJECTS WHICH MAY CAUSE CUMULATIVE IMPACTS

The projects indicated above, which had decisions on environmental conditions issued for them, can be divided into two groups, i.e. projects related to the extraction of hydrocarbons and gas and the ones related to the acquisition of wind energy in offshore areas. Each of these groups of projects has specific characteristics, with different environmental impacts including their type, scope, time range and scale.

Decisions on environmental conditions for the projects related to the extraction of hydrocarbon and gas indicate their impacts and their significance. In the context of the impacts that characterise the BC-Wind OWF, and which may generate a cumulative impact, the impacts of hydrocarbon and gas extraction are irrelevant as they will not cause a cumulative impact.

In the decision on environmental conditions for Deposit B8, it was indicated that the noise associated with the operation of the machines on the platform would not be emitted into the waters, and thus, no adverse impact on the surroundings or the marine environment is expected. Similarly, for Deposit B4 and B6 as well as Deposit B3, the impact of the noise generated during the works related to these projects will be irrelevant. In the case of Deposit B4 and B6, the gas pipeline construction will cause local and temporary water turbidity, but only in the immediate vicinity of the works. Entries from the decisions on environmental conditions which indicate the possible impacts resulting from the implementation of these projects are presented in the table below (Tab. 11.2).

Tab. 11.2. Entries from the decisions on environmental conditions for the projects: Deposit B3, Deposits B4 and B6 and Deposit B8 regarding their impact on the environment

Project	Entries from the decisions on environmental conditions
Deposit B3	Noise emissions into the environment related to the operation of pumps and other equipment which is part of the system for purification and injection of water. The noise intensity concerns the area restricted by the drilling platform structure. Noise has no harmful effects on surroundings and the aquatic environment and as such is not emitted into the waters around the platform
Deposit B4 and B6	As the planned boreholes will be drilled successively by the same drilling rig, no cumulative effects are anticipated due to the drilling of the planned operation boreholes in Deposits B4 and B6 with prospecting wells drilling in adjacent exploration concessions
	According to the EIA Report, the underwater noise emitted in connection with the planned work will not exceed the background parameters
	The impact on the ichthyofauna will consist of local and temporary water turbidity increase during the excavation and the burying of the gas pipeline, which may particularly affect individuals in the early stages of development. The discontinuation of work in the spawning season of the species inhabiting the area of works or arriving there to spawn was ordered
	No negative impact on marine mammals is expected due to their unlikely presence in the work area
Deposit B8	No negative impact of the operation of Deposit B8, including the injection of reservoir waters, on geological structure and seabed sediment pollution in the mining area is expected
	The noise associated with the operation of machines on the platform will not be emitted into the water, so no harmful effects on surroundings and the aquatic environment are anticipated

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 325

In the case of the implementation of six OWFs, i.e. Bałtyk III, Bałtyk II, Baltica 2 with Baltica 3, Baltic Power, Baltic II and BC-Wind, due to the analogous nature of the projects and the resulting practically identical impacts and their relatively close location, cumulative impact may occur. Each of these projects allows for a similar method of the laying of foundations for wind turbines and the development of the space above the water surface with large-size structures. Moreover, regardless of the dates of the commencement of construction works, the exploitation phase of each of these investments is planned for a period of several dozen years, which indicates that from a certain point in time, the resulting environmental impacts may occur.

11.3. ASSESSMENT OF CUMULATIVE IMPACTS

The assessment of impacts caused by the implementation and operation of the BC-Wind OWF in the variant selected for implementation (WWR 2024) on particular elements of the environment, including the impact scale and significance, is presented in Chapter 9.

The cumulative impact of the BC-Wind OWF with other projects implemented in the PMA may occur if activities generating similar impacts are carried out simultaneously. In the case of impacts that have been classified as temporary, cases of simultaneous execution of the same activities by different

Investors should be considered rare. The impacts that have been identified as local will not cause cumulative impacts, as in most cases, their range will not extend beyond the BC-Wind OWF area.

Therefore, the BC-Wind OWF impacts which may generate a cumulative impact with other projects include impacts that are at least medium-term and have a range extending beyond the BC-Wind OWF area, i.e.:

- underwater noise;
- the increase of suspended solids and their sedimentation;
- spatial disturbances, including: barriers restricting the free movement of birds, disturbances in the landscape, and disturbances in radar operation, as well as the restrictions on fishing.

The first two of the indicated impacts will occur during the construction phase, while the third one will occur during the exploitation phase.

11.3.1. Underwater noise

According to current knowledge on the subject, there should be no accumulation of underwater noise during piling at the Baltic Power OWF location, which is located closest to the BC-Wind OWF. This is primarily due to the current schedules of both projects:

- Baltic Power OWF – piling is scheduled in 2025,
- BC-Wind OWF – piling is scheduled in 2027.

Below are the results of the modelling of cumulative underwater noise, assuming simultaneous piling at the two locations.

Marine mammals

Modelling of noise propagation during simultaneous piling at two locations was performed for the purposes of a cumulative assessment of the impact of underwater noise on marine mammals. Three sound source location scenarios, and the application of mitigation measures in the form of a Noise Reduction System (HSD+DBBC were considered as an example) were taken into account. The results were analysed in terms of the predicted areas and furthest ranges of impact, as well as for the effects of hearing damage in the form of cumulative TTS and PTS, and behavioural changes (Tab. 11.3). The details of the conducted modelling are presented in Appendix 3 (Volume III).

Based on the results of the modelling, it can be assumed that if mitigation measures in the form of an NRS are applied during simultaneous piling at two locations, the effect of noise impacts in the form of hearing damage will be negligible for both harbour porpoises and seals. For the behavioural response, the areas of impact on harbour porpoise are large, with the highest values in the scenario with two sources 20 km apart (2980 km²). For seals, the projected behavioural change covers much smaller areas, with the largest values in the case of two sources less than 1 km apart (57 km²).

The final selection of a Noise Reduction System will depend on the final choice of hammer power and the parameters of the monopile and the seabed depth. Details on how noise reduction will be implemented and how marine mammals will be protected from acoustic impacts, primarily hearing damage, will be developed 6 months prior to the commencement of piling and submitted to the RDEP in Gdańsk for approval in the form of a document entitled 'Piling strategy'. Currently, the adopted modelling parameters and the obtained results are based on conservative assumptions and were intended to demonstrate the possibility of achieving the threshold set in the environmental decision. The cumulative noise impact ranges listed below will be verified before the piling is commenced, and should be considered illustrative.

Tab. 11.3. Predicted impact ranges for underwater noise generated during simultaneous piling at two locations obtained for the BC-Wind OWF Area and beyond, assuming the use of mitigation measures in the form of NRS

Animal group	Modelled variable	Effect	1 source	2 sources, < 1 km	2 sources, 20 km	2 sources, significant distance
Harbour porpoise	Maximum impact range [km]	PTS cum.	0.1	0.1	0.1	0.1
		TTS cum.	0.1	0.1	0.1	0.1
		Behavioural response	33.9	52.8	44.2	33.9
	Area of impact [km ²]	PTS cum.	0.03	0.03	0.06	0.06
		TTS cum.	0.03	0.03	0.06	0.06
		Behavioural response	1468	2729	2980	2936
Seals	Maximum impact range [km]	PTS cum.	0.1	0.1	0.1	0.1
		TTS cum.	0.1	0.2	0.1	0.1
		Behavioural response	3	4.9	3	3
	Area of impact [km ²]	TTS cum.	0.03	0.07	0.06	0.06
		PTS cum.	0.03	0.03	0.06	0.06
		Behavioural response	21.9	57.3	44.4	43.8

Source: noise propagation modelling (Appendix 3, Volume III)

Ichthyofauna

The maximum variant provided for the implementation of the project is two simultaneous pilings in the area covering the BC-Wind OWF as well as the Bałtyk II, Bałtyk III, Baltica 2, Baltica 3 and the Baltic Power OWFs.

The models illustrating the maximum range of behavioural response indicate a maximum of approx. 90 km. In the case of the impact of noise and vibrations causing TTS (temporary shift in the hearing threshold and for fish with a swim bladder – reversible hearing damage), the maximum range will not exceed 0.2 km for a single strike and 27.5 km for the cumulative SEL (Tab. 11.4). As is the case with the marine mammals discussed above, the cumulative noise impact ranges listed below relate to conservative assumptions that will be reviewed prior to piling, and should be considered illustrative.

Tab. 11.4. Impact ranges and areas for fish with a swim bladder in the case of simultaneous piling at several locations outside of the BC-Wind OWF Area, at a distance of 20 km or a significantly greater distance (piling with the use of mitigation measures in the form of an NRS)

Effect	2 sources – 20km	2 sources – significant distance
Maximum range [km]:		
Behavioural response	89.7	65.7
TTS (single strike)	0.1	0.1
TTS (cumulative)	27.5	9.2
Reversible hearing damage (single strike)	0.1	0.1
Reversible hearing damage (cumulative)	0.4	0.4
Area of impact [km²]:		
Behavioural response	8973	8616
TTS (single strike)	0.03	0.06
TTS (cumulative)	450	348
Reversible hearing damage (single strike)	0.06	0.06
Reversible hearing damage (cumulative)	0.5	0.06

Source: noise propagation modelling (Appendix 3, Volume III)

In addition, the use of a soft-start method before the commencement of works, which aims to scare the ichthyofauna away from the area subject to impact, should additionally reduce the impact causing TTS (the modelling did not take into account the receptor moving away from the sound source, which was considered in the case of modelling for marine mammals). For this reason, the analysis does not include the possibility of increased mortality or tissue damage in ichthyofauna. For the purposes of the cumulative analysis, the maximum variant was adopted, in which the simultaneous piling is performed at two locations (including one location within the BC-Wind OWF), with the use of a Noise Reduction System.

The cumulative TTS value was adopted as the boundary of **significant** impact of underwater noise on ichthyofauna, although this threshold is questionable due to its inappropriateness for marine conditions, as described further in this Report in the chapter on modelling assumptions (Chapter 8.2). In the case of behavioural responses of organisms to underwater noise, its effect is discontinuous, short-term and does not cause significant changes in behaviour of the organisms due to the acclimatisation to the conditions of increased noise.⁶⁴⁹

Analysing the area within the **TTS_{cum.} impact** range (a maximum of 27.5 km from the source of piling) in the context of the impact on spawning grounds, it does not constitute significant breeding grounds for any fish species. In summer, sprat spawning can be expected there, which, at that time, takes place across the entire Baltic Sea up to a depth of 50 m.

Sprat breeds in the period from February/March to August, with the greatest intensity in the open sea, above the deep-water areas. The spawning intensity in the waters close to the shore is relatively low.⁶⁵⁰ An important fact is that sprat reproduces in large dispersion and over a large area, without forming dense spawning groups.

During the early spring period, the area subject to the impact of noise is part of the area where the spawning migrations of adult (sexually mature) sprats take place between the deep-water spawning grounds. In the second phase of the mass late-spring sprat spawning, the indicated area partially overlaps with the area of occurrence of sexually mature fish and the roe drift in the water depth of the Baltic Sea. However, due to the relatively small impact area, it will not have a significant impact on the final effect of the reproduction process, including the size of the new generation of fish.

The significance of the impact was assessed as moderate for all the examined fish species. As far as protected fish are concerned, only their larval stages occurred during the surveys, for which the impact will be local.

In the transboundary context, the analysis of underwater noise indicated that the extent of significant impact, determined by the TTS value, does not exceed the boundary of the Polish EEZ. Moreover, there is no negative impact on the condition of fish stocks, mainly due to the fact that the analysed area does not play a major role in the overall assessment of the spawning efficiency of most fish species.

The results of the modelling of the impact of underwater noise propagation are presented for fish with a swim bladder as the ichthyofauna group with the highest sensitivity to this factor. Taking into account the area within the range of **behavioural response** (a maximum of 89.7 km for fish with a swim bladder), sprat spawning grounds can be expected to occur within the impact range.

The occurrence of the roe and larvae of other species such as herrings, gobies or ammodytids in the analysed area will result from the spawning taking place outside of this area, in shallow coastal

⁶⁴⁹ Thomsen F., Mueller-Blenkle C., Gill A., Metcalfe J., McGregor P.K., Bendall V., Andersson M.H., Sigray P., Wood D., *Effects of pile driving on the behavior of cod and sole. Advances in Experimental Medicine and Biology* 2012, 730: 387-388

⁶⁵⁰ Horbowa K., Fey D.P., *Atlas wczesnych stadiów rozwojowych ryb. 34 gatunki ryb Bałtyku Południowego i jego zalewów. Morski Instytut Rybacki – Państwowy Instytut Badawczy, Gdynia* 2013

waters and in the waters of the Słupsk Bank.^{651, 652, 653, 654} The spawning of these species directly in the analysed area is unlikely.

In the case of the spawning grounds of cod, the area within an 89.7 km range from the source of the piling may extend to the slopes of the Gdańsk Deep.

The abundance of cod roe in water in the spawning period is the highest in the region of the Bornholm Basin. Since 1986, the Gdańsk Deep has been considered of marginal importance as the spawning grounds for cod. This situation in the Gdańsk Deep is the result of insufficient salinity and oxygen content of the water.^{655, 656} Since 1980s, the abundance of cod larvae is also significantly lower in the Gdańsk Deep than in the Bornholm Deep, indicating a very limited significance of the Gdańsk Deep region for the reproduction of cod.⁶⁵⁷

The reproduction of cod takes place in the water layer below the halocline, where the hydrological conditions for the proper growth of roe such as salinity >11 PSU and oxygenation >2 ml O₂/l are met.^{658, 659} The specific water density resulting from high salinity ensures the buoyancy of roe, and at the same time enables its growth in the higher water layers with better oxygenation. Such conditions are often met in the area of the main cod spawning grounds in the Bornholm Deep, in the water layers >55 m; whereas, in the Gdańsk Deep, the conditions are met only at the depth of >80 m. The latest results of the NMF surveys confirm the presence of unfavourable conditions for the reproduction of cod in the recent years.^{660, 661}

Moreover, taking into account the propagation of sound in acoustic channels, there will no longer be noise levels capable of causing an avoidance reaction at depths below the halocline.

In summary, the analysed area is the location of the spawning grounds of sprat and flounder, but the spawning intensity is generally low. The aforementioned possibility of the occurrence of a more intensive spawning of these two species should not have negative consequences due to the fact that it will take place only on the outskirts of the analysed area (a small area), and at a considerable distance

⁶⁵¹ Margoński P., Ameryk A., Białowas M., Czugała A., Dębek M., Horbowa K., Jakubowska A., Nurek B., Pawlikowski K., Rossa P., Spich K., Warzocha J., Witalis B., Wodzinowski T., Woźniczka A., Wróblewska H., Zalewski M., *Rekrutacja wybranych gatunków ryb a warunki hydrologiczne oraz skład i dostępność bazy pokarmowej – sprawozdanie z realizacji tematu statutowego*. Gdynia 2018

⁶⁵² Margoński P., Ameryk A., Białowas M., Dębek M., Horbowa K., Nadolna-Aftyn K., Nurek B., Pawlak J., Pawlikowski K., Witalis B., Wodzinowski T., Woźniczka A., Wróblewska H., Wybierała I., Zalewski M., *Rekrutacja wybranych gatunków ryb a warunki hydrologiczne oraz skład i dostępność bazy pokarmowej – sprawozdanie z realizacji tematu statutowego*. Gdynia 2019

⁶⁵³ Margoński P., Ameryk A., Celmer Z., Czugała A., Fey D., Horbowa K., Pawlikowski K., Rossa P., Stembarski J., Szymanek L., Vaniała A., Warzocha J., Wodzinowski T., Woźniczka A., Zalewski M., *Relacje pomiędzy rekrutacją wybranych gatunków ryb a czynnikami ją warunkującymi takimi jak warunki hydrometeorologiczne oraz skład i dostępność bazy pokarmowej – sprawozdanie z realizacji tematu statutowego*. Gdynia 2017

⁶⁵⁴ Margoński P., Ameryk A., Dębek M., Fey D., Greszkiewicz M., Horbowa K., Jakubowska A., Nurek B., Pawlikowski K., Rossa P., Spich K., Szkudlarek-Pawelczyk A., Warzocha J., Wodzinowski T., Woźniczka A., Wróblewska H., Zalewski M., *Rekrutacja wybranych gatunków ryb a warunki hydrologiczne oraz skład i dostępność bazy pokarmowej – sprawozdanie z realizacji tematu statutowego*. Gdynia 2017

⁶⁵⁵ MacKenzie B.R., Hinrichsen H.H., Plikshs M., Wieland K., *Quantifying environmental heterogeneity: estimating the size for successful cod egg development in the Baltic Sea and its influence on recruitment*. *Marine Ecology Progress Series* 2000, 193: 143-156

⁶⁵⁶ Köster F.W., Vinther M., MacKenzie B.R., Eero M., Plikshs M., *Environmental effects on recruitment and implications for biological reference points of eastern Baltic cod (Gadus morhua)*. *Journal of Northwest Atlantic Fishery Science* 2009, 41: 205-220

⁶⁵⁷ Köster F.W., Huwer B., Hinrichsen H.H., Neumann V., Makarchouk A., Eero M., Dewitz B.V., Hüsey K., Tomkiewicz J., Margonski P., Temming A., Hermann J., Oesterwind D., Dierking J., Kotterba P., Plikshs M., *Eastern Baltic cod recruitment revisited – dynamics and impacting factors*. *ICES Journal of Marine Science* 2017, 74: 3-19

⁶⁵⁸ Bagge O., Thurow E., Steffensen E., Bay J., *The Baltic cod*. Dana 1994, 10: 1-29

⁶⁵⁹ Nissling A., Westin L., *Salinity requirements for successful spawning of Baltic and Belt Sea cod and the potential for cod stock interaction in the Baltic Sea*. *Mar. Ecol. Prog. Ser.* 1997, 152: 261-271

⁶⁶⁰ Radtke K., Wodzinowski T., Wójcik I., *Wyniki badań oceanograficzno-rybackiego rejsu r.v. Baltica zrealizowanego w lutym i marcu 2019 r.* *Wiadomości Rybackie*. Pismo Morskiego Instytutu Rybackiego – Państwowego Instytutu Badawczego 2019, 3-4 (228): 4-8

⁶⁶¹ Radtke K., Wodzinowski T., Wójcik I., *Wyniki badań oceanograficzno-rybackich r.v. Baltica w rejsie jesiennym 2019 r.* *Wiadomości Rybackie*. Pismo Morskiego Instytutu Rybackiego – Państwowego Instytutu Badawczego 2020, 1-2 (233): 4-9

from the sound source (the weakest impact). The fact that both species reproduce within the vast areas of the southern Baltic and the analysed area does not play a major role in the overall approach to the spawning efficiency of these species' stocks is not without significance for the assessment of the negligible adverse impact of the planned work on the spawning grounds.

Taking into account the noise reduction system adapted for piling, resulting from the need to protect marine mammals, the significance of the cumulative noise impact on ichthyofauna can be described as negligible.

In the transboundary context, the analysis of underwater noise indicated that the extent of the behavioural response occurrence does not exceed the boundary of the Polish EEZ. Moreover, underwater noise has a discontinuous and short-term impact in the case of behavioural response, and does not cause significant changes in the behaviour of ichthyofauna due to its acclimatisation to the conditions of its increased level.⁶⁶²

Impact areas for fish with a swim bladder also decreased with the increasing distance from the simultaneously operated piling sites. The areas were largest in the case of behavioural response.

11.3.2. Increase of suspended solids and their sedimentation

The issue of the increase in the concentration of suspended solids and their sedimentation in terms of the cumulative impact of the BC-Wind OWF with the Baltic Power, Bałtyk II, Bałtyk III, Baltica 2 and Baltica 3 OWFs is described in detail in Appendix 2 to the EIA Report, Volume III.

On the basis of the performed model calculations, it has been established that the cumulative effect of the increase in suspended solids content is possible as a result of various human activities during the construction phase, but that the cumulative impact will be local and short-term.

Additionally, in the case of carrying out works disturbing seabed sediments in two locations located 3 km apart on non-cohesive bottom, the cumulative impact does not occur, and in the case of a cohesive bottom, the impact is minimal.

Due to the temporal and spatial gap between the activities carried out within the OWF and in the area of the external connection infrastructure, there will be no cumulative impact resulting from the increase in the content of suspended solids and their sedimentation.

The impact associated with the increase in suspended solids will be a negative, direct, local and short-term. It may accumulate only if there is a simultaneous execution of works at the Baltic Power OWF, which is directly adjacent to the BC-Wind OWF. However, due to the advancement of the Baltic Power OWF project (planned start of works in 2024), no cumulative impact is expected to occur.

11.3.3. Spatial disturbances

Creation of a physical barrier

The analysis of cumulative impact refers to the planned offshore wind farms in the central Baltic region – in the PMA, the following are in phase I: Bałtyk II, Bałtyk III, C-Wind, Baltica 2, Baltica 3, FEW Baltic II, and Baltic Power – as well as to the concessions for gas and oil extraction (currently there are three exploration concessions valid in the Baltic Sea and concessions for the production of oil and gas from two areas near the BC-Wind OWF Area), since the additional structures and specialised vessels may generate additional disturbances in the environment. Potential cumulative impacts on migratory birds are the barrier effect and the risk of collision. The detailed results of the model calculations and the assessment of the impact of the physical barrier on migratory birds are contained in Appendix 4 to the EIA Report (Volume III).

Cumulative impacts of the BC-Wind OWF with other OWFs may occur in the case when more than one OWF is in a construction/exploitation/decommissioning phase at the same time. The intensity

⁶⁶² Thomsen et al. 2012...

and scale of these impacts are currently unknown. Currently (December 2024), the Baltic Power OWF is in construction. With the construction of the last of the listed OWFs, a maximum spatial disturbance caused by the presence of above-water structures arranged over a significant area of 639.6 km² shall occur.

The gas and oil concession areas are located in deep waters, away from the planned OWFs. Extraction- and related activities will concern a very small area (e.g. of an oil rig), therefore they were omitted in further analysis.

The barrier effect, as an impact on species migrating over long distances, results in changes in the migration route and flight altitude, which is also associated with increased energy expenditure. In order to quantify the impact of the barrier effect of the BC-Wind OWF and other projects planned in this region, the migration route was modified assuming that migratory birds will perceive the OWF areas as a physical barrier which they will bypass at a distance of approx. 1-2 km. In the figure below (Fig. 11.2), sample flight routes of migratory birds are marked in order to trace the potential overlap between OWF areas and flight routes. Given the flight direction and location of OWFs, it is unlikely that birds will encounter more than 1-2 OWFs during their migration.

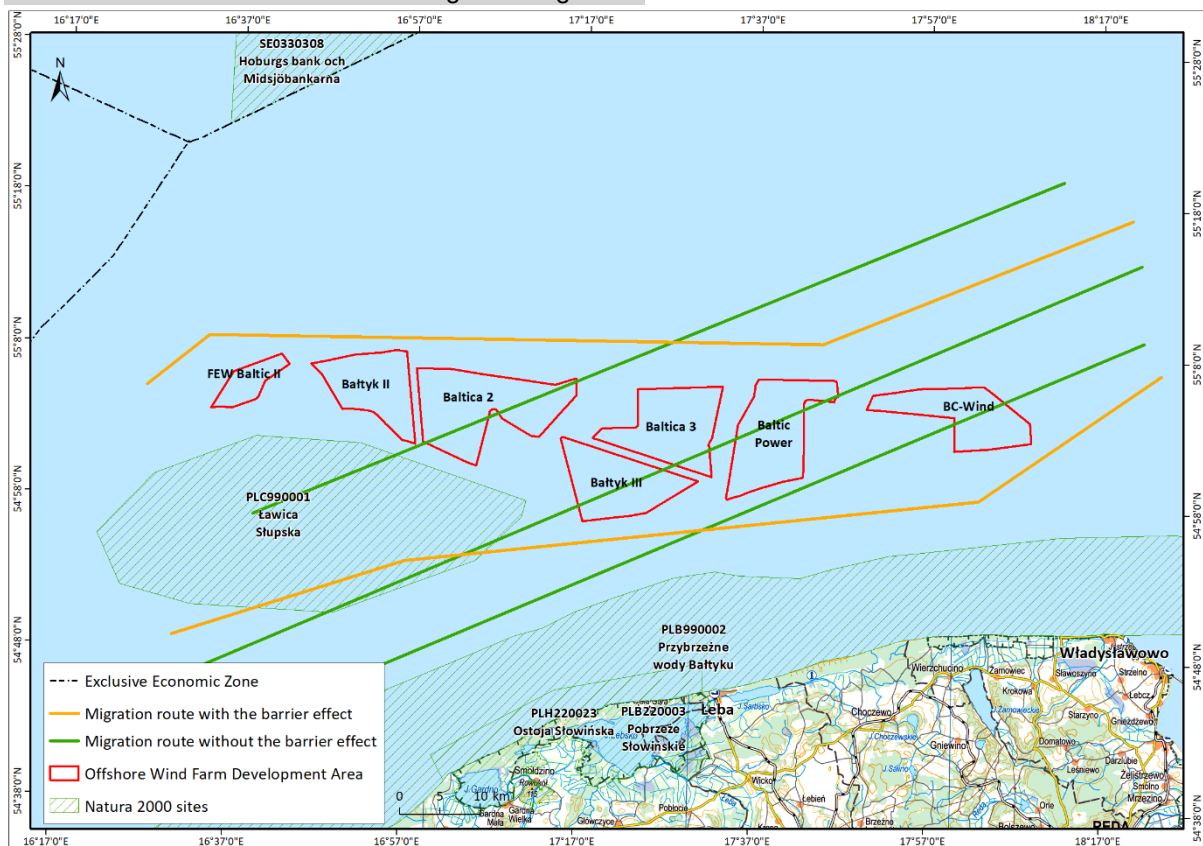


Fig. 11.2. Examples of theoretical migration routes of birds migrating along the axis from the northeast to the southwest

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 322

Impact on flight routes

Due to the marginal increase in energy expenditures related to the change in flight trajectory, the impact significance was assessed as negligible for the majority of species. Only for the long-tailed duck, the common scoter, and the velvet scoter it was assessed as low (Tab. 11.5).

Cumulative collision risk

The cumulative collision risk was analysed as part of the modelling in Appendix 4 to this Report (Volume III). To estimate the number of possible collisions of migratory birds in the case of cumulative impact, the results obtained from the collision risk modelling were multiplied by 16.25, a factor which takes into account the capacity of the remaining seven OWFs in relation to the capacity of the BC-Wind OWF. For most species, mortality still remains at a very low level. The cumulative impact in the case of the common scoter cannot be excluded (from a few to over a dozen individuals subject to collisions), and in the case of the crane, it concerns a maximum of 91 individuals in autumn and 18 in spring in the smallest clearance variants (20 and 25 meters). For the RAV 2024, the collision risk was estimated at a maximum of 186 individuals in autumn and 36 in spring (Appendix 4, Volume III). Despite the almost halved collision risk, the significance of the cumulative impact for the migration of cranes was assessed as moderate. The good condition of this species' population, even at the maximum collision mortality rates, will not change. The significance of the cumulative risk of collision was determined to be low for the long-tailed duck, the common scoter, and the velvet scoter (Tab. 11.5).

Tab. 11.5. Summary of cumulative impacts on migratory birds

Species/group of species	Receptor value/significance	Impact	Impact reversibility	Size of impact	Significance of impact
Long-tailed duck <i>Clangula hyemalis</i>	High	Barrier effect	Reversible	Irrelevant	Low
		Risk of collision	Irreversible	Irrelevant	Low
Common scoter <i>Melanitta nigra</i>	Moderate	Barrier effect	Reversible	Irrelevant	Low
		Risk of collision	Irreversible	Irrelevant	Low
Velvet scoter <i>Melanitta fusca</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Low
Ducks (Eurasian wigeon, etc.) <i>Anatini</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Greater scaup <i>Aythya marila</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Geese <i>Anseridae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Swans <i>Cygnidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Divers <i>Gaviidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Auks <i>Alcidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Great cormorant <i>Phalacrocorax carbo</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Little gull <i>Hydrocoloeus minutus</i>	Moderate	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Black-headed gull <i>Larus ridibundus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Lesser black-backed gull <i>Larus fuscus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Common gull <i>Larus canus</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible

Species/group of species	Receptor value/significance	Impact	Impact reversibility	Size of impact	Significance of impact
Terns <i>Sternidae</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Charadriiformes <i>Charadriiformes</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Negligible
Common crane <i>Grus grus</i>	High	Barrier effect	Reversible	Irrelevant	Negligible
		Risk of collision	Irreversible	Irrelevant	Moderate
Passerines <i>Passeriformes</i>	Low	Barrier effect	Reversible	Irrelevant	Negligible

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp. 331-332

The spatial disturbance created as a result of the construction of the OWF stems from the presence of a structure above the water surface, in the sea areas previously free from any physical barriers. The formal conditions indicated in the PSZW permit for the BC-Wind OWF, as well as the other OWFs, introduce restrictions concerning the possibility of their development. They indicate that the distances between individual wind turbines cannot be smaller than four times the length of the diameter of the rotors. The currently planned placement of the wind turbines within the BC-Wind OWF meets this condition. Therefore, the disturbed space is practically limited to the rotor working height range. Thus, within the BC-Wind OWF area, as well as in the remaining OWF areas, a partial, long-term (limited to the time of operation) limitation of aerial space use will occur. Within all of the OWF development areas (between individual wind turbines and the accompanying structures) as well as around the individual OWF areas, the space will remain undisturbed. The discontinuous nature of the development, with significant distances between individual OWF structures (approx. 1000 m with the currently being applied for rotor diameter of 250 m), will create a discontinuous and uneven spatial disturbance. This unevenness will also occur within the structures themselves. The greatest spatial disturbance will occur within the operating range of the rotor, i.e. more than 20 m above the water surface.

The aerial space above the marine areas is used regularly by birds, including especially migratory birds. Its disturbance caused by the creation of a physical barrier will result in the necessity to bypass it, both during the spring and autumn migrations.

Taking into account the investment plans related to wind energy in the central part of the southern Baltic (the sea areas of POM.43.E, POM.44.E, POM.45.E and POM.46.E from the MSPPSA), and assuming that they will be implemented, it can be indicated that eventually an area with a length of approx. 130 km will be developed. For the birds flying in accordance with the prevailing directions of migration in this region, the actual width of the barrier will be approx. 90 km.

The BC-Wind OWF constitutes the eastern boundary of the areas listed in the MSPPSA, bordering only from the west with the Baltic Power OWF and from the south with the 46.E.1 area (A-Wind OWF). The development-free between the OWFs listed above, allowing for the migration of avifauna, is at least 4 km (between the Baltic Power OWF and the BC-Wind OWF) and 500 metres (between the BC-Wind OWF and the A-Wind OWF), in accordance with the changes made in the BC-Wind OWF development area (Fig. 11.3). In addition, the distance between individual turbines in the OWF area is planned to be four times the rotor diameter, ensuring a disturbance-free space for birds moving inside the OWF area. This area shall create a system of space free from development, allowing for the movement of birds in a way minimising the potential disruptions in their migration.

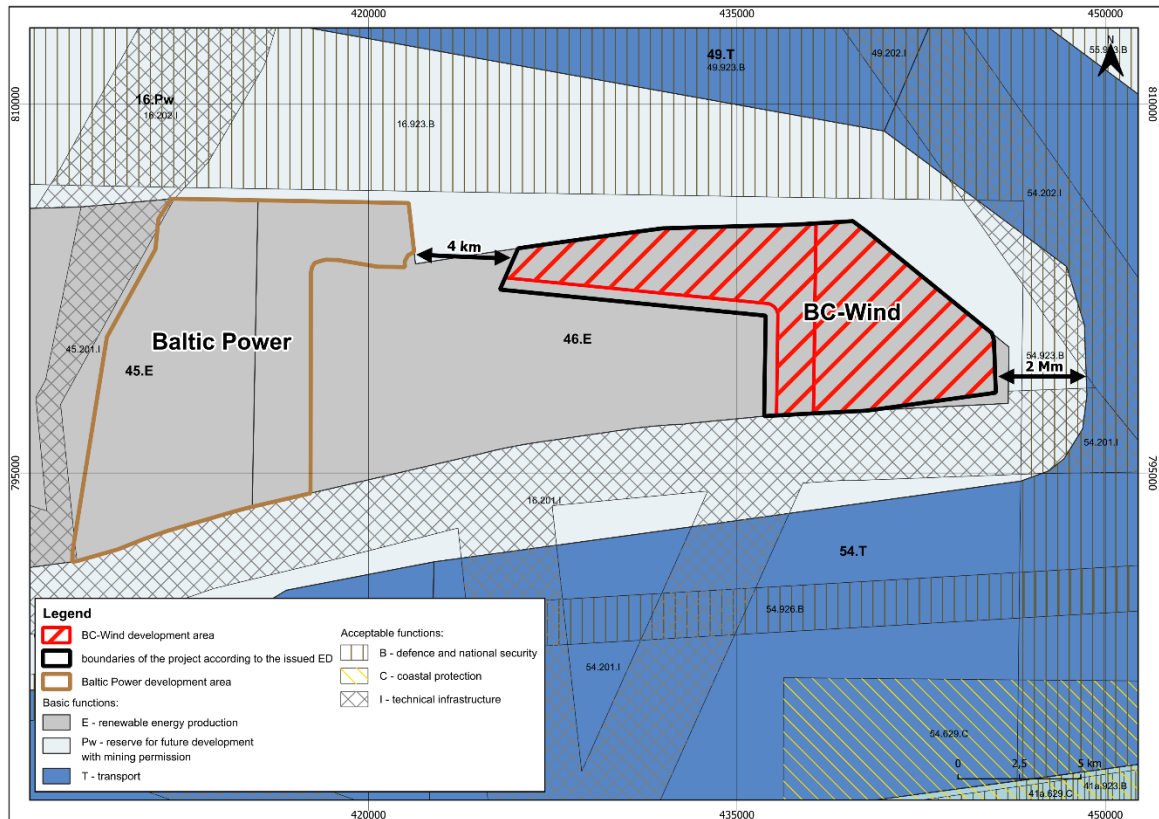


Fig. 11.3. Development area of the BC-Wind OWF in the context of preserving migration and transport corridors

Source: own elaboration

Without the full knowledge on the possible behaviour of birds in the context of such an extensive disturbance of the space used by them during periods of migration, and taking into account the precautionary principle, it can be concluded that the introduced restrictions on the area of the BC-Wind OWF and the spacing between the individual turbines constitute a solution beneficial from the point of view of birds using this area, both during migration, and for local movement.

On the basis of the conducted surveys and with the application of the solution of leaving the proposed areas (corridors) between the OWFs free from development, the significance of cumulative impact in the form of a physical barrier was assessed as, at the maximum, low.

Landscape disturbance

Landscape disturbances, in the case of cumulative impacts related to the simultaneous operation of the BC-Wind, Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III OWFs, as described in Chapter 9.7, depend mostly on weather conditions, i.e. the visibility and the curvature of the Earth.

Fig. 9.23 presents the number of hours per year for a given visibility (how often the visibility is greater than a specific value) based on the data from the atmospheric model UMPL (calculated by the ICM UW – data from approx. 5 years). These values are shown for 4 locations – Łeba, Lubiatowo, Dębki and Jastrzębia Góra. In the case of Łeba, single wind turbines may be visible for even approx. 5000 hours per year, but 50% of wind turbines installed in these OWFs may be visible for a very short period of time (several dozen hours per year). From Lubiatowo, single wind turbines may be visible for over 5000 hours per year, while 25% of the wind turbines installed in the OWF under assessment will practically not be visible at all. The observer from Dębki and Jastrzębia Góra may see single wind turbines for more than 5000 hours per year, but in practice they will never see more than 25% of the wind turbines installed.

In addition, the constraint associated with the visibility of wind turbines from land is the curvature of the Earth and the associated height restriction of the objects that can be seen from a great distance. In practical terms, this limitation manifests itself by the phenomenon that the further the offshore wind turbines are located from the observer, the fewer of them can be seen. The figures below (Fig. 11.4, Fig. 11.5) present the visualisations of the view on the BC-Wind OWF together with the Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III OWFs from Białogóra and Dębki.



Fig. 11.4. Visualisation of the view on the BC-Wind OWF together with the Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III OWFs from Białogóra

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 334



Fig. 11.5. Visualisation of the view on the BC-Wind OWF together with the Baltic Power, Baltica, Baltic II, Bałtyk II and Bałtyk III OWFs from Dębki

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 334

As in the non-cumulative scenario, the impact was assessed as negligible, although it varies depending on the distance of the observer from the OWF. In the open sea, the landscape is not immune to the disturbance, but its value is not high, because very few people and only for a short time will be exposed to the change of landscape, and some of them (e.g. tourists) may perceive it as positive or interesting. The scale of the impact will have a large spatial extent, which will decrease with the increasing distance from the OWF. This will be a long-term but reversible change. On land, the upper fragments of the OWF can be sporadically seen (Fig. 11.4, Fig. 11.5).

The visualisation of the BC-Wind OWF together with the Baltic Power, Baltica, Baltica II, Bałtyk II and Bałtyk III OWFs is additionally included in Appendix 5 to the EIA Report (Volume III).

Interference in the operation of systems using EMF

The space above the OWF areas is used for the functioning of systems using the electromagnetic field, such as: navigational radars of vessels, shore radar systems, radio communication devices and systems for transmitting radio and terrestrial television signals. The construction of a single OWF, as well as more OWFs, may disrupt the proper functioning of these systems. The magnitude of the disturbances would be directly proportional to the number of structures erected in sea areas and could cover a proportionately larger sea area.

Considering the possible negative effects of disturbances in the systems using electromagnetic field, the minister responsible for maritime economy obliged Investors to perform a number of specific actions in the PSzW issued for all of the OWFs. These activities will be aimed at ensuring state defence and security, as well as the safety of navigation.

The necessity to perform these compensatory actions indicates that the impact of the BC-Wind and other OWFs on systems using EMF should be considered only hypothetical, and it will not occur.

Fishing

The planned projects related to the implementation of OWFs and transmission infrastructure will be located within 13 fishing squares (K8, L8, M8, N8, O8, P8, L7, M7, N7, O7, P7, L6, O6 and L5), with their total area amounting to 1035.38 km².

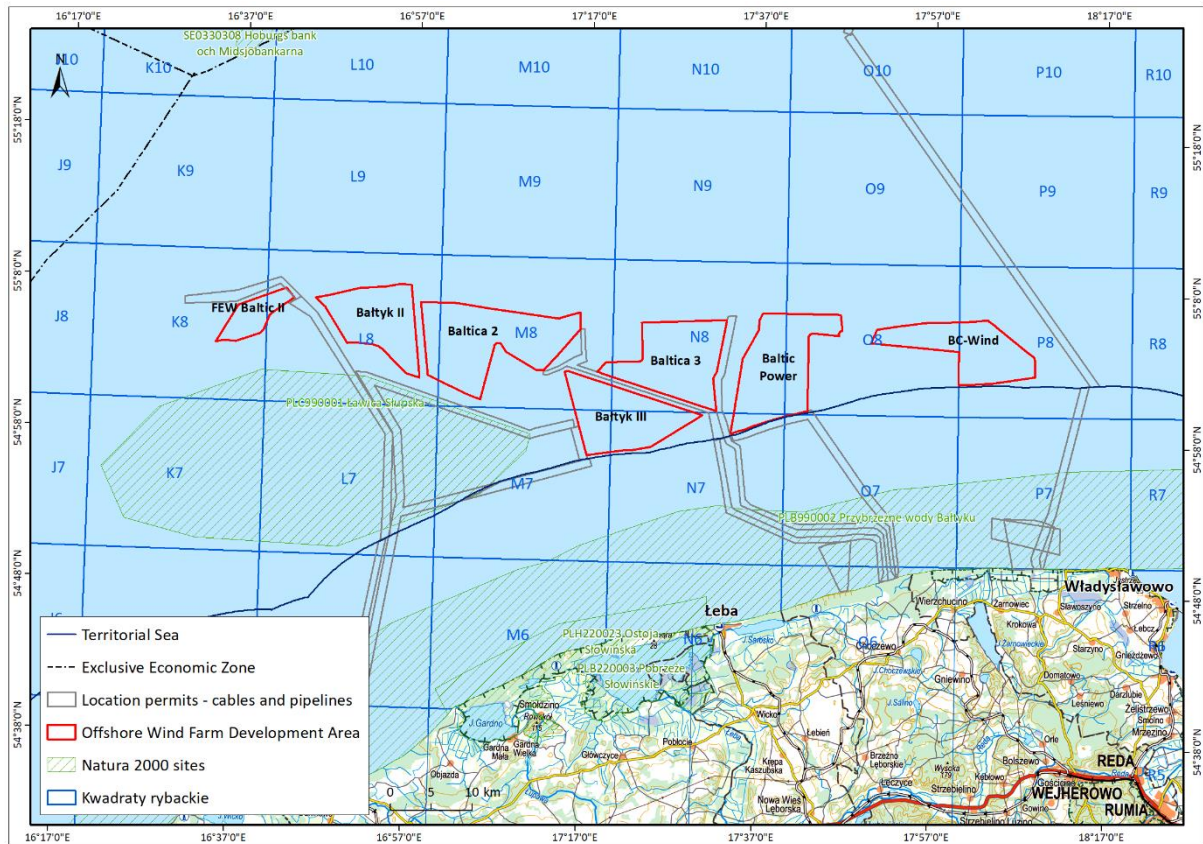


Fig. 11.6. Location of OWFs and the areas intended for transmission infrastructure against the background of fishing squares

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 328

In the indicated fishing squares, between 113 and 155 fishing vessels were operating to a greater or lesser extent in 2015-2019, representing between 14-19% of all the Polish fishing vessels (Tab. 11.6) actively operating in the Baltic Sea.

Tab. 11.6. Number of vessels fishing in the squares occupied by OWFs and transmission infrastructure, as well as the total number of registered vessels in 2015–2019

Year	Number of fishing vessels operating		Share of the number of vessels fishing in the squares occupied by OWFs and transmission infrastructure in relation to the number of vessels fishing in the Baltic Sea and registered in Poland [%]
	In the squares occupied by OWFs and transmission infrastructure	In the Baltic Sea, registered in Poland	
2015	155	810	19
2016	129	812	16
2017	115	797	14
2018	143	777	18
2019	113	786	14

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 335

The value of catches in the fishing squares where OWFs and transmission infrastructure will be located was between 2.8 and 6.4 million PLN in 2015-2019, with the average value for this period being 4.8 million PLN (Tab. 11.7). This represented between 1-3% of the value of Polish catches in the Baltic Sea. The volume of catches in individual squares varied considerably. The highest average catch values in 2015-2019 were obtained in the P8 and L8 squares, amounting to 950 thousand and 534 thousand PLN, respectively. The areas of these squares are to be occupied for the purposes of the OWF and the transmission infrastructure in 15.1% and 44.2%, respectively. Estimated on the basis of the share of the areas to be occupied by OWFs together with transmission infrastructure in relation to their total area, the value of the catches conducted in 2015-2019 was on average 960 thousand PLN, varying from 0.5 million PLN in 2019 to 1.2 million PLN in 2015. This represented between 0.3 and 0.6% (on average 0.5%) of the value of the Polish catches in the Baltic Sea.

Tab. 11.7. Value of catches conducted in fishing squares (the entire area) in the area where the OWFs are to be located

Fishing square	Value of catches [thousand PLN]					Average value of catches in 2015-2019 [thousand PLN]
	2015	2016	2017	2018	2019	
K8	188.8	220.6	54.9	518.3	41.4	204.8
L5	773.2	842.5	410.5	286.6	317.5	526.1
L6	710.7	674.1	240.2	568	190.5	476.7
L7	460.1	362.6	246.5	449.3	171.2	337.9
L8	639.9	758.5	548.9	468.8	251.8	533.6
M7	403	509.9	312.8	369.5	147.9	348.6
M8	338.8	622.3	527.3	314.3	117	383.9
N7	308.4	240.7	271.1	226.3	93.9	228.1
N8	209.4	151.9	250	56.6	59.7	145.5
O6	461.6	223.2	151.3	217.1	64.8	223.6
O7	362.8	200.8	144.8	144.2	42.9	179.1
O8	382.9	119.4	374.5	160	79.3	223.2
P8	1138.8	361.6	1278.1	793.6	1207.4	955.9
Total	6378.4	5287.9	4810.8	4572.6	2785.1	4767.00

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 336

In 2015-2019, in the area of the 13 squares under analysis, set gear accounted for the dominant share of the catch value (on average 53%). Following the declining quantities of cod caught from year to year (due to the deteriorating stock condition), the share of set gear also decreased in terms of value (from 54% and even 70% in 2015-2016 to 38% in 2019). The most important species caught throughout the period under analysis in terms of value was cod at 54%, followed by herring and flounder. In 2019, the share of cod in the value of catches decreased to only 23% in favour of an increase in the proportion of herring (up to 29%).

Tab. 11.8. Catch volumes in 2015-2019 in the area of the 13 fishing squares where the OWFs and transmission infrastructure will be located

Species/group	Catch volume by year [t]				
	2015	2016	2017	2018	2019
Cod <i>Gadus morhua</i>	907	802	426	433	125

Species/group	Catch volume by year [t]				
	2015	2016	2017	2018	2019
Flounder <i>Platichthys flesus</i>	311	230	156	470	188
Herring <i>Clupea harengus</i>	981	270	979	365	670
European sprat <i>Sprattus sprattus</i>	168	172	103	486	639
Other	27	40	41	54	37
Total	2394	1514	1705	1808	1659

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 337

The movement of fishing vessels conducting catches using set gear may cause conflicts with the existing users of the fishing grounds, where the amount of deployed gear will increase. However, given the significantly reduced fishing potential of the Polish fleet after accession to the European Union and the aforementioned deterioration of cod stocks in the southern Baltic resulting in the suspension of targeted fishing for this species in the eastern Baltic Sea in 2020 [Council Regulation (EU) 2019/1838 of 30 October 2019 fixing for 2020 the fishing opportunities for certain fish stocks and groups of fish stocks applicable in the Baltic Sea and amending Regulation (EU) 2019/124 as regards certain fishing opportunities in other waters (OJ L 281, 31.10.2019, p. 1-14)], as well as the extension of these restrictions to 2021, it should not be expected that excessive concentrations (above those recorded so far) of set nets after the shift of effort from the area occupied by OWFs will take place. With this in mind, the significance of the cumulative negative impact of the relocation of the fishing fleet can be considered of little importance.

Increased distance and time to reach fishing grounds

The creation of a barrier to the free passage of fishing vessels will constitute a negative impact of the presence of the many OWFs in the neighbouring locations. The location of other OWFs east and west of the BC-Wind OWF, without designating a navigation corridor for vessels, will extend the route of fishing vessels to productive fisheries located north of the OWF in the Słupsk Furrow area. This may incur additional costs, mainly for fishing vessels stationed in the ports of Ustka (59 vessels) and Łeba (30 vessels). This will be due to the increased amount of fuel necessary to navigate around the OWFs, and the time needed to reach the fishing grounds.

Fig. 11.7 presents the location of the planned OWFs in relation to the shortest routes to the fishing grounds in the Słupsk Furrow area, along with the potentially changed routes to those fishing grounds due to the presence of the OWFs.

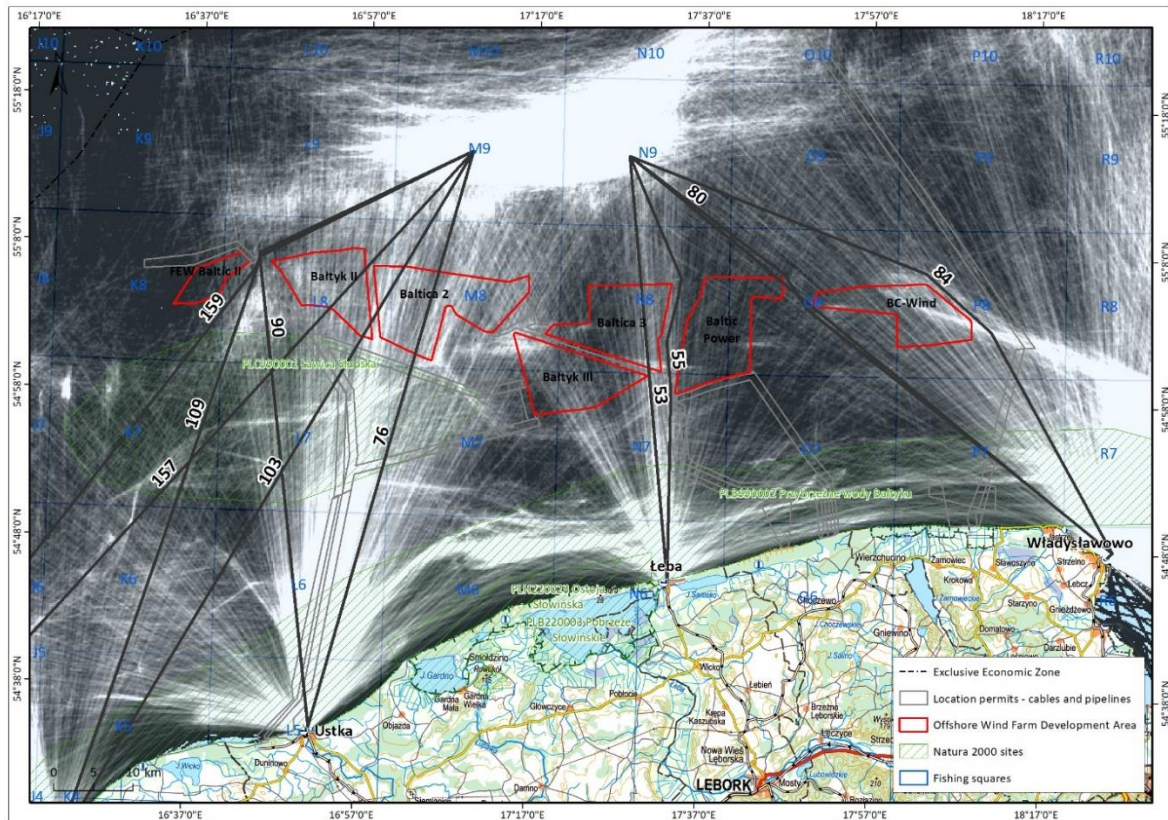


Fig. 11.7. Existing and potentially extended routes to the fishing grounds in the Słupsk Furrow area, due to the presence of the OWFs

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 331

In order to calculate the estimated increase in the costs of sea fishing activity, given the necessity to bypass the OWFs, a dedicated analysis was conducted regarding the activity of fishing vessels sailing from and returning to the ports in Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo. The calculations accounted for the number of cruises aimed at the fishing grounds located north of the OWFs. The centres of the M9 and N9 squares were selected as destination points for the purpose of the calculations. On the basis of the data from the logbooks and the register of fishing vessels, the number of fishing vessels operating in the squares was determined: M9 for the ports in Kołobrzeg, Darłowo and Ustka, and N9 for the ports in Łeba and Władysławowo. Only the cruises beginning and ending in the same port were considered. In view of the above, the analysis accounted for fishing activities of vessels that usually pass through the OWF areas in order to fish in the Słupsk Furrow. On the basis of the RRW-19 Questionnaire – ‘Report on economic results of the fishing vessel’, the average number of fishermen employed onboard the vessels subject to the analysis was determined (in order to calculate the increase in labour costs). The average diesel consumption of 15 litres/hour was assumed in the calculation of the increase in fuel costs (approximate data, information from the owner of a K-15 KS vessel with a length of 17 m and the engine power of 121 kW). The average fuel cost per kW of engine power was calculated using marine fuel prices in 2017-2019 (2047, 2505 and 2505 PLN per tonne, respectively). The cost of additional work time of fishermen was calculated on the basis of average monthly salaries in the enterprise sector (4530, 4852, and 5169 PLN, respectively). The additional time required by fishing vessels to sail around the OWFs was calculated assuming the average speed of the vessel at a level of 6 knots (11 km/h). Tab. 11.9 provides information on the extended time and length of the routes related to bypassing the OWFs as required by fishing vessels to access the fishing grounds in the Słupsk Furrow area and return to home ports.

Tab. 11.9. Additional times and route distances required to bypass the OWFs on the way to and from the fishing grounds in the Słupsk Furrow area, calculated for the fishing vessels operating from the ports of Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo

Port	Time [h]	Length [m]
Kołobrzeg	0.36	4
Darłowo	1.08	12
Ustka	2.52	28
Łeba	0.36	4
Władysławowo	0.72	8

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 339

The resulting calculations, based on the data from 2017-2019, indicate that the need for bypassing the OWFs by fishing vessels sailing from and returning to the ports in Kołobrzeg, Darłowo, Ustka, Łeba and Władysławowo, and fishing at the fishing grounds of the Słupsk Furrow, will incur an increase in fuel costs by approx. 40 thousand PLN per year (Tab. 11.10). The increased time of arrival to and return from the fishing grounds may generate additional labour costs of approx. 111 thousand PLN per year. Due to the significant importance of fishing grounds in the Słupsk Furrow area for the fishermen from the home port of Ustka, as well as the greatest extension of the route (by 28 km in both directions), the fishermen from that port will experience the largest increase in costs resulting from the need to bypass the OWF area. The estimated total increase in fuel and labour costs for this port will approximate 135 thousand PLN, which constitutes approx. 90% of the total costs for all the ports under analysis (Tab. 11.10).

Tab. 11.10. Calculation of additional costs for fisheries resulting from bypassing the OWFs en route to the fishing grounds of the Słupsk Furrow

Year	Port	Number of vessels	Average crew number	Number of cruises	kW cruise	Additional cruise time [h]	Additional labour time [h]	Cost of 1 kWh [PLN]	Cost of 1 man-hour [PLN]	Additional fuel cost [PLN]	Additional labour cost [PLN]	Total [PLN]
2017	Darłowo	2	4.0	4	974	4	17	0.21	27	221	467	687
	Kołobrzeg	8	4.0	17	2616	6	24			198	661	859
	Łeba	12	4.0	192	24590	69	276			1859	7447	9306
	Ustka	30	4.3	316	53789	796	3454			28 465	93269	121735
	Władysławowo	30	4.9	68	19 324	49	248			2922	6687	9609
Total in 2017		82	4.4	597	101294	925	4020	0.21	27	33665	108532	142196
2018	Darłowo	1	3.4	5	350	5	18	0.26	29	98	532	631
	Kołobrzeg	9	4.0	10	1696	4	14			159	418	576
	Łeba	14	3.8	113	14514	41	160			1359	4650	6008
	Ustka	29	4.3	283	53 609	713	3119			35125	90444	125569
	Władysławowo	15	4.8	44	12244	32	154			2292	4477	6769
Total in 2018		68	4.3	455	82413	795	3466	0.26	29	39032	100520	139553
2019	Darłowo	1	4.0	1	121	1	4	0.26	31	34	134	168
	Kołobrzeg	6	4.8	8	1993	3	13			187	411	597
	Łeba	11	3.8	99	10730	36	139			1004	4306	5310
	Ustka	26	4.3	339	61850	854	3736			40524	115821	156345
	Władysławowo	7	5.0	33	9616	24	118			1800	3643	5443
Total in 2019		51	4.4	480	84310	918	4010	0.26	31	43549	124313	167862
Average		67		511	89339	879	3832			38749	111122	149871

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 340

Given the above, the significance of the cumulative negative impact related to the necessity to extend the routes of fishing vessels to fishing grounds should be regarded as high. In order to limit the negative impact on fisheries in this regard, navigation corridors should be preserved between the OWFs, with the necessary width ensuring the safety of navigation. In such a case, the significance of the project cumulative impact on fishery may be considered low. Another solution could be to allow the transit of fishing vessels through the BC-Wind OWF Area. The establishment of navigation corridors or the approval of navigation through the BC-Wind OWF Area is the sole responsibility of the director of the relevant maritime office.

11.3.4 Summary of cumulative impacts

In relation to the assessment of cumulative impacts carried out at the stage of obtaining the DEC, a reduction in the risk of impacts associated with the construction phase can now be indicated:

- it can be indicated with high probability that piling within the neighbouring Baltic Power OWF will take place a few years before piling within the BC-Wind OWF starts (approx. 2 years) so there will be no cumulative noise impacts; the other OWFs are located several tens of kilometres from the BC-Wind OWF and all Investors are obliged to use noise reduction systems;
- there will be no cumulative impacts related to significant turbidity of water during the implementation of gravity foundations, as currently all Investors have excluded it from plans.

Possible impact of a cumulative exploitation phase would be lesser due to the reduction of the number of turbines and the height of the BC-Wind OWF power plant, but the impacts associated with spatial disturbance remain the same.

12. TRANSBOUNDARY IMPACTS

The BC-Wind OWF Area is located within the Polish EEZ. The distances of this area to the boundaries of the EEZs of other countries are as follows:

- over 64.7 km from the Swedish EEZ;
- 90.5 km from the Danish EEZ;
- over 67 km from the Russian EEZ;
- over 208.2 km from the German EEZ.

The impact assessment conducted for individual elements of the environment indicates that their scope will be local. Only in three cases, the impact of the BC-Wind OWF was identified as regional in scale. This refers to the impact of:

- underwater noise on adult fish during the construction phase;
- underwater noise on marine mammals during the construction phase;
- the barrier effect on birds during the exploitation phase.

In the case of underwater noise, an NRS will be applied, which limits the range of noise to 11 km from the boundary of the BC-Wind OWF in accordance with the DEC, and therefore will not result in any transboundary impact.

With regard to the Convention on Environmental Impact Assessment in a Transboundary Context adopted in Espoo on 25 February 1991 and the Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, potential transboundary impacts cannot be excluded for the BC-Wind OWF in the case of migratory and wintering birds. Almost all species passing through this area are birds covering long distances between nesting sites and wintering grounds or birds moving locally. This means that the barrier effect and the risk of collision affect birds that spend at least part of their lives in northwest Russia and Scandinavia. In addition, some of the affected species are listed in Annex I of the Birds Directive or included in the Natura 2000 network of protected sites in neighbouring countries, and therefore, the impacts of the BC-Wind OWF may affect the abundance of birds which are the subject of protection in those areas.

Surveys carried out as part of the migratory bird inventory for this project indicate that the impacts of the barrier effect and the risk of collision, for the vast majority of species, were considered negligible and irrelevant. The significance of the barrier effect at the level of a single OWF was assessed to be negligible for all species. Transboundary impacts were assessed likewise (in a few cases they were assessed as being of low significance). For most species, the increased bird mortality due to collisions with OWFs will constitute an undetectable part of the total mortality on a transboundary scale (natural and related to human activity). The moderate significance of the risk of collision in the case of the crane will not affect the condition of the populations nesting and wintering in the remaining Baltic countries (the mortality threshold for cranes that its biogeographic population can cope with and remain in good condition is 1887 individuals per year⁶⁶³) and will be negligible or of low significance when mitigation measures are applied (a periodic shutdown of individual wind turbines during the intensive passage of cranes). The predicted mortality resulting from collisions will not pose a threat to the population, which will be able to compensate for the lost individuals as a result of the project impact.

In the case of a larger number of OWFs, with the application of recommended mitigation measures (also included in the EIA Reports for other OWFs in the area) it will be possible to avoid exceeding the mortality threshold mentioned above. It should be noted, however, that the effect will depend on the number of flying cranes, which, based on long-term observations of migration across the Baltic Sea, is characterized by a large variability, both in the number of individuals and in the location of migration.

⁶⁶³ Skov H., Mortensen L.O., Tuhuteru N., Site selection for offshore wind farms in Danish waters. Investigations of bird distribution and abundance. DHI 2019

In the context of all the OWFs in this area, an important element reducing the risk of collision is the creation of a system of corridors (areas free from development), enabling the free movement of birds between individual OWFs.

The OWF area is a place of periodic (winter season) concentrations of the long-tailed duck, the velvet scoter, the razorbill and the European herring gull, and in the summer period also the common guillemot. The performed surveys have indicated that the birds wintering in this part of the Baltic Sea travel locally in all directions with no distinct pattern during short feeding flights. This confirms the rule that seabirds have a strong attachment to their wintering grounds.^{664, 665, 666} In the transboundary context, the results of the modelling of avifauna abundance at the BC-Wind OWF during the wintering period and the data from literature on their Baltic population size were compared and presented in the table below (Tab. 12.1).

Tab. 12.1. Comparison of the abundance of birds wintering in the OWF area and the Baltic Sea area

Species	BC-Wind OWF	Baltic Population
Long-tailed duck <i>Clangula hyemalis</i>	62	1500000*
Velvet scoter <i>Melanitta fusca</i>	3	373000*
Razorbill <i>Alca torda</i>	288	155000**
European herring gull <i>Larus argentatus</i>	631	No data
Total	984	-

* source: HELCOM 2013⁶⁶⁷

** source: Chylarecki et al.⁶⁶⁸

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 344

In comparison with the Baltic population, the size of the long-tailed duck population in the OWF area is 0.004%, the velvet scoter – 0.001%, and the razorbill – 0.2%. There is no data on the size of the Baltic population of the European herring gull. However, due to the fact that these birds accompany fishing boats at fishing grounds, their occurrence in the open sea is strongly conditioned by human activity. Thus, no transboundary impacts of a single project of the construction of the BC-Wind OWF are expected.

The impact assessment performed at this stage with the use of modelling based on the updated parameters of the BC-Wind OWF indicates that no new negative impacts will occur. The significance of the impacts remains the same but the scale of the impacts will be smaller compared to the assessment carried out at the stage of obtaining the DEC. The current parameters of the BC-Wind OWF have been reduced, most significantly by reducing the number of wind turbines and decreasing their height.

⁶⁶⁴ Iverson S.A., Esler D., Site fidelity and the demographic implication of winter movements by a migratory bird, the harlequin duck *Histrionicus histrionicus*. *Journal of Avian Biology* 2006, 37: 219-228

⁶⁶⁵ Kirk M., Esler D., Iverson S.A., Boyd W.S., Movements of wintering surf scoters. *Predator responses to different prey landscapes*. *Oecologia* 2008, 155: 859-867

⁶⁶⁶ Oppel S., Powell A.N., Dickson D.L., Timing and distance of king eider migration and winter movements. *The Condor* 2008, 110: 296-305

⁶⁶⁷ HELCOM, HELCOM Red List Species Information Sheets (SIS) Birds. Helsinki 2012.

⁶⁶⁸ Chylarecki P., Chodkiewicz T., Neubauer G., Sikora A., Meissner W., Woźniak B., Wylegała P., Ławicki Ł., Marchowski D., Betteja J., Bzoma Sz., Cenian Z., Górski A., Korniluk M., Moczarska J., Ochocińska D., Rubacha S., Wieloch M., Zielińska M., Zieliński P., Kuczyński L., *Trendy liczebności ptaków w Polsce. Biblioteka Monitoringu Środowiska*. GIOŚ, Warszawa 2018

13. RISK OF A MAJOR ACCIDENT OR NATURAL AND CONSTRUCTION DISASTER

13.1. TYPES OF ACCIDENTS RESULTING IN ENVIRONMENTAL CONTAMINATION

The undertaking of the construction, exploitation and decommissioning of an OFW is a project involving decades of complex onshore and offshore activities.

The undertaking which is the subject of this Report is not a site for the storage of substances decisive for the classification of the undertaking as an establishment with an increased or high risk of a serious industrial accident pursuant to the Regulation of the Minister of Development of 29 January 2016 on the types and quantities of hazardous substances present at the establishment, decisive for the classification of the establishment as an establishment with an increased or high risk of a serious industrial accident (Journal of Laws of 2016, item 138).

The manufacture of all components for the construction of the OWF and its operation takes place onshore. At sea, the construction, installation, servicing, repair and then demolition work is carried out. All these activities depend on vessels: transport, servicing and construction.

Ports and ships are of key importance during the development. Large-scale components of wind power plants, foundations or support structures and towers, accommodation and service and research and measurement platforms and substations, are all manufactured in ports or immediate vicinity. The technologies and production processes involved in their manufacture do not pose a risk of emergency situations. Potential emergency events will not cause significant emissions of pollutants that threaten the environment. Also, during the decommissioning or disposal of dismantled elements of the wind power plants, which will take place in port or industrial areas, no environmentally hazardous events are expected to occur.

The main hazards that may occur during the construction and decommissioning of SHPPs are spills of petroleum-based substances, mainly diesel, hydraulic, transformer and lubricating oils. To a lesser extent, the marine environment may be incidentally threatened by materials containing hazardous substances, if such are used. During the exploitation phase, oil spills can be the main cause of pollution in marine waters. Both within open marine waters (e.g. OWFs) and close to shore, these can be an issue with long-term effects on fauna, flora, fisheries and contaminated beaches. In order to counteract this risk, OWF installations will be equipped with spill prevention measures, as described in Chapter 3.3.

The magnitude of oil contamination can be classified as follows:

- I degree (small spill, up to 20 m³) – minor spills of petroleum substances, not requiring the intervention of external forces and resources, possible to remove by own means. These spills are of a localised nature, their clean-up does not pose particular technical difficulties, and they do not pose a major threat to the marine environment;
- II degree (medium-size spill, up to 50 m³) – oil spills the scale of which requires coordinated countermeasures within the marine area under the authority of the Director of the Maritime Office, who decides on the required scale of countermeasures;
- III degree (catastrophic spill, above 50 m³) – oil spills having the character of an extraordinary environmental hazard, for the combating of which forces and resources under the authority of more than one Director of the Maritime Office are required.

13.2. COUSE OF FAILURE WITH ASSESSMENT OF POTENTIAL CONSEQUENCES

Spillages of petroleum substances (during normal ship operation)

During normal ship operation, spills of various types of petroleum substances (lubricating and diesel oils, petrol) may occur. It should be assumed that these will be small (1st degree) spills.

From the point of view of the environment, the most sensitive places in case of possible spills are: the Słupsk Bank and the coastal area approximately between Ustka in the west and Dębki in the east. Taking into account the prevailing westerly wind direction and occurring coastal currents, the

coastal strip with tourist localities (Jarosławiec, Rowy) and the harbours in Ustka and Łeba in the west to the town and harbour in Władysławowo are at risk.

Areas particularly sensitive to potential pollution are protected natural areas, including Natura 2000 sites.

It should be stressed that the key issue here is not so much the size of the spill, but where it occurs. Indeed, there are known cases of high bird mortality in small oil spills at sea. Vast patches of oil drifting away from the coast in areas with very low numbers of birds do not entail such high losses in populations as smaller spills in the place of numerous concentrations of marine avifauna.⁶⁶⁹ In the area of the planned BC-Wind OWF, bird densities were considerably lower than in the other surveyed areas of importance for seabirds. It should be emphasised, however, that in case of 1st degree spills and with appropriate organisation of ship traffic, a situation in which uncontrolled spread of oil substances reaches areas of natural importance is unlikely.

It will only be practically possible to determine the actual extent of the spill during the event, based on current meteorological data and data on the type and potential amount of contamination. Therefore, it is not possible to make a more detailed assessment of the impact on marine organisms that are most vulnerable to the effects of oil spills at the report stage.

The number of potential spills is proportional to the number of vessels used for the development of the project, its operation or decommissioning.

Spill of petroleum substances (in an emergency)

During the construction, operation or decommissioning of the BC-Wind OWF, oil spills may occur, resulting in the contamination of water and bottom sediments. Spills may occur as a result of failure or collision of vessels, their collision with OWF facilities, their sinking or grounding, as well as during operational spills and leaks from vessels, leakage from the wind turbine oil installation, leakage from the transformer at the substation, or oil spills associated with inspections and repairs of OWF components. In the worst-case scenario, 2nd grade spills (medium-sized spills) will occur during the construction or decommissioning phase. It has been calculated that the probability of serious accidents is very low, in the order of 10⁻⁵ (practically impossible – 1 case per 100000 years) to 10⁻³ (very rare – 1 case per 1000 years).

Assuming a worst-case scenario and the release of 200 m³ of diesel into the marine environment, and taking into account the type, behaviour in seawater, and the time it takes for the oil slick to disperse and drift, the extent of the contamination is not expected to exceed 5 to 20 km from the BC-Wind OWF. The nature of this type of oil means that it is not a particularly hazardous or cumbersome pollutant.

Release of chemicals and waste

During the construction of the OWF, on vessels, at the back of the construction site located onshore (in the port servicing the execution of the investment) and at the place of the execution of the project, there will be created waste directly related to the construction process. This waste may include, i.a., damaged parts of assembled OWF elements, cement, grout, mortar, binders used to join the elements of the power plant, and other chemical substances used during the construction works. These may be accidentally released into the sea.

Bulk cement is packaged in bags of approximately 1 m³. It has been assumed that approx. 5 m³ of the product may sink during handling. Grouts, mortars and other binders often contain hazardous substances. Epoxy (two-component) grouts, e.g., contain, in various proportions: epoxy resin, alkyl glycidyl ethers and polyamines. Once in water, these substances sink and settle to the bottom due to

⁶⁶⁹ Meissner W., *Birds as victims of marine pollution by oil and its derivatives*. *Wiadomości Ekologiczne* 2005, 51: 17-34

their high density (approximately 1.3 g·cm⁻¹). They are considered a serious threat as they cannot be easily removed from the bottom, and are toxic to marine organisms.

The potential for the release of waste or chemicals into the water is proportional to the activity associated with the use of chemicals. Releases during handling can be prevented by following appropriate work procedures.

13.3. OTHER TYPES OF RELEASES

Release of municipal waste or domestic sewage

During the construction of the OWF, waste, mainly municipal and other waste not directly related to the construction process, as well as domestic sewage, will be generated on vessels and at the construction facilities located onshore (in the port serving the project). Waste and wastewater may be accidentally released into the sea when picked up by another vessel and in the event of an accident, causing a local increase in nutrient concentrations and the deterioration of water and sediment quality.

It is assessed that the potential occurrence of the above releases will not affect the structure and function of marine organisms in the project area, or cause mortality.

Contamination of water and bottom sediments with antifouling agents

To protect ship hulls from fouling, biocidal substances are used, which can include e.g. copper compounds, mercury compounds and organotin compounds (e.g. TBT). These substances may pass into the water and eventually be retained in the sediment. It should be assumed that the emissions of these compounds will be negligible. Of the substances listed, organotin compounds are the most harmful (toxic) to aquatic organisms. TBTs are currently banned in antifouling paints, but the presence of these compounds in the protective coatings of older vessels cannot be ruled out. This impact can be mitigated by introducing controls on the type of protective coatings on units used in the operations in the OWF area.

It was assessed that the potential occurrence of the above events will not affect the structure and function of marine organisms in the project area, or increase their mortality.

Releases of pollutants from anthropogenic structures on the bottom

The possibility of the release of contaminants from underlying objects of anthropogenic origin cannot be completely ruled out. During the geophysical survey in 2020, the BC-Wind area was subjected to a systematic bottom inspection for the presence of objects of anthropogenic origin, including packaging and containers that may contain hazardous chemicals. Such objects may e.g. originate from insufficiently secured ship cargo passing through the BC-Wind area. No such objects have been identified on the bottom of the BC-Wind area. However, it is not excluded that such objects may be buried in the bottom and therefore remain undetected during the geophysical survey. During the geophysical survey, a review magnetometer survey was also carried out to reveal only larger ferromagnetic objects. As a result of these surveys, a torpedo was identified in the BC-Wind development area. It cannot be ruled out that new anthropogenic objects (e.g. lost small barrels or unexploded ordnance) may be revealed during the preparatory work for the construction process, including in particular the examination of the cleanliness of the seabed for unexploded ordnance and chemical weapons. In order to determine how to deal with such findings, the Applicant will prepare a plan for dealing with hazardous objects, both from the point of view of operational work at sea (e.g. rules for working in the vicinity of potentially hazardous objects) and from the point of view of possible removal or avoidance of the sites of such objects. The basic premise of the plan for dealing with hazardous objects is to avoid danger to human life and health and to avoid the spread of contamination from such objects.

13.4. ENVIRONMENTAL RISKS

13.4.1. Construction phase

Based on data from other OWF projects and similar projects, as well as on the knowledge and experience of the authors of the study, the following potential environmental risk events during the construction phase, which may become a source of negative environmental impacts of the OWF, were found:

- leakage of petroleum substances as a result of a ship collision, accident or construction disaster (during normal use or in an emergency);
- accidental release of municipal waste or domestic sewage;
- accidental release of construction materials or chemicals;
- contamination of water and bottom sediments with antifouling agents.

It is important to note that the abiotic environment, primarily marine waters and, to a lesser extent, seabed sediments, may be directly contaminated as a result of incidents and emergencies. In contrast, living organisms inhabiting or otherwise using the seabed, the water depth and the sea surface may also be indirectly affected by these events. Contamination of water or seabed sediments by municipal waste or domestic sewage is a negative impact, which is direct, temporary or short-term, reversible, and of local extent. Impact significance is negligible.

Ship collision and the resulting release of hazardous substances (especially oil) into the environment is a factor that can cause increased mortality and disease in marine organisms. The probability of such events can be considered low. In addition, the implementation of a proper collision and spill response plan aims to reduce the impact of such events on marine organisms.

The main threat to Natura 2000 sites during the construction phase is the release of hazardous substances (especially oil) into the environment as a result of ship collisions. This may cause increased mortality and disease to marine organisms, including those protected in these areas. The probability of such events can be considered low. The implementation of a collision and spill plan in accordance with current legislation for the duration of the project is intended to minimise the impact of such events on marine organisms. It can be assumed that this factor will not significantly affect protected areas.

13.4.2. Exploitation phase

Environmental hazards may also occur during the operation of the OWF, in particular water and bottom sediment pollution with:

- petroleum substances;
- antifouling agents;
- accidentally released municipal waste or domestic sewage;
- accidentally released chemicals and waste from the operation of the OWF.

Waste and effluent can be generated by people onboard the vessels, as well as during operations and during the servicing of towers and transmission infrastructure.

Ship collisions resulting in the release of hazardous substances (especially oil) into the environment are a factor that can cause increased mortality and disease in marine organisms. The probability of such events can be considered low. The implementation of a collision and spill plan is intended to minimise the impact of such events on marine organisms.

The impacts that could be caused by an emergency situation in the exploitation phase are identical to the impacts that may occur during the construction phase of the OWF. Only the aspect of accidental release of chemicals and waste is slightly different. During the exploitation phase of the OWF, maintenance of its facilities will occur. Accidental release of small amounts of waste or exploitation fluids to the sea cannot be excluded. It is assessed that the possible occurrence of the accidents listed above will not affect the structure and functioning of marine organisms in the project area, and will not cause their mortality.

During the operation of the OWF, due to collisions and breakdowns of vessels involved in the operation of the investment, harmful chemical substances may leak into the environment, mainly fuels, engine oils or hydraulic fluids. Their impact on marine organisms may be a significant pathogen and result in increased mortality. However, the likelihood of such events can be considered low. The implementation of a collision and spill plan is intended to minimise the impact of such events. The risk of this factor can be considered negligible.

The main threat to Natura 2000 sites during the exploitation phase is the release of hazardous substances (especially oil) into the environment as a result of ship collisions. This may cause increased mortality and disease of marine organisms, including protected objects. The likelihood of such events can be considered low. The implementation of a collision and spill plan is intended to minimise the impact of such events on marine organisms. It can be assumed that protected areas will not be significantly affected by this factor.

13.4.3. Construction and exploitation phase

Ship collision and the resulting release of hazardous substances (especially oil) into the environment is a factor that can cause increased mortality and disease in marine organisms. The likelihood of such events is considered to be low if works associated with the construction and exploitation phases are carried out separately. However, the simultaneous presence of vessels carrying out construction and maintenance activities increases the risk of collisions and associated negative impacts. Therefore, the initial impact significance (minor to negligible) may increase to moderate, but this will not result in the need for minimisation measures.

13.4.4. Decommissioning phase

During the decommissioning of the OWF, there may also be impacts from emergencies and other environmental hazards, particularly water and bottom sediment pollution with:

- accidentally released municipal waste or domestic sewage;
- petroleum substances;
- antifouling agents.

The danger of ship sewage entering the water exists during the collection of ship sewage by another vessel, and in the event of an accident. This may result in a localised increase in nutrient concentrations, and the deterioration of water quality. The pollutants should disperse quickly and thus not contribute to any permanent deterioration of the environment in the project area.

The impacts related to environmental hazards during the decommissioning phase are the same as those described above for the construction phase of the OWF.

During the decommissioning of the OWF, as a result of collisions and breakdowns of vessels involved in the operation of the investment, harmful chemical substances may leak into the environment, mainly fuels, engine oils or hydraulic fluids. Their impact on marine organisms may be a significant pathogen and result in increased mortality. However, the likelihood of such events can be considered low. The implementation of a collision and spill plan is intended to minimise the impact of such events. The risk of this factor can be considered negligible.

13.5. PREVENTION OF ACCIDENTS

Accident prevention is the totality of activities related to the protection of human health and life, the environment and property, as well as the reputation of all participants in the processes involved in the construction, operation and decommissioning of an OWF. These activities include, but are not limited to:

- the development of plans for the safe construction, operation and decommissioning of the OWF in accordance with legislation current for the duration of the project;

- the development of rescue plans and the training of crews and personnel, including rules for updating and verifying through regular exercises, in particular the definition of procedures for the use of own units, external units, including helicopters;
- the development of a plan to counteract the risks and pollution arising during the construction, operation and decommissioning of the OWF;
- the selection of suppliers and certified OWF ingredients and components;
- the designation of protection zones;
- the accurate marking of the OWF area, its facilities and vessels moving within;
- the planning of maritime operations;
- the application of International Maritime Organisation (IMO) standards and guidelines, recognised classification societies and maritime administration recommendations;
- the development of a plan for safe navigation within the OWF and traveling to ports;
- the provision of adequate navigational support in the form of charts and navigational warnings;
- the provision of direct or indirect navigational surveillance using a surveillance vessel or remote radar surveillance and automatic information system (AIS);
- the continuous monitoring of vessel traffic within the OWF, either directly or remotely throughout the construction, operation and decommissioning of the OWF;
- the creation of a coordination centre to oversee the construction, operation and decommissioning of the OWF;
- the maintenance of permanent lines of communication between the OWF coordination centre and the offshore coordinator and other coordination centres (Maritime Rescue Coordination Centre in Gdynia, the maritime administration).

13.6. DESIGN, TECHNOLOGICAL AND ORGANISATIONAL SAFEGUARDS

Design, technological and organisational safeguards mainly consist of conducting navigational risk assessments and developing countermeasure plans:

- threats to human life – evacuation plans, rescue plans;
- fire hazards;
- environmental pollution risks – oil pollution and risk prevention plans. The principle of the obligation to have a plan will apply not only to the facility, but also to all large and medium-sized vessels involved in the construction, operation and decommissioning of the OWF;
- risks of construction disasters – all structures are designed with possible extreme conditions in mind, for at least double the service life.

The Investor has already developed a rescue plan on his side, which was accepted by the Director of the Maritime Office in Gdynia on 11 August 2023 (decision no. 8/IRM/23 of 11.08.2023) and an oil pollution and risk prevention plan (accepted by the Director of the Maritime Office in Gdynia on 8 January 2024, decision no. 1/IRM/2024).

13.7. POTENTIAL CAUSES OF ACCIDENTS, INCLUDING EXTREME SITUATIONS AND RISKS OF NATURAL AND CONSTRUCTION DISASTERS

OWF structures, by the virtue of their purpose, are designed and built to withstand extremely severe weather conditions. All components, despite being subjected to extremely high stresses, are designed for many years of operation. All units are subjected to continuous monitoring and any sign of deviation from the situation classified as safe operation automatically triggers remote service interventions or changes to the operating parameters up to and including shutdown. The rotor is stopped automatically when the wind speed exceeds safe operation for the wind turbine. The service plan is to ensure trouble-free operation.

The potentially greatest risks are during the construction phase, although the risk of disaster is minimal due to the fact that the planning of marine operations always takes into account weather

conditions and the possibility of their change. Every maritime operation has its limitations in terms of visibility, wind speed, sea state (wave height), or ambient temperatures. The occurrence of the negative effects of climate change in the form of too strong winds or too high waves can only result in a longer construction cycle and an increased energy demand – fuel consumption.

13.8. RISKS OF MAJOR ACCIDENTS OR NATURAL AND CONSTRUCTION DISASTERS, TAKING INTO ACCOUNT THE SUBSTANCES USED AND THE TECHNOLOGIES EMPLOYED, INCLUDING RISKS RELATED TO CLIMATE CHANGE

The risk of a major accident resulting in the emission of hazardous substances is minimal. The probability of such events as ship collisions falls into the category of very rare events (probability of occurrence 1/100 y.), and such as ship contact with the OWF structure – into the category of very rare events with a probability of occurrence once in 200 years. Considering the impact in terms of emission of 200 m³ of diesel, the level of risk is within the acceptable range. The emission of 200 m³ of diesel fuel will cause insignificant environmental damage as it will dissipate within 12 hours.

13.9. SUMMARY OF WAYS TO PREVENT AND MITIGATE UNPLANNED EVENTS

Assumptions on how to counteract unplanned events and mitigate their effects on environmental and human safety resulting from the implementation of the BC-Wind OWF are indicated in the table below (Tab. 13.1).

Tab. 13.1. *Ways of preventing unplanned events resulting from the implementation of the BC-Wind OWF and limiting their effects on environmental and human safety*

Event	Method of counteraction
Potential collisions with vessels travelling in the surrounding shipping lanes and vessels involved in the construction of neighbouring wind farms	During the construction and operation of the BC-Wind OWF, all feasible mitigation measures will be applied to minimise the risk of collision with vessels, in accordance with current legislation and best practices for this type of project in offshore areas. Such actions include, but are not limited to: the coordination of vessels operating within and in the area of the OWF through the MCP (Marine Coordination Plan), their remote monitoring, marking the area of the OWF at each stage of its development with navigation buoys, the use of surveillance (guard) vessels having the ability to intercept other vessels. In addition, the Applicant will be in constant contact with the relevant persons responsible for the safety of navigation within other OWF projects to ensure the coordination and alignment of activities resulting from shipping activity
Oil leaks	In cases of emergency situations resulting in an oil spill, measures will be taken to prevent the spread of such substances, and they will be removed from the environment. In addition, it should be indicated that all vessels involved in the BC-Wind OWF activities are subject to all provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL)
Collisions with line infrastructure lying on the bottom (pipelines, cables)	No pipelines or submarine cables are located within the area of the planned project or in its immediate vicinity, so there is no risk of collision with this type of infrastructure
Encountering unexploded ordnance or chemical warfare agents in connection with seabed intervention works	In the event that unexploded ordnance or chemical warfare agents are encountered, action appropriate to the specific situation will be taken, including notifying the relevant authorities and services and, in consultation with them, the Applicant will take further action to eliminate the threat
Potential explosions generated by neighbouring industrial and military facilities	There are no industrial and military facilities in the vicinity of the BC-Wind OWF area
Events related to climate change and extreme weather events	The scale and nature of climate change and extreme weather events that may occur in the area of the planned project is difficult, if not impossible, to predict. However, due to the nature of the planned project, this risk is most likely to be low. Moreover, at the stage of designing the structural elements of the BC-Wind OWF, the aspects related to potential sea level rise, ice phenomena and extreme winds will be taken into account

Event	Method of counteraction
Scattering of ice accumulated on blades	Blades covered in ice can be a hazard to service workers due to the ice falling off and scattering in clumps, which may, e.g., cause injury to a worker. To mitigate this risk, procedures will be developed to protect people and vessels present at the turbine during servicing.

Source: EIA Report for BC-Wind, MEWO S.A., 2021, pp.100-101

A Hazard and Spill Contingency Plan approved in January 2024 exists for the BC-Wind OWF. However, this plan needs to be updated a few months before construction starts. This update will include, i.a., a procedure listing appropriate steps if an object is dropped into the water that will clearly define the form in which information is to be communicated to the maritime office. Under this procedure, all dropped objects will have to be reported within 24 hours, and attempts to recover the object will have to be made unless it will be impracticable to do so. It should be noted that it is unlikely to be possible to locate and recover small objects that do not pose a significant environmental or safety risk. Complete removal of liquid waste is also unlikely. In the case of spills, depending on the nature of the liquid spilled, the Maritime Office will consider each case individually. In addition, each vessel will have a SOPEP (Ship Board Oil Pollution Emergency Plan).

14. ANALYSIS AND COMPARISON OF THE VARIANTS UNDER CONSIDERATION, AND THE ENVIRONMENTALLY PREFERABLE VARIANT

The table below (Tab. 14.1) compares the variant approved by the DEC (currently the RAV 2024) with the variant selected for implementation (the WWR 2024).

Both variants cause environmental impacts of the same nature, but the WWR 2024 will cause impacts of a smaller magnitude due to the proposed change in the parameters of the BC-Wind OWF, i.e.:

- the reduction of the number of turbines from 41 to 39 (with 34 intended to be implemented);
- the reduction of the rotor diameter (from 280 m to 250 m), and consequently the height of the whole structure (from 330 m to 300 m);
- a significant reduction in the length of the cables inside the farm (resulting from the locations of turbine foundation established at the present stage⁶⁷⁰) from 188 km to approx. 100 km;
- the exclusion of gravity foundations from the power plant foundation technology and the selection of monopile foundations as the preferred option.

The significant difference in the construction phase relates to the reduction in suspended solids, which is associated with the complete exclusion of gravity foundations in the WWR 2024 and the reduction of the length of the cable routes from approx. 188 km in the RAV 2024 to approx. 100 km in the WWR 2024.

The smaller number of wind turbines under the WWR 2024 will also require fewer maintenance and operational activities during the exploitation phase of the OWF compared to the RAV 2024, consequently contributing to the lower environmental impact.

The WWR 2024 will result in fewer environmental impacts in terms of collision risk between migratory birds and wind turbine structures in comparison to the RAV 2024. The results of the collision modelling indicate that in most cases this risk is higher for RAV 2024, and in no case is it lower. With that said, it is worth noting that the lower collision rate did not change the significance of the impact – it remains at the same level for both the WWR 2024 and the RAV 2024, despite the lower collision rate shown in the modelling.

⁶⁷⁰ the locations of the turbines may be corrected in the course of further project work

Tab. 14.1. Comparison of the impact significance of the planned project on environmental components during the individual phases of its implementation in the WWR 2024 and the RAV 2024

Environmental components	Construction phase		Exploitation phase		Decommissioning phase	
	WWR 2024	RAV 2024	WWR 2024	RAV 2024	WWR 2024	RAV 2024
Seabed	N	N	N	N	N	N
Sea waves and currents	-	-	N	N	-	-
Seawater	N	N	N	N	N	N
Bottom sediments	L	L	L	L	L	L
Climate	L	L	N	N	L	L
Systems using EMF	-	-	N	N	N	N
Phytobenthos	-	-	N	N	N	N
Macrozoobenthos	L	L	M	M	M	M
Ichthyofauna	M	M	N	N	L	L
Marine mammals	M	M	M	M	M	M
Migratory birds	L	L	L	L	N	N
Seabirds	H	H	H	H	H	H
Bats	N	N	L	L	N	N
Ecological corridors	N	N	N	N	N	N
Biodiversity	L	L	H	H	L	L
Cultural value, monuments and archaeological sites and objects	L	L	-	-	N	N
Basin use and development and material assets	L	L	L	L	N	N
Landscape	N	N	N	N	N	N
Population	M	M	N	N	N	N

N – negligible; L – low; M – moderate; H – high; - (none)

Source: own elaboration

For the impact on marine mammals, a more detailed remodelling of underwater sound propagation was carried out for the maximum possible hammer parameters when driving the monopile and for the most unfavourable location of the power plant (deepest seated). Furthermore, an additional modelling of the sound source was performed, which makes possible a more precise prediction of the noise propagation under given sea conditions (at the stage of the 2021 Report, this modelling had not yet been practised, relying primarily on the available literature). In addition, the WWR 2024 modelling included a soft-start method, an animal movement model, and a 24-hour exposure to sound generated during pile driving, which had not yet been modelled in the previous modelling, as the RAV 2024 model assumed a 1-hour exposure, a static nature of the exposed organisms, and no gradual increase in sound levels.

The use of a different type of Noise Reduction System (NRS), the different technical parameters of the pile, and the different assumptions made in the numerical modelling indicated above affected the results of the modelling. Consequently, the modelling results from 2021 (for the RAV 2024) and 2024 (for the WWR 2024) are difficult to compare. In contrast, the assessment of impacts on marine mammals carried out on the basis of the WWR 2024 modelling shows the same conclusions, i.e. that following the application of an NRS, all impacts on harbour porpoise, grey seal and common seal were assessed to be of low or moderate importance under both variants.

It is worth mentioning that the EIA Report submitted to the authority issuing the DEC in 2021 (in which the RAV 2024 was assessed) was based on the so-called envelope assessment, in which all reasonable foundation methods were considered, moreover, the maximum rotor diameter and thus the total height of the power plant were assumed with some margin. For safety reasons, it was assumed that two OSS stations could be used to operate the BC-Wind OWF, and a service and accommodation stations were also included. It is now known that there will be one OSS station and that there is no need to locate a service and residential station in the farm area. In addition, due to the early stage of obtaining

the DEC, the locations of the power plants and their final number were not yet known, and therefore e.g. the length of the cables inside the farm was assumed by a large margin. It was estimated that this length could be approx. 188 km, however once the number and locations of the power plants and OSS were determined, the length of the cables is reduced to approx. 100 km. All of these elements contribute to the possibility of a more precise environmental impact assessment, including a remodelling of underwater noise emissions, suspended solids emissions, and potential collisions between migratory birds and rotor blades. Specific power plant and OSS locations were used for the modelling in contrast to the modelling done for the EIA Report prepared in 2021, where purely theoretical power plant locations had to be assumed due to the early stage of the project.

Due to the possibility to carry out an environmental impact assessment within this EIA Report for the specified, narrowed parameters of the project, and on the basis of the already selected specific locations of the BC-Wind OWF facilities, it can be concluded that the most environmentally beneficial variant is the WWR 2024, as shown above and as pointed out in many cases in the assessment in Chapter 9 of this EIA Report, with regard to such environmental components as:

- the impact on geological structure and bottom sediments,
- the impact on marine waters,
- the impact on benthos
- the impact on ichthyofauna
- the impact on wintering birds,
- the impact on migratory birds,
- the impact on protected areas.

In summary of the table above, both of the analysed variants, i.e. the variant selected for implementation (the WWR 2024) and the variant for which the Investor obtained the DEC (the RAV 2024) will cause impacts of the same nature and significance. On the other hand, it is worth emphasising that the assessment of the WWR 2024 was based on more detailed data on the parameters of the project and was developed on the basis of the actual location of the power plants and OSS station indicated by the Investor at the current preparation stage of the project. Even if, in the course of further works, some locations are corrected by a few hundred metres, it will not affect the indication/determination of the impacts of the construction, operation and decommissioning phases of the BC-Wind OWF. Therefore, it is not necessary to perform a new environmental impact assessment at the stage of obtaining the construction permit, as possible corrections that may be introduced during works on the construction and operation design will not result in a change in the nature and scale of the impacts assessed in this Report.

15. PROPOSED MINIMISATION MEASURES

The performed environmental impact assessment of the BC-Wind OWF in the variant indicated for implementation WWR 2024, based on the refined parameters of the project, indicates that no significant negative impacts will occur as a result of the project. The specification of the project parameters required bird collision modelling and suspended solids dispersion modelling to be conducted again, based on the planned layout of cables and wind turbines. The results of the remodelling showed less significant impacts than in the case of the variant for which the Investor obtained the DEC (the RAV 2024). In the case of the new noise propagation modelling, different assumptions were made, resulting from the use of a more advanced noise propagation modelling methodology and more detailed data on the project and on the environmental conditions prevailing within the BC-Wind OWF. Therefore, the results of the two modelling exercises, i.e. those performed in 2021 (for the RAV 2024) and 2024 (for the WWR 2024) are not comparable, however both indicated the need for an appropriate Noise Reduction System to be applied when analysing noise propagation as a result of hammer blows used

for foundation piling, in order to ensure the protection of marine mammals in accordance with the conditions imposed by the DEC.

Despite the re-established lack of significant environmental impacts at the current stage of the project, impacts of lesser significance are nevertheless inevitable. Hence, this chapter is an indication, on a phase-by-phase basis, of reasonable measures to avoid, prevent and reduce negative environmental impacts to occur as a result of the BC-Wind OWF project.

As the nature and scale of the impacts have not changed, the proposed minimisation measures remain the same in relation to the 2021 EIA Report, with some clarification or further description in some cases.

15.1. MINIMISATION MEASURES FOR THE IMPACT OF THE CONSTRUCTION PHASE

15.1.1. Measures minimising the impact on fish and marine mammals in the construction phase

Due to the possible negative effects of piling noise on marine mammals, mitigation measures are recommended for the construction phase of the planned wind farm. As part of the implementation of the measures, it will be necessary to take technical and organisational actions and appropriate equipment to limit noise propagation, as well as methods to increase the chances that no animal will be in the immediate range of the sound during its emission.

A soft start procedure is recommended as a method of deterring marine mammals from the construction site. It involves a gradual increase in the acoustic energy of the impact hammer. The method is commonly used in offshore pile driving, and its specifics depend primarily on the ground conditions at the site. A possible schedule for the soft start procedure is shown in the noise propagation model, i.e. impact energy will build up as follows: first 5 minutes – 250 strikes (15% of maximum hammer power), next 10 minutes – 500 strikes (55% of maximum hammer power); after 15 minutes – the maximum target hammer power can be used.

The execution of construction works should account for the introduction of a marine mammal observer (MMO) programme, implemented each time before the piling commences. The MMO programme will serve as a control system to ensure that no animals are in the immediate vicinity of the piling area.

Recommended technical mitigation measures include systems to limit noise propagation. The results of acoustic modelling have shown that their application will be necessary to implement the construction phase of the OWF in a manner that is safe for marine mammals. Mitigation of underwater noise for marine mammals will at the same time be a sufficient preventive measure for ichthyofauna, under the so-called 'umbrella effect'. Commonly used methods that have been at the same time taken into account in the analyses performed for the planned wind farm include the air curtain (single and double – BBC and DBBC), as well as the HSD (Hydro Sound Damper) system, and other technical and organisational solutions.

An air curtain is an accumulation or 'wall' of air bubbles that are produced around the area in which piles are driven. The air bubbles create acoustic impedance discontinuities, which effectively blocks sound transmission. An HSD type shield is a specially designed mesh with sound attenuating elements. The mesh is installed around the monopile at its full height so that noise is attenuated directly at its source. The effectiveness of BBC, DBBC and HSD systems can be increased by using them simultaneously. The reduction in sound level is frequency dependent, as illustrated by a study by Bellmann et al. (2020).

The use of Acoustic Deterrent Devices (ADDs) is also allowed during piling, as a tool to reduce the risk of physical injury to marine mammals (death or permanent and temporary loss of hearing). Despite the short-term deterioration of the acoustic climate, the use of an ADD is intended to ensure that no marine mammals are present in the vicinity of the area where piling is to commence.

Acoustic Deterrent Devices (ADDs) are devices used to keep animals, especially marine mammals, from certain areas. They emit sounds that deter animals from approaching, which is useful in cases like protecting elements of aquaculture, reducing bycatch in fishing nets, and preventing animals from entering construction sites. ADDs can be applied during construction phases of wind farm projects, when the piling of a wind turbine foundation causes underwater impulsive noise of considerable intensity. This noise, although decreasing with distance from the source according to the physics of sound in water, can cause temporary and permanent hearing damage to marine mammals at closer distances, injury, or even death. ADDs' short-lived sound emissions preceding the piling (and the soft start procedure at the start of the operation) would help scare animals out of the zones potentially most dangerous to them.

The duration of use of an ADD and the type of the device should be carefully selected and used in accordance with the 'Piling strategy' as further described in Subchapter 15.1.3. The application of an ADD must not exceed 15 minutes. Short-term ADD use has been tried at other wind farms, with a reduction in ADD use from 15 minutes to 5-10 minutes during construction of the Moray OWF due to the high effectiveness of the device.

In summary, due to the need to protect the marine environment from impulsive noise, including the critically endangered harbour porpoise, the following minimisation measures are required:

- the use of a noise reduction system that will ensure noise reduction to the level of:
 - 140 dB re 1 μ Pa_{2s} SEL_{cum.} and weighted by the HF function (HF-weighting function for marine mammals with high sensitivity to high frequency sounds – harbour porpoise);
 - 170 dB re 1 μ Pa_{2s} SEL_{cum.} and weighted by the PW function (PW-weighting function for pinniped marine mammals – seals);
 at a distance of max. 11 km from the piling site;
- simultaneous piling in max. two locations (in order to limit noise), no matter whether the two sources are located in the area of the BC-Wind OWF, or one of them is in the area of another neighbouring OWF, i.e. Baltic Power or area 46.E1;
- each commencement of works should be preceded by a soft start procedure in order to allow animals such as fish and marine mammals to move away from the piling area;
- prior to and during piling, visual observations should be conducted by qualified Marine Mammal Observers (MMOs) from onboard the vessel in accordance with the methodology specified by the JNCC Commission in conjunction with Passive Acoustic Monitoring (PAM) based on the use of a set of hydrophones (PAM detectors) in the water;
- immediately prior to piling, the use of ADDs (Acoustic Deterrent Devices) is allowed as a tool to reduce the risk of physical injury to marine mammals (death or permanent and temporary hearing loss) – the duration of use of the ADD and the type of device must be carefully selected and used in accordance with the 'Piling strategy', but duration must not exceed 15 minutes.

15.1.2. Measures minimising the impact on seabirds in the construction phase

The negative impacts of the construction phase identified for three duck species: the long-tailed duck, the velvet scoter and the common scoter can be minimised by:

- limiting the sources of strong, upward-directed light at night to the level necessary according to current regulations and operational safety standards – this is especially relevant during bird migration periods;
- constructing structures in the area of the OWF as gradually as possible by building subsequent wind turbines starting from one location in order to reduce bird scaring;
- leaving an unobstructed migration corridor for birds (an area free from the presence of turbine blades), the width of which will not be smaller than 4 km, and its axis will be a straight line, between the area of the BC-Wind OWF and the area of the nearest neighbouring OWF from the west;
- introducing ornithological monitoring during piling in periods of possible higher duck density, i.e. from August to March, taking into account weather conditions and the safety of its performance; in the absence of sightings of the common guillemot, the razorbill, the long-tailed duck and the velvet scoter

within a radius of 1 to 2 km from the piling site, works may be commenced, preceded by a soft start procedure. In the event of sightings of the aforementioned bird species, the ornithologist must inform the site manager of the further course of action.

During the construction phase, significant noise will be emitted during the installation of the wind turbine foundations (piling), which may have a negative impact on seabirds residing in the area where these works are carried out.

Due to the very low density values of seabirds recorded during the nature inventory performed for the RDEP, especially of key species (from the point of view of the impacts of the planned project), i.e. the long-tailed duck *Clangula hyemalis*, the razorbill *Alca torda* and the common guillemot *Uria aalge*, it is recommended that ornithological monitoring be performed only in those months in which potentially higher numbers of those bird species may occur. The validity of this assumption is confirmed by data collected at the Dutch OWF during ornithological monitoring, in which case works carried out outside the period of high bird densities showed the absence of key species during piling (Leopold & Camphuysen, 2007).

The following approach to ornithological monitoring is proposed:

- monitoring should be carried out from vessels – aerial observations are also acceptable under conditions that ensure their safety;
- in the case of daytime piling, observations should be carried out before each piling session;
- in the case of nighttime piling, observations should be made before dusk;
- in the case of sightings of the previously listed bird species, the ornithologist should inform the Investor's representative and provide the next steps;
- the results of each ornithological monitoring should be reported prior to the commencement of piling and submitted regularly to the RDEP in Gdańsk (it is suggested to submit reports every 4 weeks).

The ornithologist is primarily required to determine the species of observed birds, as well as their numbers. Actions which can be suggested by the ornithologist if a significant number of birds is observed include e.g. the application of the soft start procedure combined with observation of the birds' reactions. Stopping piling should be considered a measure of last resort, used in special cases, e.g. if there is a direct threat to the life of valuable bird species.

Ornithological monitoring prior to piling has not yet been carried out in practice in the PMA. The results of research into seabird responses to a source of impulsive noise accompanying piling are also unknown. In view of the above, the presented ornithological monitoring plan, despite the fact that it has been developed as a result of a prediction of bird response to impulsive noise, based on current technological possibilities and dynamic development of remote sensing methods, may be modified as a result of the occurrence of unexpected bird behaviour.

The obligation to take into account the ornithologist's opinion prior to any commencement of piling (as well as the obligation to report to the Gdańsk RDEP), gives the possibility to adjust to the conditions present in the area of the planned piling commencement. This applies in particular to a situation in which there are birds that have not moved away from the piling site and the commencement of piling may cause them injury or death, of a magnitude that would cause population loss or disrupt the integrity of the Natura 2000 network of sites established to protect migratory and wintering birds. Sea ducks are very sensitive to disturbance caused by the presence of boats and other human activities at sea, hence it is assumed that the birds will leave the site of the piling and there will be no need to stop the works. Details of how ornithological monitoring will be carried out will be presented in the 'Piling strategy', which will be developed 6 months prior to the planned commencement of piling. Details of the 'Piling strategy' are provided in Subchapter 15.1.3.

The proposed variation of the ornithological monitoring area from 1 to 2 km allows the ornithologist to reliably verify the potential presence of the species listed above; it also means that piling

can take place after dark or when visibility is less than 2 km (e.g. in bad weather), which is important for construction planning.

15.1.3 Piling strategy

The 'Piling strategy' is a procedure to reduce the risk of sudden death or injury to marine mammals, i.e. grey seals and harbour porpoise, and fish with and without swim bladders, resulting from the piling process at the BC-Wind OWF.

The 'Piling strategy' is a document that outlines such actions and measures to mitigate environmental impacts during the piling process that can be applied while ensuring a predictable and efficient piling installation process, including in particular:

- minimising the risk of sudden death or injury (physical or auditory) to marine mammals during piling as a result of a single strike/sound pulse at close range;
- the commencement of piling after dark, in poor visibility or after a break in engineering operations;
- a safe installation technique for use in the marine environment;
- optimisation of piling time during the construction period.

The 'Piling strategy' will be developed based on the technical, geological and natural data collected during the preparatory phase of the project. The following key elements will be taken into account during the development of the strategy:

Pile penetrability analysis

The Investor will use the results of geotechnical surveys to develop an analysis of pile penetrability for each individual foundation location to minimise the risk of the pile not being able to be driven to the desired depth.

Based on this analysis, it will be possible to produce a predictive pile energy profile for groups of turbine foundation locations. The analysis will aim to show that during the piling process, the energy level is adjusted on an ongoing basis to ensure a measured progression, which typically increases with depth until the planned foundation depth is reached.

Determination of influence zones on the marine environment

For the individual piling sequences, the Investor will estimate the environmental impact zones (risk of sudden death or injury) for individual mammals and fish with and without swim bladder based on the results of geotechnical surveys and underwater noise modelling. The exact technical parameters of the foundations to be installed and the required zone-specific initial hammer impact energy for the individual sequence will be used for the analysis.

Submission of a procedure/protocol for the commencement of piling including mitigation measures (if required)

The Investor will consider and submit to the relevant authority the recommended mitigation measure for each potential impact zone. This will be presented in the form of a diagram taking into account JNCC guidelines, the soft start procedure, the optional use of Acoustic Deterrent Devices (ADDs), and other available and acceptable mitigation measures to avoid instantaneous death and injury situations.

Presentation of the procedure/protocol for planned and unplanned interruptions in the piling process

The Investor will specify the downtime/interruptions in piling that would require the reapplication of ADDs, the soft start procedure or other mitigation measures in the strategy document.

Monitoring and auditing

The Investor will present a method for monitoring the piling process in the strategy document, aimed at controlling and ensuring that the applied mitigation and minimisation methods work according to their specifications during the piling process, that the hammer energy does not exceed set thresholds (expressed in kJ) during the soft start procedure, and that the various procedures for monitoring and

reporting the piling process to a relevant authority are carried out in accordance with the requirements of the DEC. At the same time, the piling strategy will be consistent and integrated with the Environmental Management Plan and the Draft Environmental Monitoring Programme.

The strategy document will be submitted for approval to the RDEP in Gdańsk 6 months prior to the commencement of piling.

15.1.4. Measures minimising the impact on cultural heritage

The measure to minimise the impact on cultural heritage is to ensure archaeological supervision during the works so that if an object, not yet located, is encountered which may be recognised as a historic object, action is taken in accordance with the provisions of the Act of 23 July 2003 on the protection and care of historic monuments (Journal of Laws of 2021, item 710, as amended), hereinafter referred to as the 'the Act on the protection of historic monuments', including such actions as:

- stop any works that may damage or destroy the discovered object;
- if possible, secure, using available means, the object and the place of its discovery;
- immediately notify the appropriate Director of the Maritime Office in Gdynia of the discovery of the object in the PMA.

The current wording of the Act on the protection of historic monuments does not contain specific information on how to proceed in case of discovering an archaeological finding. Therefore, for the purposes of construction organisation, an appropriate procedure for dealing with unexpected or accidental archaeological finds will be developed together with the Protocol for Archaeological Discovery (PAD), which will be submitted to the appropriate authority 6 months before the commencement of construction works.

The procedure will cover, i.a., information such as:

- the type and location of the unexpected object and the deadline for reporting on it;
- the width of the protection zone around minor finds to protect them against unintentional damage;
- the width of the protection zone around possible major finds to protect them against unintentional damage;
- the possibility of using a guarding vessel to enforce the established protection zone against vessels.

Works will only be suspended if it is safe to do so (as there may be circumstances where it is not safe to stop or it would cause a serious problem for the project, e.g. in the case of laying a cable when the cable is attached to the seabed and the vessel, in which case the cable would have to be cut and dropped).

15.2. MINIMISATION MEASURES FOR THE IMPACT OF THE EXPLOITATION PHASE

15.2.1. Measures minimising the impact on migratory birds

Measures to minimise the impact on migratory birds include:

- equipping the wind farm with a system allowing to stop (slow down) selected wind turbines for a short period of time during bird migration periods; the system should be used if the results of operational monitoring indicate that an intensive migration of cranes at collision height takes place over the OWF area;
- carrying out monitoring of migratory birds to exclude their collisions with turbines.

The proposed slowdown system significantly reduces the risk of collisions with cranes, with the probability of crane migration over the BC-Wind area being quite low as few crane overflights over the BC-Wind OWF Area were recorded during the annual inventory conducted for this EIA Report. The monitoring, which will be carried out by means of a camera and radar system of De Tect (a or similar system) company, will enable a permanent control of possible overflights over the area of the operating BC-Wind OWF. In addition, the reduction in the number of turbines and their height that is underway, according to the obtained modelling results, has resulted in the probability of collision dropping to 8 individuals per year (in the earlier report, it was estimated at 14 individuals). The system responsible for

slowing down the wind turbines does not have the ability to trigger mechanical deceleration (i.e. the ability to stop). Rapid deceleration of the turbine is also a risky procedure that can cause mechanical damage to the rotor due to its high momentum. Hence, deceleration of the rotor must take place through gradual speed loss. The resumption of turbine operation also involves additional energy input, which, if more than one turbine has to be stopped, can result in significant power generation losses.

De Tect bird detection system

The De Tect detection system was chosen by the Investor based on a review of available bird detection systems with an automatic wind turbine slowdown function. The choice of the De Tect system was determined by the following features:

- the presence of radars operating in the S-band (2-4 GHz) and the X-band (8-12.5 GHz), together with software enabling initial identification based on wingspan and torso size, flight height and style, and trajectory; the radar's horizontal range is 7.5 km, while its vertical range is 7 km;
- the presence of cameras mounted on movable heads allowing 360-degree horizontal and more than 180-degree vertical viewing, recording images and identifying bird species, and using image analysis software supported by artificial intelligence algorithms;
- accessing, processing and presenting data in real time;
- generation of statistics on bird flights, frequencies, and deceleration times of individual wind turbines.

The deployment of bird or flock detection equipment has been designed to enable radar coverage of the area beyond the boundaries of the OWF. The radar and camera coverage (1 km) will enable early identification of approaching individuals or flocks of species in order to slow down turbine operation and allow the safe passage of birds. The planned location of system components is shown in the figure below.

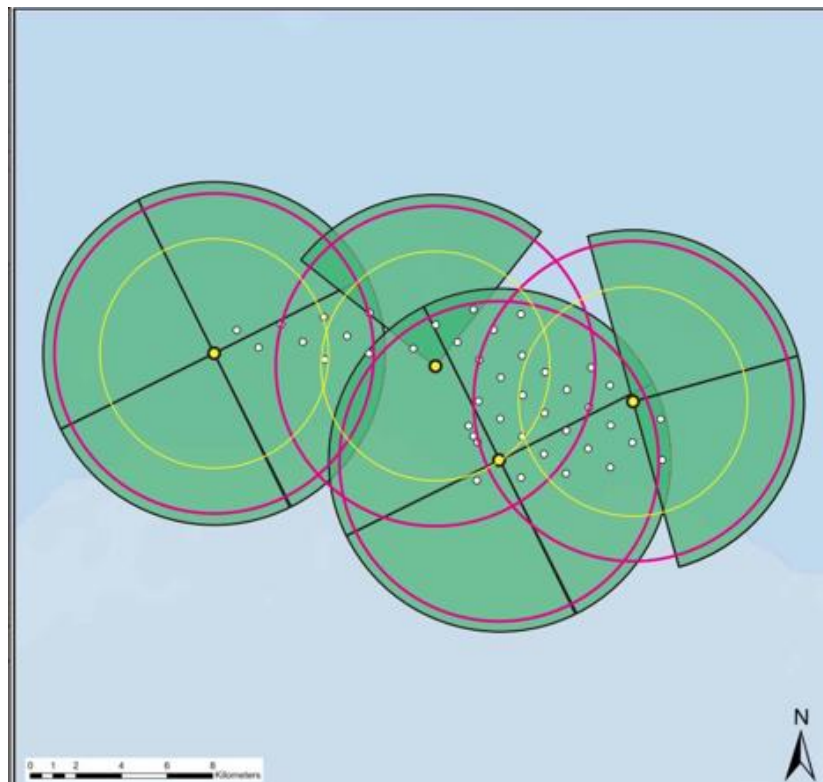


Fig. 15.1. Spatial distribution of the radar and camera system recording birds within the BC-Wind OWF

Source: Investor data

The total number of S-band radars is 11, while the number of X-band radars is 4. In order to enable monitoring coverage of the entire wind farm area, radar sets will be located at the four transition

elements of the offshore wind turbines. Achieving coverage of the entire wind farm area will require the X-band radars to be distributed unevenly.

Tab. 15.1. List of key components of the bird detection system

Set designation	Set composition
BMMS-1	4 S-band radars + 1 X-band radar, camera
BMMS-2	1 S-band radar + 1 X-band radar, camera
BMMS-3	4 S-band radars + 1 X-band radar, camera
BMMS-4	2 S-band radars + 1 X-band radar, camera

Source: Investor data

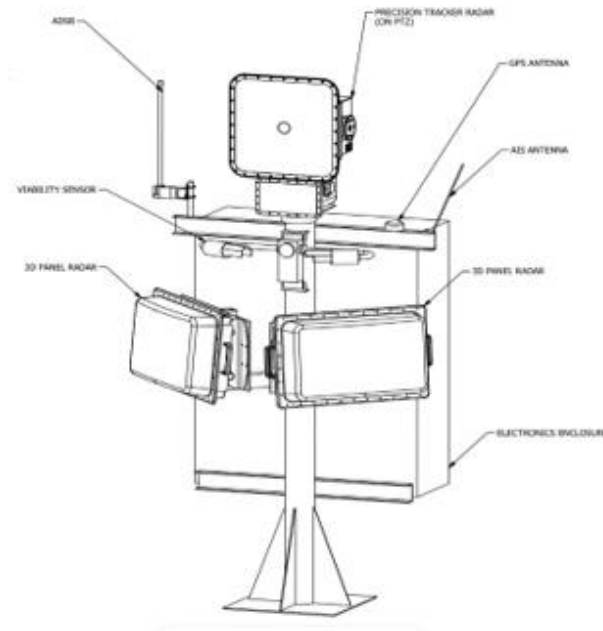


Fig. 15.2. Bird flight recording set

Source: Investor data

The system will be tasked with collecting, processing and analysing the following parameters:

- flight trajectory,
- flight direction,
- location of individuals/flocks and their distance from the BC-Wind OWF,
- speed and type of flight,
- flight altitude above sea level,
- abundance assessment,
- bird species.

The monitoring data will be archived on a server located in a land power station building.

The key function of the system is to identify individual birds and flocks of birds the migration routes of which may pass through the BC-Wind OWF Area, especially at collision heights, in order to adjust the operation of wind turbines for safe passage through the farm area. Initial species identification will be based on radar imagery to identify wingspan, flight style and other key parameters characterising the behaviour of individuals or flocks of birds.

The process of accurately identifying the species will be possible when the birds fly within a radius of approx. 1 to 2 km from the image recording site. The recorded image will be continuously analysed by software supported by artificial intelligence algorithms. Based on these parameters, the system will determine the most likely flight route through the wind farm area and adjust the turbine mode by slowing down or temporarily stopping operation.

During the first year of operation of the bird detection system, a monitoring programme will be carried out in cooperation with the system's supplier and ornithology specialists. The participation of ornithologists will support the process of 'teaching the system and verifying its ability to recognise bird species. Monitoring will be carried out with a view to expanding the ability to recognise species composition. The 'teaching process of the system will also include the optimisation of turbine operation by slowing down or stopping rotor movement altogether, depending on the species (speed and flight pattern), to optimise losses in electricity generation.

The results and experience gained from the annual monitoring to enhance the system's ability to identify bird species migrating through the BC-Wind OWF Area will be used to improve the system's operation, particularly in terms of minimising the risk of bird mortality, and in particular protected species.

15.3. MINIMISATION MEASURES FOR THE IMPACT OF THE DECOMMISSIONING PHASE

At present, it is difficult to predict with which methods and to what extent the farm will be decommissioned. This will depend, i.e., on whether valuable habitats will be created on the support structures, which will require appropriate adjustment of the methods and scope of decommissioning of the support structures while ensuring navigational safety. The decommissioning method for the BC-Wind OWF will be determined approx. 2 years prior to the end of the exploitation phase, and submitted to the Gdańsk RDEP for approval, including information on how the impact on benthos will be minimised.

Regardless of the adopted decommissioning methods, the following actions can be indicated at present:

- to the extent that this will be possible, the removal of successive power plants starting from one location so that the body of water occupied by the OWF is freed from the structures gradually;
- taking the so-called soft start procedure into consideration prior to the commencement of demolition works, which generate a significant level of underwater noise;
- using a noise reduction system if it will be necessary to use equipment generating impulsive noise.

16. PROPOSED MONITORING AND ENVIRONMENTAL ACTION PLAN

On the basis of the conducted environmental impact assessment of the variant selected for implementation (the WWR 2024), which was found to be the most environmentally beneficial, it was concluded that the significance of impacts will be in most cases the same (or lower) than for the Applicant Proposed Variant for which the Gdańsk RDEP issued the DEC in 2022. Due to the fact that the impacts are similar, the monitoring scope proposed in the 2021 Report also refers to the same components of the environment, however it has now been made more detailed and adjusted to the current knowledge on the subject, and the most important conclusions from the GDEP Guidelines for Offshore Wind Farms, which are currently in the final stage of development.

The proposed environmental monitoring addresses the 3 main phases of the BC-Wind OWF:

- the beginning of the construction phase – understood as the first activities in the BC-Wind OWF Area related to its construction (it is estimated that the construction will start around 2026/2027 and will last approx. 2-3 years)⁶⁷¹;
- the beginning of the exploitation phase – understood as launch of the BC-Wind OWF after which the energy generated by the BC-Wind OWF will be transmitted to the National Power System (it is estimated that the exploitation of the OWF will last approx. 35 years);
- the completion of the exploitation phase – understood as the shutdown of all of the power plant facilities and the termination of the supply of energy to the NPS from all wind turbines; the method of decommissioning of the farm will be planned approx. 2 years before the end of the operation of the BC-Wind OWF and will be submitted to the RDEP in Gdańsk for approval; planning of the

⁶⁷¹ construction may take longer – up to a maximum of 5 years, e.g. in the event of problems with the supply and availability of vessels

decommissioning method of the BC-Wind OWF will be preceded by year-long marine environment research (benthos and ichthyofauna research), the aim of which will be to assess the ecological quality of the ecosystem that is likely to be created within the area of the support structures – the obtained results will constitute the basis for the determination of the optimal decommissioning method, taking into account the ecological quality of the ecosystem within the wind farm, and navigational safety.

As set out in the DEC and in this Report update, the methodologies for the selected monitoring will be submitted to the Regional Director of Environmental Protection for approval prior to the commencement of the surveys. This is primarily due to the fact that the methodologies may be modified relative to those described in this Report as a result of various situations that may arise over the years. This is mainly related to the expected technological progress in the field of measurement equipment and the uncertainty of impact forecasting, which will be gradually verified during the implementation of the first wind farms in the PMA, i.e. the Baltic Power OWF and the Baltica 2 OWF, which are currently (at the turn of 2024/2025) starting the construction process. The results of construction phase monitoring may influence the modification of the monitoring approach prior to the commencement of the BC-Wind OWF project, which is planned for late 2026/2027. It will be particularly important to submit the results of the benthos and ichthyofauna monitoring to the RDEP for approval after several decades of the farm's operation, and to indicate the decommissioning method that will be least invasive for the marine environment.

16.1. MONITORING PRIOR TO THE CONSTRUCTION PHASE

16.1.1. Monitoring of seabirds prior to the construction phase

Year-long research on seabirds should be conducted one year prior to the commencement of the construction of the OWF. A detailed methodology of the pre-investment monitoring, developed by an ornithologist specialised in seabirds, will be submitted for approval to the RDEP in Gdańsk 4 months prior to the planned start of the monitoring.

The pre-investment monitoring of the OWF in terms of seabird surveys should include daytime counts of birds present in the area of the OWF and on selected transects in a belt up to 5 km wide from the boundary of the OWF, as from a distance of up to 5 km from the BC-Wind OWF boundary, a decrease in densities related to bird scaring is expected. The extension of the survey area to include a buffer zone of up to 5 km, where transects will be delineated, is intended to determine the extent to which seabirds use the area around the farm. This data, collected prior to construction, will serve as a baseline to assess the avoidance response exhibited by wintering birds during the exploitation phase (based on the monitoring of wintering birds during the exploitation of the BC-Wind OWF).

Surveys may be conducted using vessels or from an aircraft, meaning that digital surveys from survey sessions conducted from a flight, which allow the collection of a permanent record of the number of birds, rather than approximate numbers, down to the species level and their exact locations, over approx. 2 hours of monitoring, are acceptable. Performing seabird counts from an aircraft is in accordance with the HELCOM 2021 methodology.

The route of a research session (understood as a cruise or a flight) should be determined in such a way to cover a 5 km zone around the OWF borders and to assess changes in the density of birds staying at different distances from the future wind turbines. The surveys must cover first of all the period of the most numerous bird occurrence in the southern Baltic Sea, i.e. they should last from October to May with a frequency of no less than 1 survey session per month. In the other months, the abundance of birds in the BC-Wind OWF Area is low, therefore it is sufficient to carry out two survey sessions in the summer period, one each in August and September.

It is not necessary to conduct research on the so-called reference area, understood as an area distant from the BC-Wind OWF (outside the area of impact of the farm) with similar environmental

conditions, which would constitute a reference point for the assessment of changes occurring in the area of the BC-Wind OWF after its launch. According to the information received during the briefing on 10 October 2024 on the Guidelines for Environmental Analysis and Monitoring in the Construction of Offshore Wind Farms, the GDEP indicated the possibility of departing from the need to study reference areas. As justification, it was stated that there is currently a wealth of seabird abundance data available for the PMA, which can provide a reference point for analyses of monitoring results.

At the stage of the final version of the construction design, transects in the area of the OWF BC-Wind will be determined in order to take into account the future deployment of wind turbines, and to ensure the safety of the BC-Wind OWF facilities. This is important as the post-investment monitoring should be performed along the same transects.

16.2. MONITORING DURING THE CONSTRUCTION PHASE

16.2.1. Monitoring of underwater noise

Monitoring of underwater noise should be conducted throughout the piling process. The location of the noise monitoring station should be determined in such a way that the underwater noise level at the border of the Ostoja Słowińska PLH220023 Natura 2000 site for the works performed in the area of the BC-Wind OWF can be assessed.

The measurements of noise can be carried out using calibrated hydrophones in the frequency range of 10 Hz to 20 kHz, with monitoring at two different depths (at 33% and 66% water depth, but always >2 m below the sea surface), with the SEL determined for each pile driver strike (if used).

The underwater noise monitoring results should be submitted to the Regional Director of Environmental Protection in the form of periodic reports. It is proposed to submit the report 6 months after the completion of the piling process. In case the indicated noise levels are exceeded, preventive or minimising actions should be proposed together with the indication of their implementation, and control over their results. When presenting the results of the aforementioned monitoring studies, they should be compared with previously conducted monitoring studies for this project, and with other available studies in this field.

The method for conducting underwater noise monitoring will be detailed in the Piling strategy.

16.3. MONITORING POST THE CONSTRUCTION PHASE

16.3.1. Monitoring of benthic organisms

Due to the occurrence of temporary negative impacts on benthic communities, monitoring of these organisms should be carried out as the construction of the OWF will affect local changes in the structure of the seabed biocoenosis. In the construction phase there will be, first of all, a disturbance of the seabed sediment structure and physical destruction of invertebrates; in the exploitation phase, there will be a loss of a fragment of the seabed fauna habitat and the effect of an artificial reef, the significance of which for the PMA is not clear at the moment. Therefore, the aim of the proposed monitoring is to determine the scale, spatial and temporal extent of the aforementioned factors, especially as no OWF is yet in operation in the PMA, so the actual intensity of impacts caused by such an investment in this part of the Baltic is not supported by knowledge from post-investment monitoring. At least 12 OWF units are planned to be sited in the Polish part of the open waters of the southern Baltic Sea by 2040. An important issue in the monitoring of benthic organisms is also to sort out the so far piecemeal knowledge on the colonisation of artificial hard substrates by animal and plant communities in the PMA. An important strategy of the monitoring studies is to be able to compare them with the data provided by the inventory surveys. Therefore, the planned monitoring should cover similar seasons as the inventory surveys.

The research on macrozoobenthos should be conducted in accordance with standard methodologies, and on flora and epiphytic fauna – in accordance with the methodology of Kruk-Dowgiałło et al.⁶⁷². A proposal for the scope of the methodology of benthic organisms is presented in the table below (*Programme for benthic monitoring research in the BC-Wind OWF Area*).

Tab. 16.1. *Programme for benthic monitoring research in the BC-Wind OWF Area*

Period	Parameter	Methodology
During the first year after the installation of wind turbine foundations	Macrozoobenthos	Surveys of macrozoobenthos complexes (soft bottom – with a van Veen grab sampler, hard bottom – with an ROV) in the area of 5 foundations/supporting structures of wind turbines. In the vicinity of a single foundation/ supporting structure, 6 stations should be designated, including 3 stations on the main profile transect (along the near-seabed current axis) at a distance of 20, 50 and 100 m from the foundation, and 3 stations along the transect perpendicular to the main profile (reference profile) at the same distances. Additionally, 5 stations should be located in the central point (outside the cable route) between four adjacent foundations/supporting structures of which one will be covered by the above-mentioned monitoring along two profiles. The surveys will be carried out after the construction of the structures selected for monitoring has been completed, once in a period similar to the period of inventory surveys (May–June)
Second year after the installation of wind turbine foundations	Periphytic fauna and flora	The survey of periphytic fauna and flora will be carried out on 5 underwater structural components of wind turbines. At each object surveyed, a video (or photographic) documentation of the entire section covered with macroalgae and periphytic fauna will be made (note: the depth of periphytic flora occurrence may differ from the range of periphytic fauna occurrence). Beginning from the water surface to the depth of the maximum range established for the periphyton occurrence, at particular depths, within a maximum interval of 2 m, samples from a specific area will be collected by a scuba diver or an ROV for the surveys on taxonomic composition and biomass of periphytic flora and fauna. The surveys will be carried out once a year in June
Third year after the installation of wind turbine foundations	Macrozoobenthos	Continuation of the survey from the first year on the same stations during the restoration and formation of the originally damaged macrozoobenthos complex
Fourth year after the installation of wind turbine foundations	Periphytic fauna and flora	Continuation of the survey from the second year on the same stations during the formation of a new periphytic fauna and flora complex
Fifth year after the installation of wind turbine foundations	Macrozoobenthos	Continuation of the survey from the first year on the same stations during the restoration and formation of the originally damaged macrozoobenthos complex
Sixth year after the installation of wind turbine foundations	Periphytic fauna and flora	Continuation of the survey from the second year on the same stations during the formation of a new periphytic fauna and flora complex

Source: EIA Report for BC-Wind, MEWO S.A., 2021, p. 346

Other methods may also be used in accordance with the current state of knowledge on the subject, and available techniques.

⁶⁷² Kruk-Dowgiałło L., Michałek-Pogorzelska M., Dubiński M., Brzeska P., Opióła R., Kuliński M., Osowiecki A., Bieńska M., Przewodniki metodyczne do badań terenowych i analiz laboratoryjnych elementów biologicznych wód przejściowych i przybrzeżnych. Biblioteka Monitoringu Środowiska. Inspekcja Ochrony Środowiska, Warszawa 2010

16.3.2. Monitoring of ichthyofauna

Due to the disturbance that the construction phase will cause and the uncertainty of predicting how this will affect the ichthyofauna, it has been proposed to carry out monitoring of the ichthyofauna immediately after the construction is completed. The purpose of this monitoring is to confirm that the construction phase has not caused changes in the behaviour of the ichthyofauna.

Surveys to be carried out in spring and summer immediately after the construction is completed:

As part of the monitoring, use a set of research tools in the form of multi-panel bottom nets and, in the case of early stages, a Bongo-type ichthyoplankton net.

- Establish research stations both in the OWF Area, with the safety rules that will apply within the farm and will also be related to the numerous cables planted in or on the seabed, and at some distance from it, in a body of water not intended for offshore energy, but characterised by similar parameters of the marine environment (depth, distance from the shore, etc.).
- Investigate whether the effect of the artificial reef is limited to attracting fish from the nearby area to the area, or whether a real increase in productivity is found.

At the same time, it has been proposed to abandon monitoring ichthyofauna in the following years, considering that benthic monitoring, spread over several years after the completion of the construction works, will provide information on changes occurring in the habitat.

Monitoring of ichthyofauna should be conducted immediately after the completion of construction works in order to assess the impacts (including cumulative impacts) of the construction of the BC-Wind OWF on ichthyofauna.

16.3.3. Monitoring of migratory birds

Monitoring of migratory birds will be carried out using a dedicated radar and camera system (Detect equipment) and additionally, in the first year following the launch of the farm, monitoring will be carried out by an ornithologist until the effectiveness of the species recognition by the camera system has been confirmed.

The following data is required to assess the extent of impacts, i.e.: flight trajectories (radar), flight altitude (radar), species identification (visual observations, automated radar/camera system), flight behaviour to assess micro-, meso- and macro-communication rates (radar).

The ongoing technological advancement makes it possible to use different technology in monitoring and obtain results that coincide with the data collected during classical monitoring performed from onboard research vessels. The advantage of a radar-camera system permanently mounted on an OWF is that it is possible to carry out continuous surveys on an annual basis, dispensing with sampling surveys as is the case with classical methods. The effectiveness of radar systems in terms of detecting bird flight paths and determining height has been known for years. In contrast, the use of a camera system for species recognition in the Baltic Sea area based on artificial intelligence requires the system to 'learn' through the provision of samples to be processed, as well as the verification of effectiveness. Therefore, it was assumed that during the first year of post-completion monitoring, surveys would be conducted in conjunction with visual observations by ornithologists, using the radar and camera system. After the first research cycle it will be allowed for the radar-camera system to work on its own, without the need for the participation of an ornithologist in the field work, if the system will be able to provide data necessary for the assessment of impacts, including data on identification of species, including key species, and the amount of samples provided will make it possible to calculate streams of bird flights through the OWF area.

Monitoring of migratory birds includes both flight observations using a radar and camera system and counts of birds present in the OWF area performed during the daytime:

- Target radar surveys at the trajectory of birds flying towards the OWF and their reactions to encountering the barrier of the OWF, as well as to determine the intensity of migration in the OWF Area and in the immediate vicinity, in order to allow a comparative analysis with other available surveys in this area, as well as to provide new data for the analysis of the barrier effect and avoidance frequency.
- Carry out radar surveys during the migration period, in the months of March to May, and from late July to mid-November.
- Monitoring should consist of simultaneous visual and radar-camera observations allowing identification not only of flight direction and response, but also of species.
- The research stations should be located on a fixed platform (e.g. a substation) or an anchored ship, so that it is possible to observe the OWF from the direction from which the birds fly at a given stage of migration (the southwestern side of the OWF in spring, and the northeastern side of the OWF in autumn).
- Carry out no less than 20 days of observations in 2-5 day sessions for each migration season, evenly distributed over the migration season.
- Carry out monitoring in two cycles per year, resulting from the two migration periods of birds, i.e. from March to May and from July to November,
- After the first research year, apply a radar and camera system covering the whole wind farm – for the next four years.

At the same time, the abandonment of bird mortality monitoring has been proposed due to the lack of technical possibilities to conduct such monitoring in marine conditions. Moreover, it should be pointed out that the identified (as a result of renewed modelling) low collision for crane during autumn migration – i.e. 8 individuals are forecasted for the current variant selected for implementation, i.e. the WWR 2024; in the case of the variant for which the investor obtained the DEC, it was 14 individuals, and in the case of the Baltic Power OWF (for which no mortality monitoring is required), it is 47 individuals. At the same time, the monitoring of migratory birds carried out at the farm using radar and camera systems makes it possible to carry out modelling of potential bird mortality on the basis of the collected data.

16.3.4. Monitoring of seabirds

The post-investment monitoring of the OWF in terms of seabird surveys should include counts of birds present in the OWF area and at selected locations up to 4 km away, similar to the pre-implementation monitoring, performed during the daytime.

The route of a research cruise should be the same or very similar to the pre-investment (pre-construction) monitoring. The research must primarily cover the period of the most numerous bird occurrence in the southern Baltic Sea, i.e. it should last from October to May with a frequency of no less than 1 research session per month (optimally 2 research sessions per month). In the remaining months, the abundance of birds in the BC-Wind OWF Area is low, therefore in the summer period it is sufficient to carry out 2 research sessions, one each in mid-August and mid-September. These studies should be conducted for 2 consecutive years (the first 2 years of the OWF exploitation phase). In the first season there will be a gradual habituation of birds to the situation, when the area designated for the investment will become inaccessible for them (the so-called habituation), which will result in changes in their distribution. Therefore, this period can be treated as a transition period, and only in the second year the scale of impact of the BC-Wind OWF on sea birds residing in the area will stabilise.

16.3.5. Monitoring of marine mammals

Protection of the harbour porpoise focuses primarily on the mitigation of underwater noise during piling and the use of all available measures to exclude the presence of impulsive noise during emissions. The post-construction survey aims to find out whether harbour porpoises are using the water body in question, even after the construction is completed. As harbour porpoises were observed sporadically

during the year-long monitoring, it has been proposed to carry out year-long post-construction monitoring.

Acoustic monitoring of harbour porpoises in the area of the BC-Wind OWF was carried out in 2019-2021. The results obtained confirmed the occurrence of the animals in the analysed area and were used for the purposes of the preliminary environmental impact assessment (2021), as well as this update of the assessment (2024). Taking into account that harbour porpoises occur in the area of the planned BC-Wind OWF as well as in adjacent waters (as confirmed in literature data), and also considering the sensitivity of these animals to underwater noise, it has been shown that the piling process could potentially have a negative impact on the analysed species. Therefore, the EIA Report recommended mitigation measures during the construction phase (including technological methods, the soft start procedure, and the MMO programme), as well as acoustic monitoring of harbour porpoises during and after the completion of the works, as stipulated in all DEC for offshore wind farms in the PMA. The purpose of the monitoring is firstly to check the effectiveness of the minimising measures used by the Investor, as well as to check the assumptions made by the authors of the EIA Report to assess the impact of the Project on marine mammals. The implementation and exploitation of the Project must not negatively deteriorate the condition of the studied component and only the information from the monitoring will allow such an assessment to be made.

The above recommendation is connected with making a later description and assessment of the impact required by the EIA Act possible, covering how the construction and exploitation of the planned Project affected the level of activity of the species in the analysed area. This analysis is furthermore necessary as the Baltic harbour porpoise population has a critically endangered status and any possible disturbance must be controlled.

The location of porpoise detection devices should be deployed in similar locations as during the earlier monitoring (carried out in 2019-2020). In addition, 5 detectors should be installed in a gradient arrangement covering an area of not less than 20 km outside the impact zone (for the range of behavioural responses associated with piling following Brandt et al.⁶⁷³). The gradient arrangement requires classification of samples according to distance and excludes the issue of selecting a control site.⁶⁷⁴ It is also more efficient than random selection of control points to detect changes due to disturbance. The method has been shown to be effective in studying the movement of porpoises in response to the piling process and in examining how instantaneous impacts vary with distance.⁶⁷⁵

As harbour porpoise were observed sporadically during the monitoring carried out prior to the Report, it was proposed to primarily use data that will be collected during the SAMBAH 2 harbour porpoise monitoring programme.

SAMBAH II/24 – Survey of harbour porpoise population in the Baltic based on acoustic monitoring in the Polish Marine Areas as part of the SAMBAH II project – Maritime Fisheries Institute – National Research Institute

The planned SAMBAH II survey points are located in the vicinity of the farm and one survey point is planned directly in the area of the BC-Wind OWF. C-PODs/FPODs record the presence of harbour porpoises but, like other monitoring methods, do not provide direct data on their numbers in a given area. The detection range of harbour porpoises, the size of which is highly dependent on local time-varying signal transmission conditions and the behaviour of the animal and can be several hundred

⁶⁷³ Brandt M.J., Diederichs A., Betke K., Nehls G., *Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. Marine Ecology Progress Series* 2011, 421: 205-216

⁶⁷⁴ Bailey H., Brookes K.L., Thompson P.M., *Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. Aquatic Biosystems* 2014, 10 (1): 8

⁶⁷⁵ Dähne M., Gilles A., Lucke K., Peschko V., Adler S., Krügel K., Sundermeyer J., Siebert U., *Effects of pile-driving on harbour porpoises (Phocoena phocoena) at the first offshore wind farm in Germany. Environmental Research Letters* 2013, 8: 025002

metres. Therefore, C-pod monitoring only gives information on the occurrence of porpoises and not their numbers.

On the basis of available data on porpoise activity in the BC-Wind OWF Area, a methodology for C-POD distribution will be prepared taking into account the results of monitoring from the SAMBAH II project.

The harbour porpoise detection devices should be deployed in similar locations as during the earlier monitoring (carried out in 2019-2020).

16.3.6. Monitoring of bats

As recommended by the *Guidelines for assessing the impact of wind farms on bats* (Kepel A., 2011 and 2013), an integral part of the assessment of the impact of a wind farm on bats is post-implementation monitoring, which allows the study of bat activity and mortality during the exploitation phase of the project.

Post-implementation monitoring for onshore farms, according to the *Guidelines*, consists of two elements:

- continuous recording of bat activity at rotor height on selected turbines, and
- bat mortality surveys by searching for dead animals under the turbines.

For offshore wind farms, monitoring is limited to the study of bat activity at rotor height due to the impossibility of finding dead bats in offshore conditions. The collision (mortality) analysis for offshore wind farms is therefore based on the probability of collision with the turbines, derived from the degree of bat activity at rotor height. As there is no reference scale or regulation for this, this is an analysis based on best practices, available research, and to the best knowledge of a specialised chiropterologist.

The aim of the monitoring carried out during the period of operation of the BC-Wind OWF is to verify the assumptions derived from the nature inventory, assess the actual impact on migrating bat populations, and propose any appropriate mitigation measures, in line with standards, best practices, and current knowledge.

To verify the forecast of the impact of the BC-Wind OWF on bats, data obtained from two migration seasons in spring and autumn are necessary. Research conducted over two seasons allows for the collection of sufficient data to assess the annual variability of bats migrating through the BC-Wind OWF Area, the activity of which has been low so far. Bat populations and their behaviour can vary significantly from year to year due to various factors, including weather conditions, food availability, or reproductive success in a given season, therefore two seasons of research will be necessary to draw the right conclusions. Two research seasons will also allow for the detection of possible collisions of bats with turbines, which may be relatively rare events. Monitoring conducted over two seasons increases the probability of detecting these events and their frequency. The monitoring will also allow for the detection of possible behavioural adaptations of bats, which may change their behaviour over time in response to the presence of wind turbines, which may not yet occur in the first year of monitoring, but may happen in the second.

Due to the low to moderate bat activity detected during pre-implementation monitoring, bat monitoring should be conducted over a two-year period starting from the first year of the exploitation of the OWF. Monitoring should only cover the spring and autumn migration periods, i.e. from 1 April to 30 May and from 15 August to 30 September, which is in line with the recommendations included in the Kepela et al. (2013) guidelines.

Monitoring should be carried out with equipment enabling continuous recording of bat activity at the height of the rotor on selected turbines, i.e. determining the species composition and numbers. The number of recording devices should be adjusted according to the final number of turbines.

Due to the low to moderate bat activity found during pre-implementation studies, it is proposed to deploy four permanent recording points for the BC-Wind OWF in the first year of monitoring and to possibly increase their number after the first year of monitoring, if increased bat activity is found.

Automatic monitoring will enable identification of bat species flying at collision altitude, as well as their level of activity. This data will be used to determine the probability of collisions with turbines and the application of possible mitigation measures.

Due to the fact that dead bats are not searched for in marine conditions, which is standard for onshore farms, there is no possibility of verifying the calculations of the probability of collisions. The guidelines by Kepel et al. (2013) do not recommend alternative methods of mortality analysis for offshore farms. Monitoring technologies are constantly developing, allowing the use of increasingly advanced systems for analysis; it is worth considering research supplementing the knowledge of actual collisions of bats with turbines. It is also possible to consider using the same system that will monitor collisions of migratory birds at the BC-Wind OWF to the extent that the technology of the planned equipment allows it. This would allow for the comparison of data from automatic monitoring with visual data and the verification of the actual collision rate, using the same equipment.

16.4. MONITORING PRIOR TO THE COMPLETION OF THE EXPLOITATION PHASE

16.4.1. Monitoring of ichthyofauna

Annual monitoring has been proposed to investigate whether the effect of the artificial reef will be limited to attracting fish from the nearby water body to its area or whether an increase in species diversity and productivity will be noted. Monitoring should be carried out 4 years before the decommissioning of the OWF. The results of the monitoring will constitute an important premise for determining whether, in connection with this, the demolition of the farm elements will not destroy a valuable habitat for ichthyofauna.

The research should be carried out in spring and summer. A set of research tools should be used in the form of multi-panel bottom nets, and in the case of early development stages, a Bongo-type ichthyoplankton net.

16.4.2. Monitoring of benthic organisms

Benthos monitoring should be carried out 4 years before the decommissioning of the BC-Wind OWF in order to determine the ecological quality of the ecosystem created during the 20-30 years of the exploitation of the power plant. Macrozoobenthos studies should be conducted in accordance with standard methodologies⁶⁷⁶, and flora and fauna in accordance with Kruk-Dowgiałło et al. (2010)⁶⁷⁷ and Osowiecka A., Błęńska M. (2020)⁶⁷⁸ methodology.

The aim of the study is to evaluate the habitat, which will form the basis for the method of decommissioning the farm.

16.5. ENVIRONMENTAL ACTION PLAN

Below is a chronological list of actions that the Investor will have to take to ensure the appropriate level of environmental protection:

- 16 months **before the beginning of the construction phase**, submit the seabird monitoring methodology to the Gdańsk RDEP;

⁶⁷⁶ Hawkins A.D., Pembroke A., Popper A., *Information gaps in understanding the effects of noise on fishes and invertebrates. Reviews in Fish Biology and Fisheries* 2015, 25: 39-64

⁶⁷⁷ Kruk-Dowgiałło L., Michałek-Pogorzelska M., Dubiński M., Brzeska P., Opiola R., Kuliński M., Osowiecki A., Błęńska M., *Przewodniki metodyczne do badań terenowych i analiz laboratoryjnych elementów biologicznych wód przejściowych i przybrzeżnych. Biblioteka Monitoringu Środowiska. Inspekcja Ochrony Środowiska, Warszawa 2010*

⁶⁷⁸ Osowiecki A., Błęńska M. *Makrozoobentos w wodach przejściowych i przybrzeżnych w Podręczniki do Monitoringu Elementów Biologicznych i Klasyfikacji Stanu Ekologicznego Wód Powierzchniowych* red. Kolada A. Biblioteka Monitoringu Środowiska, Inspekcja Ochrony Środowiska, Warszawa 2020

- 2 months **before the beginning of the construction phase**, conduct seabird monitoring and submit its results to the Gdańsk RDEP within 6 months of its completion;
- 6 months **before the beginning of the construction phase**, update the Threat and Pollution Combating Plan;
- 6 months **before the beginning of the construction phase**, submit the Procedure for dealing with unexpected or accidental archaeological finds together with the Protocol for Archaeological Discoveries (PAD) for approval by an appropriate authority;
- 6 months **before the beginning of the piling process**, submit the 'Piling strategy' for approval by the Gdańsk RDEP;
- **during the piling process**, submit a report on ornithological monitoring every month;
- 6 months **after the completion of the piling process**, submit the results of acoustic monitoring;
- 6 months **after the completion of cable laying**, prepare post-implementation documentation of the cable laying and submit it to the Gdańsk RDEP;
- **after the completion of the construction phase**, 6 months before the planned start of porpoise monitoring, submit its methodology to Gdańsk RDEP;
- **after the completion of the construction phase**, perform monitoring of benthos, ichthyofauna, seabirds, migratory birds, marine mammals and bats, and submit the results to the Gdańsk RDEP within the period of: 3 months from the completion of year-long (partial) studies; 6 months from the completion of the entire monitoring period conducted for a given component;
- 4 years **before the end of the exploitation phase**, perform monitoring of benthos and ichthyofauna, constituting the basis for planning the method of decommissioning of the farm;
- 2 years **before the end of the exploitation phase**, submit information regarding possibly leaving some of the facilities located in/on the seabed for the approval of the Gdańsk RDEP.

17. ANALYSIS OF POSSIBLE SOCIAL CONFLICTS

2011 and beyond should be understood as the information period for the planned BC-Wind OWF, when:

- the Applicant applied for and obtained the decision of the Minister of Transport, Construction and Maritime Economy No. MFW/7/12 of 9 May 2012 on the permit for the erection and use of artificial islands, structures and equipment on the PMA for the project entitled 'A complex of offshore wind farms with a maximum total capacity of 200 MW and technical, measurement and research and service infrastructure related to the preparatory, execution and operation stages',
- the Applicant applied for and obtained the decision of the Minister of Transport, Construction and Maritime Economy No. MFW/4/13 of 6 February 2013 on the permit for the erection and use of artificial islands, structures and equipment on the PMA for the project entitled 'A complex of offshore wind farms with a maximum total capacity of 200 MW and technical, survey and service infrastructure related to the preparatory, execution and operation stages',
- basic documents defining the spatial policy of the country and the region were adopted:
 - the 'Energy Policy of Poland until 2030' adopted by Resolution of the Council of Ministers No. 201/2009 of 10 November 2009,
 - the 'Maritime Policy of the Republic of Poland until 2020 (with an outlook until 2030)' (Ministry of Infrastructure, Warsaw 2015) developed by the Inter-Ministerial Team for Maritime Policy of the Republic of Poland on the basis of the document 'Assumptions of Maritime Policy of the Republic of Poland until 2020' of 14 September 2009,
 - the Director of the Maritime Office in Gdynia, the Director of the Maritime Office in Słupsk and the Director of the Maritime Office in Szczecin on 15 November 2013 made public the information on joining the planning process aimed at drafting the 'Spatial Development Plan of the Polish maritime areas'. The planning process includes the development of: the 'Study of conditions for the plan' and the 'Spatial development plan for Polish maritime areas'; in 2015, the development of the 'Study of conditions for the spatial development of Polish maritime areas with spatial analyses' was completed. The draft plan was prepared in 2019 and implemented in 2021,

- the ‘Pomorskie Voivodeship Development Strategy 2020’ adopted by Resolution No. 458/XXII/12 of the Pomorskie Voivodeship Assembly of 24 September 2012,
- the ‘Regional Strategic Programme on Energy and Environment. Eco-efficient Pomerania’ adopted by Resolution No. 931/274/13 of the Pomeranian Voivodeship Board of 8 August 2013,
- the ‘Pomeranian Voivodeship Spatial Development Plan 2030’ adopted by Resolution of the Pomeranian Voivodeship Assembly No. 318/XXX/16 of 29 December 2016 on the adoption of the new Pomeranian Voivodeship Spatial Development Plan and, forming part of it, the TriCity Metropolitan Area Spatial Development Plan,
- the spatial development plan of internal sea waters, territorial sea and exclusive economic zone in the scale 1:200 000 adopted by the Regulation of the Council of Ministers of 14 April 2021. (Dz.U.2021.935).

The aforementioned permit and the findings of the planning documents provide for the implementation of offshore wind energy as part of the National Electricity System.

Draft strategic documents, together with environmental impact forecasts, were subject to the public participation procedure with public consultations carried out by the relevant administrative bodies prior to their adoption under the provisions of the Spatial Planning and Development Act.

The starting point for conducting public consultations on the planned OWF was the requirements of the national and European Union law, which indicate that planned projects likely to have a significant impact on the environment, which include the OWF, should consult the public at the earliest possible stage, identifying the opinions of interested persons and local communities in order to identify potential problems and determine ways of solving them, as well as provide information to interested groups or persons.

The planned OWF is located in the Baltic Sea within the Polish EEZ to the north of the seashore at a distance of approx. 22.6 to 31 km from the land. The closest seaports are Łeba and Władysławowo in the Pomeranian Voivodeship. The regional, sea-land nature of the project means there is a wide range of potential stakeholders and interested parties from the northern part of the Pomeranian Voivodeship and other interested parties.

The target groups for the information meetings were selected taking into account a number of criteria: the nature of the project, the location, the potential impacts of the planned project, and the degree and type of interest shown by different social groups in other offshore investments.

The planned OWF is to be located on a body of water exploited and used by people, therefore it can be expected that the execution and exploitation of the investment, and first of all the exclusion or restriction of the current use of the area and obstructions resulting from the establishment of transport corridors, will potentially cause social conflicts. The possibility of using the basin and safety zones and other restrictions will be determined in the future by the Director of the Maritime Office in Gdynia. Given the nature of the OWF, it was considered likely that fishing and shipping within and in the area of the OWF may be affected.

The following aspects related to the planned OWF have been identified as having the potential to create social conflicts:

- carrying out the construction and transport of large-scale offshore structures;
- the concern about the state of the environment in the Baltic Sea, nature conservation and bird protection issues in the broadest sense;
- the concern of existing and potential users of the OWF area about the possibility of accessing this body of water, including the concern about jobs, e.g. related to fishing and ensuring proper functioning of communication systems;
- the concern about navigational restrictions and their nature in the OWF area;
- landscape aspects, visibility of the OWF;
- concerns about the impact on tourism in coastal municipalities;

- concerns about the economic impact in coastal municipalities.

Potential positive changes that the planned OWF could bring about have also been identified:

- jobs for the residents of coastal municipalities during the construction phase and the long-term operation of the OWF;
- impact on tourism and the perception of the OWF as a tourist attraction.

The substrate of potential conflict regarding the planned OWF is the following:

- depending on the decisions of the maritime administration, obstructions to fishing in the area occupied by the OWF can be expected, resulting in restricted access to the area and thus impeding free fishing and transit through the OWF area;
- incompatibility of objectives and interests of the parties – the objective indicated by the fishing community is to fish and pass through the OWF area to further fishing grounds and to ensure the presence of fish in the Baltic Sea;
- the environmental disturbance that the planned OWF may cause.

Potential stakeholders (target groups) are:

- administration and state institutions;
- local government units and institutions;
- professional organisations, including fishermen;
- national, regional and local associations and social organisations;
- non-governmental environmental organisations;
- potential suppliers, partners, other offshore investors;
- research and design units.

Due to the location and scope of the tasks of the planned OWF and the direct users of the sea in the area at the current early stage of the preparation of the investment, the Applicant decided to conduct an information meeting with representatives of fishermen's organisations. As part of the preparation of the Report prepared for the purposes of obtaining a decision on environmental conditions, an information meeting with representatives of fishermen's organisations was held on 8 June 2021 in Władysławowo, for which presentations and information materials were prepared. Formal consultations will be conducted during the environmental impact assessment procedure conducted by the Regional Director for Environmental Protection in Gdańsk.

Participants at the consultation meetings highlighted a number of issues of varying importance, including environmental issues. The results of the consultations were used in the development of this OWF EIA Report.

From the information meeting held in 2021, it appears that the fishermen's primary concern is the occupation of the fishing grounds by the OWF area, the transit through the OWF area, as well as the way in which the OWF area is co-used for fishing and the transit of fishing vessels to the fishing grounds north of the OWF area and the extension of the route to these fishing grounds. The Applicant confirmed at the meeting that they do not intend to request additional restrictions over and above those set by the Maritime Administration.

The comments and requests made by stakeholders during the information meeting were recorded on electronic media and written down. At the same time, they provide the prerequisites for broad public participation in the environmental impact assessment procedure.

The Investor has also pledged to regularly inform interested parties about the progress of construction and the units and contractors located in the area of the BC-Wind OWF Development Area, especially with regard to fishermen. Such information will be updated at least once a month together with information about the progress on the development of the OWF area.

Dialogue with fishing communities is continued within the framework of the Sector Deal agreement, subgroup 6.3, where a discussion is held on the principles of coexistence of the fishing

sector and the offshore wind energy sector. Additionally, the Investor cooperates directly with fishermen stationed in Władysławowo, i.e. in the BC-Wind OWF service port, and with fishermen fishing in the area of the planned wind farm. One of the main goals of the subgroup's works is to develop a compensation system for fishermen for whom the construction of wind farms may mean the need to change fishing grounds or extend the route to reach them.

The Investor is involved in the cooperation with representatives of the local community, implemented in several areas – as part of the 'Wind-Powered Municipality' program, supporting social, cultural and educational projects implemented by the authorities of the Choczewo municipality and local social organizations. The program is implemented in cooperation with other investors – Baltic Power, PGE Baltica and Ørsted Polska. The Investor's representatives regularly participate in meetings with the Choczewo municipality council, providing information on the progress of the project, expected temporary inconveniences, as well as measures to minimise them. As an element of the investment preparation process, the launch of the so-called grievance mechanism is also planned, facilitating contact between residents of areas affected by investment-related inconveniences, including fishermen, with the Investor's representatives. Its purpose is to enable efficient reporting of complaints (concerning any aspect of the project's implementation) and their efficient and effective resolution.

18. COMPARISON OF THE TECHNOLOGY USED WITH THE TECHNOLOGY COMPLIANT WITH THE REQUIREMENTS OF ARTICLE 143 OF THE ENVIRONMENTAL PROTECTION LAW

According to Article 143 of the Act of 27 April 2001 – the Environmental Protection Law (Journal of Laws 2024.54, consol.), the technologies used in newly commissioned installations should meet requirements the determination of which takes into account, in particular, the issues indicated below:

- the use of substances with low hazard potential;
- efficient generation and use of energy;
- ensuring the rational use of water and other raw materials and fuels;
- the use of zero-waste and low-waste technologies and waste recovery options;
- determining the type, extent and volume of emissions;
- the use of comparable processes and methods that have been successfully applied on an industrial scale;
- scientific and technological progress.

This catalogue of requirements refers to newly commissioned industrial installations and equipment, which are a source of environmental risks. Offshore wind farms, due to the specific technological nature of the construction, operation and decommissioning phases and the special operating conditions in the marine environment, require verification of these requirements at an early stage of investment planning.

Structural elements of the OWF are to be constructed of materials neutral to seawater and the ground (seabed). Resistance to erosion, corrosion or activity of chemical compounds that may occur in the water is a basic condition for faultless operation of an OWF.

Efficiency of energy generation will be one of the basic criteria for the selection of OWF and their deployment, as well as the method of transmission of the generated energy from the OWF to the National Power System with the limitation of transmission losses. The overriding criterion for energy efficiency is the generation of energy, with obvious limitations related to the windiness of the basin, without the consumption of energy resources – in a fully renewable manner.

In the case of this type of renewable energy, the actual efficiency of energy use is related to the non-refundable energy used to manufacture OWF components (wind turbines and other facilities), and install them offshore.

The consumption of water, materials, raw materials and fuels will occur during the construction process (installation of subsequent wind turbines and laying of submarine cables) and during decommissioning of the OWF components after their technical wear and tear. For 25-35 years of operation, wind turbines will require the use of consumables and fuels during maintenance activities.

Emissions and their extent will primarily relate to acoustic impacts associated with the operation of the wind turbines. They will not significantly affect marine organisms or cause noticeable electromagnetic impacts.

Experience with wind turbines within the Baltic Sea enables the most efficient and proven solutions to be installed that meet the requirements of the most advanced technologies, withstanding operating conditions in a marine environment with highly variable winds.

19. LIMITED USE AREA

The issue of creating a limited use area is regulated by the provisions of Article 135(1) of the Environmental Protection Act: 'If from the ecological review or from the environmental impact assessment of the project required by the provisions of the Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments, or from the post-implementation analysis, it is apparent that, despite the application of available technical, technological and organisational solutions, the environmental quality standards outside the area of the plant or other facility cannot be met, then a limited use area is created for a sewage treatment plant, a municipal waste landfill, a composting plant, a communication route, an airport, a power line and a substation, as well as a radio communication, radio-navigation and radio-location installation'.

This EIA Report indicates that at the current stage of the preparation of the project, there are no grounds to state the possibility of exceeding the environmental quality standards with respect to air, noise, waste water and EMF – the magnetic field and electric field intensities will not exceed the permissible values outside the area to which the Applicant holds the legal title. The nearest areas for which environmental quality standards have been defined in the scope detailed above are located on land, at a distance of approx. 22.6 from the planned project.

20. INDICATION OF DIFFICULTIES ARISING FROM TECHNICAL OR KNOWLEDGE DEFICIENCIES

Phytobenthos

Macroalgae coverage of structures located in the PMA has not been investigated so far. Therefore, the analysis of impacts on phytobenthos resulting from the project in question is of predictive nature based on foreign experience gained during the implementation of such projects. It will be possible to verify the effects, force and pace of the impacts on phytobenthos only after analysing the post-implementation monitoring results.

Macrozoobenthos

The results of previous macrozoobenthos surveys within the survey area, i.e. the area of the planned BC-Wind OWF project, have not been published in scientific literature yet. It is, therefore, impossible to determine the nature and direction of changes in the taxonomic and quantitative structure of macrozoobenthos communities that occurred in this area over the years.

A potential impact on the macrozoobenthos that will be present during the construction of the BC-Wind OWF is the emission of underwater noise. The harmful effect of this impact on the physical, physiological and behavioural response of invertebrates, especially those in the Baltic Sea, is still

insufficiently identified. The research conducted so far, primarily in laboratory conditions on selected crustacean and bivalve species from the North Sea or the Atlantic Ocean, have shown that noise may lead to various negative changes in the functioning of benthic organisms, but has not provided an answer to the question of what level of anthropogenic noise has stress-inducing impact on the macrozoobenthos. The literature available on the impact of piling works causing harmful noise indicates that it is a factor of a low impact scale on the benthic fauna of the Baltic Sea. However, more detailed data with regard to specific macrozoobenthic species is unavailable, especially those that play a significant role in the ecosystem and for which it is impossible to determine the sensitivity towards the impact described.

The impact of heat emission caused by the cables connecting the wind turbines during the OWF exploitation phase is also poorly documented in literature. This factor is unlikely to adversely affect the survival of macrozoobenthos as, in principle, the benthic fauna is naturally adapted to considerable seasonal changes of temperature.

The last impact the potential influence of which on the Baltic Sea benthic fauna is becoming increasingly well-documented in existing literature, yet still equivocal, is the magnetic radiation transmitted by power cables during the exploitation phase of an OWF. The important preliminary information is specifying the depth of the cable burial, its size, as well as the exposure time and cable type (AC or DC), and, at the current stage of preparing documentation concerning the technical concept for this project, there is no detailed relevant data available. The impact of electromagnetic field on individual species of benthic fauna, including bivalves, crustaceans or polychaetes, has so far been examined only on the basis of laboratory tests, and their results vary depending on the input data of the emitted electromagnetic field and the examined organisms. The results of an experiment conducted on the benthic fauna species which are representative and important in the PMA, i.e. *Limecola balthica* mussels and *Hediste diversicolor* polychaete suggest negative, cytotoxic and genotoxic impacts of an electromagnetic field with a frequency of 50 Hz and magnetic induction of 1 mT on these organisms, leading to cancer. The authors of this experiment recommend the consideration of the *L. balthica* mussels as bioindicator species for the electromagnetic field impact on the benthic fauna. Also, in accordance with the Marine Strategy Framework Directive (MSFD; Directive No. 2008/56/EC), it is recommended to investigate the impact of electromagnetic field on aquatic organisms to determine the minimum value of harmful influence of this parameter on individual groups of animals. In summary, electromagnetic field may have a non-significant, negative impact on benthic species at the level of biochemical and physiological changes, but it is still difficult to determine whether the size of the electromagnetic field emitted by AC or DC cables will cause any undesirable impact on macrozoobenthos in the BC-Wind OWF area.

The assessment of the impact on the macrozoobenthos carried out for the decommissioning phase of the OWF should also be considered. Since currently there is lack of experience in the decommissioning process of OWFs in Europe, which will begin on a larger scale only in the next decade, as well as a lack of technical assumptions for this project in terms of the OWF decommissioning, it should be underlined that this assessment is conducted on the basis of the best knowledge available to date, however, it cannot be excluded that these are only the predicted consequences for macrozoobenthos.

Ichthyofauna

Literature on the subject of impacts related to the construction and operation of an OWF is relatively rich, but it refers to areas other than the southern Baltic. Therefore, when preparing the Report, it was necessary to assume that the nature of the impacts in the project area would be similar to the one found in other cases. Data collected in the future as part of monitoring surveys carried out during the construction and operation of projects located in the PMA should fill this knowledge gap.

Particular difficulties concern the assessment of the impact of the construction phase, including primarily underwater noise (generated during piling) on fish species that may occur in the area of the BC-Wind OWF and its surroundings. The commonly used reference to the threshold of $SEL_{cum.} = 186$ dB re $1 \mu Pa \cdot s^{-1}$ – is burdened with a high level of uncertainty in the context of the potential impact on TTS in fish. The threshold is based on studies conducted on pike (*Esox lucius*), whitefish (*Coregonus nasus*) and lake chub (*Couesius plumbeus*), i.e. freshwater fish exposed to noise from air guns ($SEL_{(cum.)}$ 186 dB $1 \mu Pa^2 s$, at different frequencies from 100 to 1600 Hz) (Popper et al., 2005).

What is more, no data on potential impacts related to the decommissioning of the project was found. So far, there has been no documented ichthyofauna monitoring during a decommissioning of an OWF structure, therefore we do not possess the knowledge about its course and environmental disturbances caused by such works. It is also difficult to predict what technologies will be available in several dozen years at the time of the decommissioning of the project. During the impact assessment, it was assumed that the impact would be similar to the one occurring at the time of construction.

No ichthyoplankton surveys have been carried out in the BC-Wind OWF area. The only source of information to which the obtained results can be referred to is the data collected during the one-year long ichthyofauna monitoring conducted within the areas located in the vicinity of the planned OWFs. The scarce amount of data for the shallower areas of the southern Baltic results from the fact that this area is located outside the network of survey stations at which the NMFRI conducts standard plankton surveys. The network is designed in such a way as to cover the spawning grounds for most of the commercially caught fish species, excluding shallower sea areas. In the case of non-commercial species with early development stages present in both the deep water and the shallow coastal areas, the available information is scarce and often distant in time, and does not relate strictly to the area surveyed.

There is some information on the spatial distribution of ichthyoplankton in the coastal zone of the Baltic Sea of up to 40 m in depth. However, because these surveys are conducted randomly, often only once, at stations in different areas, the acquired data is limited. Some of them refer to single stations along the Polish coast, while others are concentrated in the Gulf of Gdańsk or in the area of the Pomeranian Bay. Moreover, there is no data on seasonal and multi-annual variability.

Despite the issues listed above, the applied survey methodology proved to be adequate for the environmental conditions of the BC-Wind OWF area (i.e., the character of the seabed, hydrometeorological conditions and fishing exploitation). In addition, the use of standard methods for the analyses of catches and biological analyses ensures comparability of the collected and analysed data.

Marine mammals

The main limitation concerning the collection of data on marine mammals results from logistic challenges during data collection at sea. In consequence, this results in knowledge gaps on the seasonal occurrence of these animals in the Baltic Sea area over a longer period of time.

As a result of the conducted monitoring, it has been concluded that marine mammals occur sparsely in the BC-Wind OWF area. In this respect, the obtained results correspond to the results obtained as part of the projects of SAMBAH and the 'Pilot implementation of species and marine habitats monitoring in 2015–2018' (CIEP). It should also be noted that the confidence interval (CI) of the results of surveys conducted as part of the SAMBAH project is very high. The estimates on the abundance of marine mammals are characterised by a high statistical variability. As a result, the environmental impact assessment is difficult. Moreover, the surveys conducted for the purposes of the OWF did not provide very precise information on the abundance of marine mammals in the survey area, due to their small spatial and temporal ranges, as well as low density of marine mammals in the southern Baltic. The ongoing SAMBAH II project will provide new data on the abundance of marine mammals in the Baltic Sea.

The noise exposure criteria are also a source of uncertainty. The criteria published by NMFS⁶⁷⁹ are a step forward as they include the frequency-dependent audibility of marine mammals in a more comprehensive way than it was possible before. However, the hearing thresholds and the weighting functions are derived from few studies and are based on the noise sources of slightly different spectral and temporal properties than the ones studied in the BC-Wind OWF project, thus the animals' reactions may be different. Nevertheless, these are currently the most up-to-date criteria and have therefore been used in this assessment. The knowledge on the impact of noise on marine mammals is continuously being extended. The calculated impact ranges should, therefore, be treated with caution.

Additionally, C-POD devices which are generally acceptable and commonly used tools in the harbour porpoise monitoring, have a limited detection range (similar to other hydrophones), which may condition the detection of harbour porpoises in the survey area. This is particularly significant in areas with low densities of these marine mammals.

Migratory birds

The knowledge available on nocturnal migrants is currently insufficient to accurately determine their species composition and to answer the question of at what altitudes exactly individual species fly. This concerns especially the species that are not vocally active. So far, there is no technology available that would enable identifying these species. The only data collected for the nocturnal migrants in the central part of the Baltic Sea concerned the areas of the Bałtyk II and Bałtyk III OWFs, and the Baltica 2, Baltica 3 and Baltic Power OWFs. Despite the lack of reports regarding nocturnal migrants, the data collected for the BC-Wind OWF is sufficient to draw conclusions from for the purposes of the environmental impact assessment for this OWF.

In the case of the Polish coastal waters, apart from environmental surveys for the Bałtyk II and Bałtyk III OWFs as well as the Baltica 2, Baltica 3 and Baltic Power OWFs, the surveys carried out in the BC-Wind OWF Area constitute the only complete study on migratory birds in the survey location during spring and autumn migrations. The results obtained for the Dębki-Białogóra OWF area (planned project) are available, however the surveys were limited to visual observations only and did not include both migration seasons (autumn observations began in October), and the surveys were focused only on waterbirds⁶⁸⁰. Nevertheless, the monitoring carried out for the investment related to the construction of the BC-Wind OWF covers all types of surveys considered the best practice for the purpose of preparing an environmental impact assessment.

Seabirds

The current knowledge on the occurrence of seabirds in the Baltic Sea is based primarily on surveys conducted in winter. In the Polish zone of the Baltic Sea, the surveys conducted in the remaining phenological periods were carried out as part of the pre-investment monitoring (for the planned Dębki-Białogóra, Bałtyk Północny, Bałtyk II, Bałtyk III, and Baltica OWFs) or as part of the development of the plans for the protection of the Natura 2000 offshore sites (Zatoka Pomorska and Baltic Coastal Waters). Also, the lack of data on birds staying at sea within the Polish EEZ outside the areas listed above constitutes a major hindrance in the interpretation of the obtained results. The exemplary detection of large, previously unknown, concentrations of the common guillemot in the OWF area demonstrates that our knowledge on birds outside the 12-mile strip of territorial waters is still incomplete.

It is also unknown whether seabirds spend entire winter in one sea area, or whether they move from one part of the Baltic Sea to another. It is very probable that they move over small distances in reaction to changes in the abundance of food. However, there is still no reliable data on the displacement

⁶⁷⁹ National Marine Fisheries Service (NMFS), 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0). Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59, 2018

⁶⁸⁰ Busse P., First Off-Shore Site Bird Monitoring in Poland (Dębki-Białogóra, 2002-2004). *The Ring* 2015, 37: 19-54

of seabirds within the Baltic Sea (including the most abundant species of sea ducks) from one wintering ground to other, distant places of wintering.

With the current state of our knowledge on the seabirds gathering within the Baltic Sea area, away from the coasts, the interconnections between the Natura 2000 network sites cannot be fully assessed.

In relation to the estimation of the collision probability, there is a serious lack of knowledge about the behavioural avoidance response to wind turbines by birds, affecting basically all species. Due to this deficit of knowledge, the risk of collision is often assessed taking into consideration the precautionary principle, and therefore, the number of potential collisions may be, on the one hand, overestimated, and on the other hand, underestimated.

At the moment, it is not known whether the bird species considered sensitive to the presence of the OWF (e.g. divers, the long-tailed duck, the velvet scoter) will adjust (and if yes, to what extent) to its presence and begin to use its area once again.

The period covered by surveys was divided into four phenological periods. This division is arbitrary to a large extent, since various species migrate at slightly different times, and thus the autumn migration of common scoters is observed as early as in August, while long-tailed ducks begin their autumn crossing at the end of September. As shown by the results obtained in these surveys, the spring migration period of sea ducks ends in April, thus for these species, May should rather be included in the summer period. The division into four phenological phases adopted here enables the grouping of observations into periods in which the majority of waterbird species the presence of which can influence decisions related to the project migrates, is wintering or stays in the coastal area.

It should be noted that the results of the visual observations of migrating birds conducted during survey cruises may constitute only an auxiliary material in the analysis of data obtained in the course of surveys with the use of radars directed at birds flying above the OWF area. The vast majority of passerine birds cross the Baltic Sea at night, hence the registration of their flights with the use of radars is necessary to study the directions, flight altitude limits, and the intensity of the migrations. Observations conducted by day are primarily related to individuals which did not adopt a typical scheme of behaviour, and so their flight over the sea does not necessarily have to be conducted the same way as at night. Moreover, the visual assessment of a flight altitude is certainly vitiated by a large error resulting from, i.a., the position of an observer in relation to the flying bird, the movement of the ship deck resulting from the wave motion, and the distance to the bird observed, as well as individual predispositions to assess the distance correctly. Additionally, birds, especially the ones belonging to small-sized species, are difficult to notice when they are flying at significant heights. This is why their number may be considerably underestimated. Therefore, the applied survey methodology does not offer a full picture of bird movements, and only supports the results acquired with the use of radars.

In this Report, the European herring gull is treated as a species *sensu lato*, i.e. a taxon including three species that are nowadays differentiated but very similar: the European herring gull *Larus argentatus* – *sensu stricto*, the Caspian gull *Larus cachinnans* and the yellow-legged gull *Larus michahellis*. The surveys conducted in northern Poland indicate that the species that clearly predominates among the three is the European herring gull, and the two others appear there rarely.

Bats

The assessment of the significance of the surveyed OWF area on the basis of the conducted monitoring was based on the reference scale included in the project 'Guidelines for the assessment of the impact of wind turbines on bats' prepared by Polish specialists and practitioners for the General Directorate for Environmental Protection in 2011⁶⁸¹. The scale presenting the boundaries of bat activity

⁶⁸¹ Kepel A., Ciechanowski M., Jaros R., Wytyczne dotyczące oceny oddziaływania elektrowni wiatrowych na nietoperze. Projekt. Generalna Dyrekcja Ochrony Środowiska, Warszawa 2011

was prepared on the basis of data obtained during surveys conducted on onshore wind farms. Currently, there are no surveys which would confirm that the limits presented also characterise the activity of bats in maritime areas.

Raw materials and paleolandscape

Since the Applicant plans to conduct core sampling of the seabed, at this stage, the presence of seabed sediments, which constitute resources of aggregate minerals or may indicate the occurrence of Paleogene settlements, cannot be confirmed or excluded.

21. SUMMARY AND CONCLUSIONS, INCLUDING THE RATIONALE FOR THE PROPOSED CHANGES

21.1. SUMMARY

This EIA Report prepared for the so-called variant selected for implementation (the WWR 2024) was assessed on the basis of the narrowed parameters of the BC-Wind Offshore Wind Farm project.

Due to the possibility to carry out an environmental impact assessment within this EIA Report for the specified, narrowed parameters of the project, and on the basis of the already selected specific locations of the BC-Wind OWF facilities, it can be concluded that the most environmentally beneficial variant is the WWR 2024, as shown above and as pointed out in many cases in the assessment in Chapter 9 of this EIA Report, with regard to such environmental components as:

- the impact on geological structure and bottom sediments,
- the impact on marine waters,
- the impact on benthos
- the impact on ichthyofauna
- the impact on wintering birds,
- the impact on migratory birds,
- the impact on protected areas.

The EIA Report submitted to the authority issuing the DEC in 2021 (in which the RAV 2024 was assessed) was based on the so-called envelope assessment, in which all reasonable foundation methods were considered, moreover, the maximum rotor diameter and thus the total height of the power plant were assumed with some margin. For safety reasons, it was assumed that two OSS stations could be used to operate the BC-Wind OWF, and a service and accommodation stations were also included. It is now known that there will be one OSS station and that there is no need to locate a service and residential station in the farm area. In addition, due to the early stage of obtaining the DEC, the locations of the power plants and their final number were not yet known, and therefore e.g. the length of the cables inside the farm was assumed by a large margin. It was estimated that this length could be approx. 188 km, however once the number and locations of the power plants and OSS were determined, the length of the cables is reduced to approx. 100 km. All of these elements contribute to the possibility of a more precise environmental impact assessment, including a remodelling of underwater noise emissions, suspended solids emissions, and potential collisions between migratory birds and rotor blades. Specific power plant and OSS locations were used for the modelling in contrast to the modelling done for the EIA Report prepared in 2021, where purely theoretical power plant locations had to be assumed due to the early stage of the project.

Both of the analysed variants, i.e. the variant selected for implementation (the WWR 2024) and the variant for which the Investor obtained the DEC (the RAV 2024) will cause impacts of the same nature and significance. On the other hand, it is worth emphasising that the assessment of the WWR 2024 was based on more detailed data on the parameters of the project and was developed on the basis of the actual location of the power plants and OSS station indicated by the Investor at the current preparation stage of the project. Even if, in the course of further works, some locations are corrected

within the current boundaries of the development area, it will not affect the indication/determination of the impacts of the construction, operation and decommissioning phases of the BC-Wind OWF. Therefore, it is not necessary to perform a new environmental impact assessment at the stage of obtaining the construction permit, as possible corrections that may be introduced during works on the construction and operation design and during the works will not result in a change in the nature and scale of the impacts assessed in this Report, and were assessed as insignificant changes by the Offshore Act.

21.2. PROPOSED AMENDMENTS OF THE DECISION OF ENVIRONMENTAL CONDITIONS

The table below shows the proposed changes to the DEC, along with their rationale, which result from the analyses conducted for this Report.

Tab. 21.1. Proposed amendments to the DEC for the BC-Wind offshore wind farm with justification (gray color indicates content that is being changed)

DEC no.	Current wording of conditions of DEC of 16 September 2022	Proposed amendment of the condition	Brief rationale																																																																																																																																							
1	2	3	4																																																																																																																																							
I. TO DETERMINE FOR THE PROJECT TITLED THE “BC-WIND OFFSHORE WIND FARM” FOLLOWING ENVIRONMENTAL CONDITIONS																																																																																																																																										
I.1.	Project type and site																																																																																																																																									
	The object of the project is the BC-Wind Offshore Wind Farm (hereinafter: The BC-Wind OWF) of the total maximum capacity of 500 MW located in the sea territories of the Republic of Poland, at the development area of 86.28 km², approximately 22.6 km north of the sea shore, the same latitude as the Choczewo and Krokowa communes (the Pomorskie region). The planned project comprises the construction, operation and decommissioning of the BC-Wind OWF. The farm will consist of a maximum of 41 wind turbines, 188 km cable pathways and a maximum of 6 other facilities. The BC-Wind OWF will comprise: - wind turbines (nacelles with rotors, towers as well as foundations or supporting structures anchored in or supported on the sea bottom); - offshore substations; - internal power transmission and ICT lines. Schedule of the most important parameters of the BC-Wind OWF for the option proposed by the Applicant: The detailed project characteristics are included in the appendix to this decision. <table><tr><th>Parameter</th><th>Unit</th><th>Value</th></tr><tr><td>Total installed capacity (maximum)</td><td>MW</td><td>500</td></tr><tr><td>Number of wind turbines (maximum)</td><td>-</td><td>41</td></tr><tr><td>Rotor diameter (maximum)</td><td>m</td><td>280</td></tr><tr><td>Clearance (minimum)</td><td>m</td><td>20</td></tr><tr><td>Structure height with rotor (maximum)</td><td>m</td><td>330</td></tr><tr><td>Number of additional structures (maximum)</td><td>-</td><td>6</td></tr><tr><td>Gravity based structure (GBS) diameter (maximum)</td><td>m</td><td>60</td></tr><tr><td>Bottom area occupied by a single gravity based structure (GBS) (maximum)</td><td>m²</td><td>2 826</td></tr><tr><td>Internal cable pathway length (maximum)</td><td>km</td><td>188</td></tr></table>	Parameter	Unit	Value	Total installed capacity (maximum)	MW	500	Number of wind turbines (maximum)	-	41	Rotor diameter (maximum)	m	280	Clearance (minimum)	m	20	Structure height with rotor (maximum)	m	330	Number of additional structures (maximum)	-	6	Gravity based structure (GBS) diameter (maximum)	m	60	Bottom area occupied by a single gravity based structure (GBS) (maximum)	m ²	2 826	Internal cable pathway length (maximum)	km	188	The object of the project is the BC-Wind Offshore Wind Farm (hereinafter: The BC-Wind OWF) of the total maximum capacity of 500 MW located in the sea territories of the Republic of Poland, at the area of 86.28 km², and construction site about 78,71 km², approximately 22.6 km north of the sea shore, the same latitude as the Choczewo and Krokowa communes (the Pomorskie region). The planned project comprises the construction, operation and decommissioning of the BC-Wind OWF. The farm will consist of a maximum of 39 wind turbines, 100 km cable pathways and a maximum of 5 other facilities. The BC-Wind OWF will comprise: - wind turbines (nacelles with rotors, towers as well as foundations or supporting structures anchored in or supported on the sea bottom); - offshore substations; - internal power transmission and ICT lines. Schedule of the most important parameters of the BC-Wind OWF for the option proposed by the Applicant:: <table><tr><th>Parameter</th><th>Unit</th><th>Value</th></tr><tr><td>Total installed capacity (maximum)</td><td>MW</td><td>500</td></tr><tr><td>Number of wind turbines (maximum)</td><td>-</td><td>39*</td></tr><tr><td>Rotor diameter (maximum)</td><td>m</td><td>250</td></tr><tr><td>Clearance (minimum)</td><td>m</td><td>20</td></tr><tr><td>Structure height with rotor (maximum)</td><td>m</td><td>300</td></tr><tr><td>Number of offshore substations (maximum)</td><td>-</td><td>1</td></tr><tr><td>Number of additional structures (maximum), (non-production infrastructure)</td><td>-</td><td>4</td></tr><tr><td>Monopile diameter (maximum)</td><td>m</td><td>11,5</td></tr><tr><td>Bottom area occupied by a single monopile structure (maximum)</td><td>m²</td><td>2 600</td></tr><tr><td>Internal cable pathway length (maximum)</td><td>km</td><td>100</td></tr></table> <i>* - Ultimately, a maximum of 34 wind turbines are planned, with the remaining 5 being spare locations</i>	Parameter	Unit	Value	Total installed capacity (maximum)	MW	500	Number of wind turbines (maximum)	-	39*	Rotor diameter (maximum)	m	250	Clearance (minimum)	m	20	Structure height with rotor (maximum)	m	300	Number of offshore substations (maximum)	-	1	Number of additional structures (maximum), (non-production infrastructure)	-	4	Monopile diameter (maximum)	m	11,5	Bottom area occupied by a single monopile structure (maximum)	m ²	2 600	Internal cable pathway length (maximum)	km	100	The basic assumptions of the project, which is the construction of the BC-Wind offshore wind farm, have not changed, while the basic parameters related to the advancement of design work have been clarified. First of all, geotechnical surveys have been carried out, which enabled preliminary determination of the location of the turbines within the OWF Area, followed by the distribution of cables inside the farm and narrowing down the foundation technology. These factors influenced the decision to update the environmental impact assessment of the BC-Wind OWF, so as to consequently adjust the content of the decision held to the current technical and organizational assumptions of the project and clarify the possible environmental impacts of its implementation. All basic parameters have been narrowed down, relative to the parameters analysed at the stage of the environmental decision, i.e.: - the number of turbines has been reduced; - the diameter of the rotor and thus the height of the entire structure has been reduced; - shortened the length of cables inside the farm (resulting from the foundation of the turbines established at the current stage); - excluded gravity foundation from power plant foundation technology. The development area has been narrowed compared to the area indicated in the DEC. At the stage of the DEC, the development area was 86.28 km²; now the development area is 78.71 km² i.e. 7.57 km² less. This is a result of moving the southern boundary of the BC-Wind OWF development 500 m away from the wind farm (46.E.1), which is to be developed in Phase II.																																																																								
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I.1	Geodetic coordinates of the BC-Wind OWF Development Area <table><tr><th>Point No.</th><th colspan="2">GRS80H geodetic coordinate system [DD°MM'SS.SSS"]</th></tr><tr><th></th><th>Λ</th><th>Φ</th></tr><tr><td>1</td><td>17°50'29,701" E</td><td>55°05'41,945" N</td></tr><tr><td>2</td><td>17°51'12,921" E</td><td>55°05'45,974" N</td></tr><tr><td>3</td><td>17°54'07,585" E</td><td>55°06'01,656" N</td></tr><tr><td>4</td><td>17°56'01,352" E</td><td>55°06'11,346" N</td></tr><tr><td>5</td><td>17°58'58,043" E</td><td>55°06'15,594" N</td></tr><tr><td>6</td><td>18°01'03,574" E</td><td>55°06'18,656" N</td></tr><tr><td>7</td><td>18°01'52,922" E</td><td>55°06'20,769" N</td></tr><tr><td>8</td><td>18°01'53,282" E</td><td>55°06'20,785" N</td></tr><tr><td>9</td><td>18°03'17,508" E</td><td>55°06'24,392" N</td></tr><tr><td>10</td><td>18°03'30,060" E</td><td>55°06'19,193" N</td></tr><tr><td>11</td><td>18°03'55,078" E</td><td>55°06'08,831" N</td></tr><tr><td>12</td><td>18°04'25,851" E</td><td>55°05'54,849" N</td></tr><tr><td>13</td><td>18°07'58,862" E</td><td>55°04'18,065" N</td></tr><tr><td>14</td><td>18°08'40,068" E</td><td>55°03'59,343" N</td></tr><tr><td>15</td><td>18°08'44,911" E</td><td>55°03'50,593" N</td></tr><tr><td>16</td><td>18°08'45,125" E</td><td>55°03'50,205" N</td></tr><tr><td>17</td><td>18°08'50,792" E</td><td>55°02'43,042" N</td></tr><tr><td>18</td><td>18°08'50,365" E</td><td>55°02'40,918" N</td></tr><tr><td>19</td><td>18°03'56,238" E</td><td>55°02'15,151" N</td></tr><tr><td>20</td><td>18°01'53,405" E</td><td>55°02'10,619" N</td></tr><tr><td>21</td><td>18°01'53,045" E</td><td>55°02'10,619" N</td></tr><tr><td>22</td><td>18°00'00,360" E</td><td>55°02'06,000" N</td></tr><tr><td>23</td><td>18°00'00,360" E</td><td>55°03'38,548" N</td></tr><tr><td>24</td><td>18°00'00,359" E</td><td>55°04'18,343" N</td></tr><tr><td>25</td><td>17°56'28,930" E</td><td>55°04'28,352" N</td></tr></table>	Point No.	GRS80H geodetic coordinate system [DD°MM'SS.SSS"]			Λ	Φ	1	17°50'29,701" E	55°05'41,945" N	2	17°51'12,921" E	55°05'45,974" N	3	17°54'07,585" E	55°06'01,656" N	4	17°56'01,352" E	55°06'11,346" N	5	17°58'58,043" E	55°06'15,594" N	6	18°01'03,574" E	55°06'18,656" N	7	18°01'52,922" E	55°06'20,769" N	8	18°01'53,282" E	55°06'20,785" N	9	18°03'17,508" E	55°06'24,392" N	10	18°03'30,060" E	55°06'19,193" N	11	18°03'55,078" E	55°06'08,831" N	12	18°04'25,851" E	55°05'54,849" N	13	18°07'58,862" E	55°04'18,065" N	14	18°08'40,068" E	55°03'59,343" N	15	18°08'44,911" E	55°03'50,593" N	16	18°08'45,125" E	55°03'50,205" N	17	18°08'50,792" E	55°02'43,042" N	18	18°08'50,365" E	55°02'40,918" N	19	18°03'56,238" E	55°02'15,151" N	20	18°01'53,405" E	55°02'10,619" N	21	18°01'53,045" E	55°02'10,619" N	22	18°00'00,360" E	55°02'06,000" N	23	18°00'00,360" E	55°03'38,548" N	24	18°00'00,359" E	55°04'18,343" N	25	17°56'28,930" E	55°04'28,352" N	Geodetic coordinates of the BC-Wind OWF Development Area (WGS 84 system) <table><tr><th>Point No.</th><th>Latitude N</th><th>Longitude E</th></tr><tr><th></th><th>Φ</th><th>Λ</th></tr><tr><td>1</td><td>55.0949847222</td><td>17.8415836111</td></tr><tr><td>2</td><td>55.0960004176</td><td>17.8524786464</td></tr><tr><td>3</td><td>55.0961037778</td><td>17.8535891194</td></tr><tr><td>4</td><td>55.1004598806</td><td>17.9021068222</td></tr><tr><td>5</td><td>55.1031515417</td><td>17.933709</td></tr><tr><td>6</td><td>55.1043316861</td><td>17.9827896556</td></tr><tr><td>7</td><td>55.1051821944</td><td>18.0176595778</td></tr><tr><td>8</td><td>55.1057692806</td><td>18.0313673611</td></tr><tr><td>9</td><td>55.0362829611</td><td>18.0314014944</td></tr><tr><td>10</td><td>55.0353214942</td><td>18.007925178</td></tr><tr><td>11</td><td>55.0607076414</td><td>18.0079301282</td></tr><tr><td>12</td><td>55.072386505</td><td>18.0078561245</td></tr><tr><td>13</td><td>55.0726849609</td><td>18.0077651794</td></tr><tr><td>14</td><td>55.0729792224</td><td>18.007639394</td></tr><tr><td>15</td><td>55.0732679521</td><td>18.0074793393</td></tr><tr><td>16</td><td>55.0735498375</td><td>18.007285742</td></tr></table>	Point No.	Latitude N	Longitude E		Φ	Λ	1	55.0949847222	17.8415836111	2	55.0960004176	17.8524786464	3	55.0961037778	17.8535891194	4	55.1004598806	17.9021068222	5	55.1031515417	17.933709	6	55.1043316861	17.9827896556	7	55.1051821944	18.0176595778	8	55.1057692806	18.0313673611	9	55.0362829611	18.0314014944	10	55.0353214942	18.007925178	11	55.0607076414	18.0079301282	12	55.072386505	18.0078561245	13	55.0726849609	18.0077651794	14	55.0729792224	18.007639394	15	55.0732679521	18.0074793393	16	55.0735498375	18.007285742	In the DEC, the boundaries of the project were defined as the development area. In view of the reduction of the development area at the current stage of the investment process, it is requested to leave the coordinates indicated in the DEC as the boundaries of the planned project and add the coordinates of the current development area indicated in column 3. In summary, the development area indicated in the DEC should now be understood as the boundaries of the project, which remain unchanged. It is only requested to clarify the development area within the boundaries of the obtained DEC.
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1	2			3			4
	26	17°51'30,273" E	55°04'42,490" N	17	55.0738235974	18.0070594814	
	27	17°49'49,441" E	55°04'47,263" N	18	55.0740879874	18.0068015853	
				19	55.0743418057	18.0065132254	
				20	55.0745838985	18.006195712	
				21	55.0748131654	18.0058504878	
				22	55.0750285641	18.0054791217	
				23	55.0752291155	18.0050833016	
				24	55.0754139079	18.0046648264	
				25	55.0755821011	18.0042255983	
				26	55.0757329306	18.0037676138	
				27	55.0758657106	18.0032929547	
				28	55.0759798376	18.0028037789	
				29	55.0760747927	18.0023023101	
				30	55.0761501442	18.001790828	
				31	55.0762055495	18.0012716581	
				32	55.0762407567	18.0007471605	
				33	55.0790211962	17.942014141	
				34	55.0829483003	17.8590532077	
				35	55.0841584453	17.8336117518	
				36	55.0949847222	17.8415836111	
				37	55.0362830111	18.0315014944	
				38	55.1057735611	18.0314673417	
				39	55.1067760796	18.0548730341	
				40	55.105348542	18.0583201052	
				41	55.100144273	18.0703811149	
				42	55.0935640432	18.0848740671	
				43	55.0865611776	18.1002935438	
				44	55.0802900869	18.1140934778	
				45	55.0733849511	18.1292796501	
				46	55.0664841689	18.1444633525	
				47	55.0640532041	18.1458109946	
				48	55.0639479736	18.1458692132	
				49	55.0501202123	18.1470359017	
				50	55.0452900172	18.1474434195	
				51	55.0447039473	18.1473255404	
				52	55.0375483849	18.065451499	
				53	55.0362830111	18.0315014944	
I.2	Conditions for the use of land at the project implementation and use/operation phase with special consideration for the need to protect precious natural values, natural resources and historic objects, and restrictions regarding the nuisance to adjacent areas:						
I.2.1	On the installed foundations, wind turbines shall be mounted one by one, starting from one place, to cover the project water region gradually thus extending the BC-Wind OWF area with adjacent turbines			If possible on the installed foundations, wind turbines shall be mounted one by one, starting from one place, to cover the project water region gradually thus extending the BC-Wind OWF area with adjacent turbines			The logistics of manufacturing, transportation of components, construction, and harsh weather and ground conditions could result in the need to install WTG on foundations that are not adjacent to each other. Keeping the condition as it was originally written could result in a longer construction period and, consequently, a longer duration of disturbances occurring in the marine environment.
I.2.2	The project shall be implemented in such a way as to exclude the possible penetration of any pollutants to the aqueous environment. For that purpose: a) in the case of marine environmental pollution with solid and liquid wastes, they shall be removed from the water surface immediately and on an ongoing basis;			The project shall be implemented in such a way as to minimise the possible penetration of any pollutants to the aqueous environment. For that purpose, it is required to follow the Maritime Office-approved the Hazard and Spill Contingency Plan for the BC-Wind offshore wind farm, updated 6 months prior to the start of construction:			A provision has been added to the condition referring to the current legislation on marine pollution. A Hazard and Spill Contingency Plan approved in January 2024 exists for the BC-Wind OWF. However, the plan needs to be updated several months before construction begins. The said update will include, among other things, a procedure on how to deal with the dropping of an object into the water, the so-called "drop object" which clearly

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	b) in the case of petroleum product spill during the works, contaminants shall be recovered from the water surface on an ongoing basis, first with mechanical recovery methods; c) machinery and equipment used at the project shall be checked and maintained regularly.	a) in the case of marine environmental pollution with solid and liquid wastes, they shall be removed from the water surface immediately and on an ongoing basis; b) in the case of petroleum product spill during the works, contaminants shall be recovered from the water surface on an ongoing basis, first with mechanical recovery and dispersion methods; c) machinery and equipment used at the project shall be checked and maintained regularly, according to the equipment maintenance schedule provided by its supplier.	defines the form in which information is to be submitted to the Maritime Authority. According to this procedure, all dropped objects must be reported within 24 hours and attempts must be made to recover the object, unless it is impracticable to do so. In the case of spills, depending on the nature of the spilled liquid, the Maritime Administration (SAR) will consider each case individually.
I.2.3	The piling process from August to March shall be conducted under ornithological supervision. Works preceded by a soft-start procedure may commence if no common murre, razorbills, long-tailed ducks and velvet scoters are spotted within the 2 km radius of the piling site.	The piling process from August to March shall be conducted under ornithological supervision, taking into account weather conditions and safety of its implementation. If no common murre, razorbills, long-tailed ducks and velvet scoters are spotted within the 1 - 2 km radius of the piling site, works can begin, preceded by a soft-start procedure. Each piling should be preceded by observations by an ornithologist, and the result of the observations reported every 4 weeks to the RDEP: - supervision should be carried out from the vessels; it is allowed to provide observation from the air, in conditions enabling its safe execution; - in the case of piling during the day, observations should be made before each piling; - in the case of piling at night, observations should be made before dusk; - in case of observation of the mentioned bird species, the ornithologist should inform the Investor's representative the construction manager and present the way of further procedure.	The condition in its current wording imprecisely defines the situation when it will be necessary to stop piling, which could lead to a threat to the indicated bird species. Therefore, an obligation to take into account the position of an experienced ornithologist was introduced, before each start of piling, and an obligation to report on an ongoing basis to RDEP in Gdansk. The introduction of a range of distances from 1 to 2 km allows an ornithologist to reliably verify the potential presence of the above-mentioned species depending on weather conditions and the equipment used; it also means that piling can take place after dark or in visibility <2 km (e.g., in bad weather), which is important from the point of view of construction programming. The methodology, which involves the use of a drone during ornithological observation, makes it possible to accurately rapel the space up to 1 km around the vessel, or to collect data at a lower density up to 2 km. The important thing is that the observer can conduct observation while being at a single point on the survey surface, which minimizes the disturbance of birds sitting on the water. In contrast, when conducting classical seabird surveys, it is customary for the observer to note birds up to 300 meters from the vessel (HELCOM 2021), and therefore the observer must move around the survey plot to effectively collect data, which can affect bird scaring at least or as much as starting a piling without conducting surveillance. Therefore, it is indicated that the use of a methodology using a drone, may be a more effective solution that reduces the impact on bird behavior and at the same time allows reliable data to be obtained in a shorter period of time HELCOM (2021) Guidelines for monitoring seabirds at sea. Helsinki, Finland, HELCOM, 46pp. DOI: http://dx.doi.org/10.25607/OBP-1918 The most important changes: - reporting by the ornithologist before each piling and submission to the RDEP every 4 weeks - flexibility in the decision regarding the number of birds and whether to stop piling by leaving this decision to an experienced ornithologist, - enabling work to be carried out at night, - enabling aerial surveillance.
I.2.4	Power cables shall be laid at the depth of up to 3 m below the sea bottom. The minimum burying depth shall be determined on the basis of the sea bottom characteristics, the type of sediments (their thermal conductivity) and the power grid type (the magnitude and type of loads, and thermal performance). If it is technically not possible to bury a cable, it shall be laid on the bottom surface. Cables on the bottom surface shall be protected with durable artificial structures.	Unchanged	-
I.2.5	The as-built cabling documentation shall be prepared, in which presented will be the cable burying or laying depth in relation to the sea bottom surface, the description of the criteria which have been applied, the assessment of compliance therewith, as well as the description of construction products or other materials and, moreover, the substantiation of the selection of the target cable laying method in or on the sea bottom. The documentation shall be submitted to the Regional Director for Environmental Protection in Gdańsk within 3 months from the completion of cabling works.	The as-built cabling documentation shall be prepared, in which presented will be the cable burying or laying depth in relation to the sea bottom surface, the description of the criteria which have been applied, the assessment of compliance therewith, as well as the description of construction products or other materials and, moreover, the substantiation of the selection of the target cable laying method in or on the sea bottom. The documentation shall be submitted to the Regional Director for Environmental Protection in Gdańsk within 6 months from the completion of cabling works.	A 3-month extension of the reporting period has been proposed, as the Investor may not be able to prepare the as-built documentation for RDEP in Gdansk within 3 months. Therefore, the Investor requests to extend the deadline to 6 months.
I.2.6	Archaeological supervision shall be provided during the works. If an object which has not been located so far has been encountered, which may be considered historic, action shall be taken in conformity with the Heritage Protection and Custody Act of 23 July 2002 (Dz. U. [Journal of Laws] of 2021, item 710, as amended), hereinafter referred to as the "Heritage Protection Act", including the following activities: a) all the works which may damage or destroy the uncovered item shall be suspended	Archaeological supervision shall be provided during the works. If an object which has not been located so far has been encountered, which may be considered historic, action shall be taken in conformity with the Heritage Protection and Custody Act of 23 July 2002 (Dz. U. [Journal of Laws] of 2021, item 710, as amended), hereinafter referred to as the "Heritage Protection Act", including the following activities:	The proposed amendment concerns the addition of a condition to submit to the competent authority, 6 months prior to the start of construction, a procedure for dealing with unexpected or accidental archaeological finds, along with the Protocol for Archaeological Discoveries (PAD). The current wording of the Law on the Protection of Monuments does not contain specific information on how to proceed, in case of the discovery of an archaeological

DEC no.	Current wording of conditions of DEC of 16 September 2022	Proposed amendment of the condition	Brief rationale
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	b) as far as possible, the item and the place of the discovery shall be protected with available means c) the competent Director of the Maritime Office in Gdynia shall be notified of the finding situated in Polish sea territories.	a) all the works which may damage or destroy the uncovered item shall be suspended b) as far as possible, the item and the place of the discovery shall be protected with available means c) the competent Director of the Maritime Office in Gdynia shall be notified of the finding situated in Polish sea territories. The Investor will deliver to the appropriate authority the procedure on unexpected or incidental archaeological finds along with the Protocol for Archaeological Discoveries (PAD) 6 months ahead the construction start.	find. Therefore, an appropriate procedure will be developed for the organization of construction, which will include such information as: - the location of the object and the type of unexpected object, and the determination of the time required for notification; - the width of the protective zone around minor finds, to protect against unintentional damage; - the width of the protective zone around possible major finds, to protect against unintentional damage; - the possibility of using a guard ship to enforce the established protective zone against vessels.
I.2.7	Construction materials, substances and preparations used at the project implementation stage, from whose material safety data sheets it follows that they may pose a hazard to waters or the soil, shall be stored in the on-shore site facilities, on the surfaced and sealed subgrade, in places protected from weather conditions and secured against unauthorised access. These places shall be equipped with the means of recovery or equipment permitting the collection of those materials, substances and preparations or their neutralisation if they release from containers accidentally. The types and quantities of the means or equipment shall be suitable for the type and volumes of the materials, substances and preparations in store.	Unchanged	-
I.2.8	Oils, greases and other materials which may be the source of petroleum products shall be stored at the site facilities on a surfaced and sealed subgrade, in closed and leak-tight containers resistant to the activity of the substances kept in those containers, in places protected from weather conditions and secured against unauthorised access. These places shall be equipped with technical and chemical measures designed to limit the dispersion and eliminate or neutralise oil-based pollutants; in the event of a leak of petroleum products, they shall be removed or neutralised immediately.	Unchanged	-
I.2.9	The components of the BC-Wind OWF shall be equipped with elements minimising the risk of oil penetration into the marine environment including, for example, leak-tight wind turbine generator enclosures and oil spill trays.	Unchanged	-
I.2.10	At the construction and operation stages, the project site and the OWF (including vessels and substations) shall be equipped with technical and chemical measures (including floating anti-pollution booms and sorbents) intended to limit the spread of, eliminate or neutralise oil-based pollutants; in the event of a leak of petroleum products, they shall be removed or neutralised immediately.	Unchanged	-
I.2.11	At the construction and operation stages, ships with hulls covered with antifouling paint containing tributyllocine (TBT) shall be excluded.	Unchanged	-
I.2.12	At the operation stage, the emission of light from the accommodation and service platforms shall be limited through the use of covers or appropriate lighting.	At the operation stage, the emission of light from the accommodation and service platforms shall be limited, if possible, through the use of covers or appropriate lighting, while ensuring safe operation and navigation	-
I.2.13	Following the completion of construction works on the BC-Wind OWF or on associated infrastructure, the remains of the construction works and impurities, if any, shall be removed from the sea bottom.	Following the completion of construction works on the BC-Wind OWF or on associated infrastructure, the remains of the construction works and impurities, if any, shall be removed from the sea bottom The Investor is required to follow the Maritime Office-approved Hazard and Pollution Control Plan for the BC-Wind OWF.	A provision has been added to the condition referring to the existing legislation on marine pollution. A Hazard and Pollution Control Plan approved in January 2024 exists for the BC-Wind OWF. However, the plan needs to be updated several months before construction begins. The said update will include, among other things, a procedure on how to deal with the dropping of an object into the water, the so-called "drop object" which clearly defines the form in which information is to be submitted to the Maritime Office. According to this procedure, all dropped objects must be reported within 24 hours and attempts must be made to recover the object, unless it is impracticable to do so.
I.2.14	Information on the development of the BC-Wind OWF area shall be updated on a regular basis.	Information on the development of the BC-Wind OWF area, construction progress, vessels and Contractors on the construction site, shall be updated on a regular basis, at least once a month.	To clarify the condition is to specify a specific time for updating information on construction progress.
I.2.15	Emergency escape and safety plans as well as risk and collapse prevention strategies shall be prepared.	Unchanged	-
I.2.16	Upon the completion of BC-Wind OWF operation, all its components shall be removed. It is allowed to leave parts of the facilities supported in/at the bottom in place if they are the habitat of valuable communities of sea organisms or, upon previous arrangements with the competent environmental protection and maritime economy bodies, on the assumption that these parts of facilities will not be an obstacle to navigation.	Upon the completion of BC-Wind OWF operation, all its components shall be removed. It is allowed to leave parts of the facilities supported in/at the bottom in place if they are the habitat of valuable communities of sea organisms or, upon previous arrangements with the competent environmental protection and maritime economy bodies, on the assumption that these parts of facilities will not be an obstacle to navigation. Within a period of at least 2 years before the end of operation of the OWF, the Investor shall submit to the authority information on whether to leave some of the objects planted in the bottom/underneath.	As of today, it is difficult to say what environmental conditions will be created on the foundations and other underwater structures. At the same time, the investor does not know what the legal requirements will be in the subject area, i.e. about 25 years. The costs of possible removal of any components are also unknown. Therefore, the decision on how to decommission the farm should be postponed. A period of 2 years has been proposed to allow the authority to verify the presented method of decommissioning the farm and to mobilize the equipment. The method of decommissioning the farm will take into account the safety conditions of navigation and the possible value of the

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			habitat produced during the 25 years of operation of the farm. This condition was coordinated with the timing of the monitoring of ichthyofauna and benthos, which will be carried out 4 years prior to the planned decommissioning and will allow the authority to determine whether valuable marine habitat has been created and how to carry out the decommissioning of the farm as a result.
I.2.17	The successive wind turbines shall be removed from the foundations starting from one place, that is in such a way that the water region occupied by the OWF is released of the structures gradually.	If possible, the successive wind turbines shall be removed from the foundations starting from one place, that is in such a way that the water region occupied by the OWF is released of the structures gradually.	The logistics of decommissioning the farm facilities, as well as harsh weather and ground conditions, could result in the need to remove non-adjacent power plants. Keeping the condition as originally drafted could result in a longer duration of the decommissioning phase and, consequently, a longer duration of disturbances occurring in the marine environment.
I.2.18	To limit underwater noise impact, the structures shall be decommissioned without blasting.	Unchanged	-
I.2.19	The project site and the OWF (including vessels and substations) shall be equipped with technical and chemical measures (including floating anti-pollution booms and sorbents) intended to limit the spread of, eliminate or neutralise oil-based pollutants; in the event of a leak of petroleum products, they shall be removed or neutralised immediately.	Unchanged	-
I.3	Environmental requirements to be taken into consideration in the building permit design:		
I.3.1	Solid wind turbine towers shall be used.	Unchanged	-
I.3.2	Between the BC-Wind OWF area and that of the nearest adjacent offshore wind farm planned in the west, a free bird migration corridor (an undeveloped area) shall be left in place, the minimum corridor width being 4 km and the axis being a straight line.	Between the BC-Wind OWF area and that of the nearest adjacent offshore wind farm planned in the west, a free bird migration corridor (WTG blade free area) shall be left in place, the minimum corridor width being 4 km and the axis being a straight line.	The change in the condition is to clarify that the 4 km corridor is understood as an area free from the presence of turbines.
I.3.3	If it is not possible to use dry type transformers, offshore substations shall be equipped with a system of oil pans with the approximate capacity of 110% of the oil volume in the transformers, i.e. such that will be able to receive the total oil leak from the transformers.	Unchanged	-
I.3.4	The BC-Wind OWF shall be equipped with a system permitting a short-term stop of selected wind turbines in bird migration periods if the operation monitoring results indicate that intensive crane migration takes place at the collision height, the system shall be used as and when required.	The BC-Wind OWF shall be equipped with a system permitting a short-term stop (slow down) of selected wind turbines in bird migration periods; the system implement, if the operation monitoring results indicate that intensive crane migration takes place at the collision height. ~~the system shall be used as and when required.~~	The change of condition is to specify that the turbines at the BC-Wind OWF will be equipped with a system of stopping or optionally slowing down the turbines. This is due to technical considerations and the need to reconcile the way the farm operates with the protection of migratory birds, including primarily cranes. The system responsible for slowing down the operation of wind turbines does not have the ability to trigger mechanical deceleration (i.e., the ability to stop). Rapid deceleration of the turbine is also a risky procedure, which can cause mechanical damage to the rotor, due to the occurrence of high momentum. Hence, deceleration of the rotor must be accomplished by depressing the speed. The resumption of turbine operation also involves additional energy expenditure, which, if more than one turbine has to be stopped, can result in significant power generation losses. At the same time, slowing down the turbine significantly reduces the risk of collision with cranes, with the probability of mass migration of cranes over the OWF area being quite small - the reduction in the number of turbines and their height, which is being proceeded with, has resulted in the probability of collision dropping to 8 individuals per year (the earlier report estimated it at 14 individuals). The EIA Report includes a description of DeTect's radar and information that the Investor will conduct bird monitoring throughout the year at the OWF site to obtain data on migratory birds and possibly include other species should the monitoring show the appearance of other protected species at the height of the low collision avoidance rotor operation. In addition, it was suggested that the condition be rewritten, by deleting <i>"the system shall be used as and when required"</i> as it is an overly general provision that is therefore difficult to apply.
I.3.5	To minimise the collision risk during a bird migration, the BC-Wind OWF lighting shall be designed in a minimal way, however, with the regulations and safety rules taken into consideration.	Unchanged	-
I.3.6	Engineering solutions minimising the impact of underwater noise on fish and marine mammals shall be used, in particular:	Engineering solutions minimising the impact of underwater noise on fish and marine mammals shall be used, in particular:	The logistics of manufacturing, transportation of components, construction, and harsh weather and ground conditions could result in the need to install

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	a) the soft-start piling procedure shall be used; b) the construction works shall be executed on the individual wind turbine foundation stages gradually, i.e. wind turbine foundations shall be installed adjacent to each other by starting from one place to fill the water region with structures incrementally thus causing the scarring effect to increase and fish and mammals to be gradually driven out of the project area.	a) the soft-start piling procedure shall be used; b) ~~if possible~~ , the construction works shall be executed on the individual wind turbine foundation stages gradually, i.e. wind turbine foundations shall be installed adjacent to each other by starting from one place to fill the water region with structures incrementally thus causing the scarring effect to increase and fish and mammals to be gradually driven out of the project area.	WTG on foundations that are not adjacent to each other. Keeping the condition as it was originally written could result in a longer construction period and, consequently, a longer duration of disturbances occurring in the marine environment.
I.3.7	The schedule of the works on the BC-Wind OWF shall be adapted to the implementation schedule for other nearby projects to prevent the build-up of adverse environmental impacts. To reduce the noise from the piling process, the works shall proceed at maximum two locations at a time. This concerns both the construction of the BC-Wind OWF, and the adjacent offshore wind farms. Piling at the BC-Wind OWF shall proceed in such a way that, before the commencement of foundation pile driving into the sea bottom, piling at the other planned wind farms in the immediate vicinity shall be taken into consideration so that the number of simultaneous piling operations is not greater than two.	The schedule of the works on the BC-Wind OWF shall be ~~consider~~ to the implementation schedule for other nearby projects, i.e.: ~~OWF Baltic Power and 46.E.1 area~~ to prevent the build-up of adverse environmental impacts. To reduce the noise from the piling process, the works shall proceed at maximum two locations at a time. This concerns both the construction of the BC-Wind OWF, and the ~~immediately~~ adjacent offshore wind farms. Piling at the BC-Wind OWF shall proceed in such a way that, before the commencement of foundation pile driving into the sea bottom, piling at the other planned wind farms in the immediate vicinity shall be taken into consideration so that the number of simultaneous piling operations is not greater than two.	The condition was rewritten by specifying which farms are adjacent to the BC-Wind offshore wind farm: i.e. Baltic Power to the west and Area 46.E.1 to the south, which is likely to be implemented in Phase II. In addition, the condition has been rewritten in terms of “consider” the construction schedules of other investors (the current wording of the condition talks about adjusting the schedule). The proposed amendment includes an action by the BC-Wind OWF investor to take into account, when creating and implementing the BC-Wind OWF construction schedule, the schedules of other projects carried out in the vicinity of the BC-Wind OWF, including neighbouring offshore wind farms (made public or made available at the investor's request) in such a way, so that it is ensured that all investors simultaneously comply, on a reciprocal basis, with the requirements of all final or enforceable administrative decisions concerning the BC-Wind OWF and other projects within the scopes that potentially require the application of these principles of reciprocal consideration of the requirements imposed under the law. From the Maritime Office's interpretation: The requirement in question is instructive (coordinating) in the course of construction and does not mean that undertaking the implementation of the BC-Wind offshore wind farm depends on the creation or implementation of schedules of other investments. Nor does it mean that any of the schedules of others, regardless of the resulting start date of the project, has primacy over others. No schedule is a basis for privileging investments whose construction began earlier than the implementation of the BC-Wind OWF, nor does it force the subordination of the BC-Wind OWF implementation schedule to the progress of other investments.
I.3.8	During the implementation of the project, the Noise Reduction System (NRS) shall be used, which is to be implemented by using engineering solutions effective in this regard. As a result, noise shall be reduced to a level not exceeding, at a distance of 11 km from the piling site, the following maximum levels: 140 dB re 1 µPa²s SEL_{cum} and weighted with the HF function (the HF weighting function for marine mammals highly sensitive to high frequency sounds – the porpoise); 170 dB re 1 µPa²s SEL_{cum} and weighted with the PW function (the PW weighting function for web-footed marine mammals – seals); 186 dB re 1 µPa²s SEL_{cum} not waighted for fish.	During the implementation of the project, the Noise Reduction System (NRS) shall be used, which is to be implemented by using ~~technical~~ solutions effective in this regard. As a result, noise shall be reduced to a level not exceeding, at a distance of 11 km from the piling site, the following maximum levels: 140 dB re 1 µPa²s SEL_{cum} and weighted with the HF function (the HF weighting function for marine mammals highly sensitive to high frequency sounds – the porpoise); 170 dB re 1 µPa²s SEL_{cum} and weighted with the PW function (the PW weighting function for web-footed marine mammals – seals); ~~186 dB re 1 µPa²s SEL_{cum} not waighted for fish.~~	The change in conditions resulting from the current status of the BC-Wind offshore wind project (identification of proposed turbine locations) and more advanced modelling of noise propagation has necessitated changes to the condition specified in the DEC for fish by revising (abandoning) the threshold, which was the reference point in earlier modelling. The current modelling results are incomparable to the earlier ones, which formed the basis for the introduction of the fish threshold into the DEC, due to the use of more precise forecasting methods. The analysis carried out showed that the adoption of a noise reduction system for the protection of the harbor porpoise (extremely endangered) provides a kind of “umbrella” that simultaneously protects the fish from a significant range of noise impacts, and that the final selection of the noise reduction system in combination with the soft-start procedure will be prepared in a so-called “piling strategy.” The piling strategy will be prepared after the final selection by the Investor of the location of the 34 power plants, the design of the foundations and the contracting of the piling rig, which will enable the performance of noise modelling for realistic assumptions and the adjustment of appropriate underwater noise mitigation measures, taking into account marine mammals and fish. The piling strategy developed on this basis will be submitted to RDEP in Gdansk for approval. The development of a piling strategy prior to the start of piling is a commonly used tool in the UK, among others. A broader rationale is provided in the EIA Report in section 21.3. In addition, the word “engineering” was replaced with “technical,” which takes into account both technological and organizational solutions.
II. THE OBLIGATIONS TO BE IMPOSED ON THE APPLICANT			
II.1.	With regard to actions minimising and mitigating the adverse environmental impact in connection with the need to reduce piling noise and the influence on birds, fish and marine mammals:		

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II.1.1	a) Starting the work each time proceeded by the soft-start procedure to allow animals such as fish, birds and marine mammals to leave and move away from the work area; b) Conducting visual observations by skilled marine mammal observers (MMO) from the board of a ship in compliance with the methodology specified by the JNCC, combined with Passive Acoustic Monitoring (PAM) based on the application of a set of hydrophones (PAM detectors) located in the water depths.	a) Starting the work each time proceeded by the soft-start procedure to allow animals such as fish, birds and marine mammals to leave and move away from the work area; b) Conducting visual observations by skilled marine mammal observers (MMO) from the board of a ship in compliance with the methodology specified by the JNCC, combined with Passive Acoustic Monitoring (PAM) based on the application of a set of hydrophones (PAM detectors) located in the water depths; c) use, if warranted, acoustic deterrent devices (ADD for short) as: a tool to mitigate and reduce the risk of physical injury (death or permanent and temporary hearing loss) to marine mammals, in the immediate vicinity of the piling; the duration of ADD use must not exceed 15 minutes. A detailed description of the application of the aforementioned methods will be included in the Piling Strategy, which will be submitted to the authority for approval 6 months prior to the start of piling.	The amendment to the condition is to add the possibility of short-term use of marine mammal deterrent devices to completely exclude the presence of marine mammals in the vicinity of pilings. Such devices were used at the Moray East wind farm, making it possible to effectively deter mammals within 5-10 minutes. Based on the monitoring carried out, this method was found to be highly effective. A detailed description of the method of piling will be known after the design of the foundations of the BC-Wind offshore wind farm and after contracting the appropriate equipment and specialized units. On this basis, i.e. on realistic assumptions of basic parameters affecting noise levels, a piling strategy will be developed and submitted to the authority for approval 6 months before the planned start of piling. A description of what the piling strategy will contain, based on the British experience, where the development of such a document is mandatory, has been included in the EIA Report.
II.2.	Applicant's obligations concerning the monitoring of the project environmental impact:		
II.2.1	Scope of pre-development monitoring (before the commencement of the construction works:		
II.2.1.1	Pre-development monitoring of the OWF with regard to marine bird surveys shall include counting of birds staying in the OWF and the reference area: a) The route of the survey voyage shall be set out so as to cover a 5-kilometre zone around the OWF boundaries and in such a way that the changes in the density of bird population staying at different distances from the future wind turbines can be assessed. b) These surveys must cover, first of all, the period of the most abundant occurrence of birds in the southern Baltic, i.e. from October to May, with the minimum frequency of one voyage per month. In other months, the numerical force of the bird population in the BC-Wind OWF area is small, therefore in the summer season it is sufficient to make two survey voyages i.e. one in August and one in September c) The dates of the survey voyages shall be synchronised so that counting at both of these water regions will be done at the same time. These surveys shall continue for one year before the commencement of the construction works on the OWF.	Pre-development monitoring of the OWF with regard to marine bird surveys shall include counting of birds staying in the OWF ~~and the reference area:~~ a) The route of the survey study shall be set out so as to cover a 4-kilometre zone around the OWF boundaries and in such a way that the changes in the density of bird population staying at different distances from the future wind turbines can be assessed. b) These surveys must cover, first of all, the period of the most abundant occurrence of birds in the southern Baltic, i.e. from October to May, with the minimum frequency of one study per month. In other months, the numerical force of the bird population in the BC-Wind OWF area is small, therefore in the summer season it is sufficient to make two survey voyages i.e. one in August and one in September c) ~~The dates of the survey voyages shall be synchronised so that counting at both of these water regions will be done at the same time.~~ These surveys shall continue for one year before the commencement of the construction works on the OWF. The pre-implementation monitoring methodology will be submitted to the authority for approval 4 months before the monitoring is scheduled to begin.	The change in condition is: - abandoning monitoring of the reference area, - introduction of the possibility of conducting aerial surveys (replacing "survey voyage" with "survey study", - adding a provision that the monitoring program must be submitted to the authority 4 months before the start of monitoring. According to information received at a briefing on 10/10/2024 on the <i>Guidelines for Environmental Analysis and Monitoring in the Construction of Offshore Wind Farms</i>, the GDEP indicated the possibility of departing from the need to survey reference areas. As a justification, it was stated that there are currently numerous data on seabird abundance in the POM, which can provide a reference point for analysis of monitoring results. At the same time, the need to examine the area adjacent to the farm at a distance of up to 4 km is due to the projected impact of the OWF on seabirds, which avoid, not only the farm area itself, but also its surroundings at a distance of 2 to 4 km. Since, according to the current state of knowledge, the maximum range of the expected impact is up to 4 km, it was proposed to reduce the observation distance from 5 to 4 km, since 5 km is not justified in the observations of offshore wind farms conducted so far. In addition, the proposed amendment allows for the use of digital data from survey study performed from the flight, which allow for the collection of a permanent record of the number of birds, rather than approximate numbers, down to the species level and their exact locations, within approximately 2 hours of survey. Leaving only survey cruises would limit the developer to performing surveys only from a ship. A detailed methodology for pre-completion monitoring will be developed by the Investor and submitted to the authority, once the final Design has been approved and the Investor has submitted a construction schedule.
II.2.1.2	Porpoise monitoring – this shall be conducted with the use of C-POD or similar equipment: a) A minimum of 5 devices shall be spaced at the same locations as those during the environmental monitoring, and 5 additional devices shall be located in the gradient configuration covering the area not smaller than 20 km off the impact zone (with regard to the range of behavioural reactions related to piling). b) Surveys shall start not later than 6 months before the planned construction works.	Removal of the condition	According to information received at a briefing on 10/10/2024 on the <i>Guidelines for Environmental Analysis and Monitoring in the Construction of Offshore Wind Farms</i>, the GDEP indicated the possibility of abandoning the need to conduct porpoise monitoring 6 months before the start of construction. As justification, it was pointed out that regardless of the results of this monitoring, it will be necessary to apply all available measures to protect the harbor porpoise from noise, so such monitoring will not bring additional information that would enable better or more effective minimization measures to be taken. The Investor has conducted monitoring of porpoise occurrence in the period from October 2019 to November 2020. Therefore, it has up-to-date monitoring results for the BC-Wind OWF area. At the same time, the Investor will rely on the available monitoring results at the planned neighboring

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			OWFs, as well as the results of the international research conducted under the SAMBAH project.
II.2.2	Scope of monitoring at the construction stage:		
II.2.2.1	Underwater noise monitoring: a) The location of the noise measuring station shall be determined in a way permitting the assessment of underwater noise at the boundary of the Natura 2000 Ostoja Słowińska PLH220023 site for the works executed at the BC-Wind OWF area; b) Noise measurements shall be conducted with the use of calibrated hydrophones within the frequency range from 10 Hz to 20 kHz, with monitoring at two different depths (given 33% and 66% of the water depth, but always >2 m below the sea surface) with the determination of the SEL for each pile hammer blow (if the pile hammer is used); c) Monitoring shall continue throughout the OWF construction period. d) Underwater noise monitoring results in the form of periodic reports shall be forwarded to the Regional Director for Environmental Protection. If the noise exposure levels are exceeded, preventive or mitigating actions shall be suggested with the ways of their implementation and control of the results; At the point of presentation of the monitoring results mentioned above, they shall be compared with previous monitoring for this project and with other relevant survey results. Monitoring results shall also be submitted to the Regional Director for Environmental Protection in Gdańsk within 3 months from the completion of the given survey cycle.	Underwater noise monitoring: a) The location of the noise measuring station shall be determined in a way permitting the assessment of underwater noise at the boundary of the Natura 2000 Ostoja Słowińska PLH220023 site for the works executed at the BC-Wind OWF area; b) Noise measurements shall be conducted with the use of calibrated hydrophones within the frequency range from 10 Hz to 20 kHz, with monitoring at two different depths (given 33% and 66% of the water depth, but always >2 m below the sea surface) with the determination of the SEL for each pile hammer blow (if the pile hammer is used); c) Monitoring shall continue throughout the OWF construction period. d) Underwater noise monitoring results in the form of periodic reports shall be forwarded to the Regional Director for Environmental Protection. If the noise exposure levels are exceeded, preventive or mitigating actions shall be suggested with the ways of their implementation and control of the results; At the point of presentation of the monitoring results mentioned above, they shall be compared with previous monitoring for this project and with other relevant survey results. Monitoring results shall also be submitted to the Regional Director for Environmental Protection in Gdańsk within 6 months from the completion of the given survey cycle.	It may take more than 3 months to prepare the monitoring results. Therefore, the Investor is requesting an extension to 6 months.
II.2.2.2	Porpoise monitoring by means of the C-POD devices shall continue throughout the construction phase in accordance with the pre-development methodology (before the commencement of the construction works), with the devices located at the same stations.	Porpoise monitoring by means of the C-POD devices shall continue throughout the piling period based on the assumptions of the pre-investment monitoring methodology performed for the EIA Report. The methodology will be further specified in the Piling Strategy, submitted for approval to RDEP in Gdansk 6 months prior to the start of piling.	The amendment is to clarify that porpoise monitoring applies to the construction period associated with the conduct of piling, as this period generates impulse noise that can cause a threat to this species. Data collected during pre-investment monitoring, data from the SAMBAH project, and projects in the neighborhood are sufficient knowledge of possible porpoise activity, which, regardless of the results, requires the use of a noise reduction system in accordance with the conditions imposed in the DEC. Monitoring should be carried out on the basis of available data and on the basis of the monitoring methodology carried out at the stage of the natural inventory made for the EIA Report and in accordance with the results of noise modeling. Details of station placement will be presented in the Piling Strategy, which will be submitted for approval to RDEP in Gdansk 6 months prior to the start of piling.
II.2.3	Scope of post-development monitoring		
II.2.3.1	Ichthyofauna monitoring shall continue both during the OWF operation and after its decommissioning. Surveys shall be conducted in the spring and summer seasons, one and five years after the end of the construction works as well as one year after the decommissioning phase. a) As part of monitoring, a set of survey tools shall be used in the form of multi-panel bottom nets and, in the case of early development stages, the Bongo ichthyoplankton net. b) Survey stations shall be set out at both the OWF area and at a distance from it, at the water region not designated for marine power engineering and distinguished by similar marine environment parameters (depth, distance from the shore and the like). c) Surveys shall be undertaken to check if the artificial reef effect will only be limited to attracting fish from the nearby water region to the reef area or rather the actual productivity increase will be noted. d) In the case of the OWF decommissioning, the extent of the changes to take place following the destruction of the artificial reef, potentially offering the dwelling, feeding and reproduction site for many fish species, shall be assessed.	Ichthyofauna monitoring shall continue both during the OWF operation and after its decommissioning. Surveys shall be conducted in the spring and summer seasons, immediately after completion of construction works end four years before the decommissioning phase and one year after the decommissioning phase. a) As part of monitoring, a set of survey tools shall be used in the form of multi-panel bottom nets and, in the case of early development stages, the Bongo ichthyoplankton net. b) Survey stations shall be set out at both the OWF area and at a distance from it, at the water region not designated for marine power engineering and distinguished by similar marine environment parameters (depth, distance from the shore and the like). c) ~~Surveys shall be undertaken to check if the artificial reef effect will only be limited to attracting fish from the nearby water region to the reef area or rather the actual productivity increase will be noted.~~ d) In the case of monitoring 4 years before the decommissioning of the OWF, assess the degree of change that has occurred as a result of the operation of the OWF, i.e., whether the habitat has been created as a place of existence, feeding, shelter and reproduction of many fish species, and therefore propose a method of decommissioning the farm.	Because of the disruption that the construction phase will cause and the uncertainty of predicting how this will affect the ichthyofauna, it has been proposed to conduct monitoring of the ichthyofauna immediately after the construction work is completed. The purpose of this monitoring is to confirm that the construction phase has not caused significant changes in the behavior of the ichthyofauna. At the same time, it was proposed to abandon monitoring of ichthyofauna in later years, including after the decommissioning of the farm. Instead, it was proposed that such monitoring be carried out 4 years before the decommissioning of the farm in order to determine whether a valuable habitat for ichthyofauna has been created and whether, therefore, the demolition of elements of the farm, will not result in the destruction of a valuable habitat for ichthyofauna. Conducting such studies, including a survey of benthic habitats, will enable proper planning of the decommissioning phase and submission of such a proposal to the RDEP in Gdansk, 2 years before the assumed decommissioning of the farm.
II.2.3.2	Migrant bird monitoring comprising both passage radar observations and the counting of birds staying in the OWF area, conducted during the day. a) Radar surveys shall be targeted on the flight trajectory of birds flying towards the OWF and their reaction to the barrier created by the farm. The survey objective will also be the determination of migration intensity at the OWF area and in its immediate	Migrant bird monitoring comprising both passage radar-camera observations and the counting of birds staying in the OWF area, conducted during the day. a) Radar surveys shall be targeted on the flight trajectory of birds flying towards the OWF and their reaction to the barrier created by the farm. The survey objective will also be the determination of migration intensity at the OWF area	The amendment to the condition is to indicate the radar-camera system for monitoring migratory birds and the need for additional monitoring by an ornithologist, until the effectiveness of species identification by the camera system is confirmed.

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	vicinity in order to allow the comparative analysis with other relevant survey results, as well as provide new data for the analysis of the barrier effect and the frequency of avoidance behaviour (birds turning back). b) Radar surveys shall be conducted in the migration period from March to May and from the end of July to mid-November. c) Monitoring to consist of simultaneous visual, radar and acoustic observations (at night, with a view to species identification) permitting the identification of not only the flight direction and bird reaction, but also of the species. d) Survey stations shall be located at a fixed platform (e.g. the OWF substation) or on board an anchored vessel so that the survey station permits the observation of the OWF from a direction from which birds come flying (at the south-western end of the OWF in spring and at the north-eastern end in autumn). e) In each migration season, a minimum of 20 days and nights of observations at 2-5 day sessions shall be conducted at equal intervals during the season. f) During the year, monitoring shall be conducted in two cycles following from bird migration periods i.e. from March to May and from July to November, in 4 monitoring blocks: - 2 survey cycles in migration periods, in the fourth year after the commencement of operation (as the construction works may continue for more than 4 years from the start of operation and due to the need to verify the assumptions to the assessment); - 2 survey cycles in migration periods, in the first year after the completion of the construction works. g) Migrant bird mortality monitoring: - this shall continue for 5 years from the completion of the construction of the entire OWF, during seasonal spring migrations (from the beginning of March to the end of May) and during autumn migrations (from mid-July to the end of November); - bird mortality shall be monitored with the use of the automatic collision/casualty registration system for bird collisions with offshore wind turbine generators or by means of another acceptable method with the option to perform measurements both during the night and the day.	and in its immediate vicinity in order to allow the comparative analysis with other relevant survey results, as well as provide new data for the analysis of the barrier effect and the frequency of avoidance behaviour (birds turning back). b) Radar surveys shall be conducted in the migration period from March to May and from the end of July to mid-November. c) Monitoring to consist of simultaneous visual, radar and acoustic observations (at night, with a view to species identification) permitting the identification of not only the flight direction and bird reaction, but also of the species. d) Survey stations shall be located at a fixed platform (e.g. the OWF substation) or on board an anchored vessel so that the survey station permits the observation of the OWF from a direction from which birds come flying (at the south-western end of the OWF in spring and at the north-eastern end in autumn). e) In each migration season, a minimum of 20 days and nights of observations at 2-5 day sessions shall be conducted at equal intervals during the season. f) During the year, monitoring shall be conducted in two cycles following from bird migration periods i.e. from March to May and from July to November, in 4 monitoring blocks: - 2 survey cycles in migration periods, in the fourth year after the commencement of operation (as the construction works may continue for more than 4 years from the start of operation and due to the need to verify the assumptions to the assessment); - 2 survey cycles in migration periods, in the first year after the completion of the construction works. ~~g) Migrant bird mortality monitoring:~~ ~~— this shall continue for 5 years from the completion of the construction of the entire OWF, during seasonal spring migrations (from the beginning of March to the end of May) and during autumn migrations (from mid-July to the end of November);~~ ~~bird mortality shall be monitored with the use of the automatic collision/casualty registration system for bird collisions with offshore wind turbine generators or by means of another acceptable method with the option to perform measurements both during the night and the day.~~	To assess the extent of impacts, data are required, including: flight trajectories (radar), flight altitude (radar), species identification (visual observations, automated radar-camera system), flight behavior to assess micro-, meso-, and macro-communication rates (radar). Ongoing technological advances allow the use of a different technology in monitoring and make it possible to obtain results that coincide with data collected during classical monitoring performed from the deck of research vessels. The advantage of a radar-camera system permanently mounted on an offshore wind farm is that it is possible to conduct continuous surveys on an annual basis, dispensing with sampling-based surveys, as is the case with classical methods. The effectiveness of radar systems in terms of detecting bird flight routes and determining altitude has been known for years. In contrast, the use of a camera system in the recognition of species in the Baltic Sea region based on artificial intelligence requires teaching the system, by providing samples to be taught, as well as verifying and checking the effectiveness. Therefore, it was assumed that in the first year of post-implementation monitoring, surveys will be conducted in conjunction with visual observations by ornithologists, using the radar-camera system. After the first research cycle, the radar-camera system is allowed to work independently, without the need for an ornithologist to participate in the field work, if the system is able to provide the data necessary for the assessment of impacts including data on the identification of species including key species, and the number of samples provided will allow the calculation of bird passage streams through the OWF area. Justification for abandoning mortality monitoring: It is proposed to abandon the monitoring of bird mortality due to the lack of technical capabilities to conduct such monitoring in marine conditions. In addition, it should be pointed out that the identified (as a result of re-modelling) low collision rate for crane during autumn migration - i.e. 8 individuals are forecast for the current variant selected for implementation, i.e. WWR 2024; in the case of the variant for which the investor obtained the DEC it was 14 individuals, and in the case of the Baltic Power OWF (for which no mortality monitoring is required, it is 47 individuals). At the same time, the monitoring of migratory birds carried out at the farm using radar and camera systems makes it possible to perform modelling of potential bird mortality based on the collected data.
II.2.3.3	Marine bird monitoring shall comprise the counting of birds staying within the OWF and the reference areas, as performed during the day. The survey voyage route shall be the same or very similar to the one in the pre-development monitoring (before the commencement of the construction works). a) Surveys must cover, first of all, the period of the most abundant occurrence of birds in the southern Baltic, i.e. from October to May, with the minimum frequency of one voyage per month (optimally, two voyages per month). In other months, the numerical force in the BC-Wind area is small, therefore in the summer season it is sufficient to make two survey voyages i.e. one in mid-August and one in mid-September. b) The dates of the survey voyages shall be synchronised so that counting at both of these water regions can be done at the same time. c) These surveys shall be undertaken for the next 2 years (the first 2 years of OWF operation) if construction is not staged. Otherwise, these surveys shall be conducted after the completion of the first construction phase and the completion of the construction of the entire OWF.	Marine bird monitoring shall comprise the counting of birds staying within the OWF ~~and the reference areas~~, as performed during the day. The survey ~~study~~ route shall be the same or very similar to the one in the pre-development monitoring (before the commencement of the construction works). a) Surveys must cover, first of all, the period of the most abundant occurrence of birds in the southern Baltic, i.e. from October to May, with the minimum frequency of one voyage per month (optimally, two voyages per month). In other months, the numerical force in the BC-Wind area is small, therefore in the summer season it is sufficient to make two survey ~~studies~~ i.e. one in mid-August and one in mid-September. ~~b) The dates of the survey voyages shall be synchronised so that counting at both of these water regions can be done at the same time.~~ c) These surveys shall be undertaken for the next 2 years (the first 2 years of OWF operation) if construction is not staged. Otherwise, these surveys shall be conducted after the completion of the first construction phase and the completion of the construction of the entire OWF.	The change in condition is to standardize the approach to seabird monitoring, analogous to the wintering birds monitoring before construction works. The change in condition is: • abandoning monitoring of the reference area, • introduction of the possibility of conducting aerial surveys (replacing “survey voyage” with “survey study”). The survey study should include OFW area as well as 4-kilometers zone, as in the survey study before construction phase.
II.2.3.4	Porpoise monitoring shall be carried out for at least 2 years after the completion of the construction of the planned project with the use of the same methods as during the pre-development monitoring.	Carry out monitoring of porpoise occurrence 1 year after construction with selection of C-Pod locations based on methodology submitted for approval of the authority a minimum of 6 months prior to the planned start of monitoring.	Protection of the porpoise focuses primarily on mitigation of underwater noise during piling and the use of all available measures to exclude the presence of impulse noise during emissions. A post-construction survey could only be aimed at obtaining information on whether porpoise are using a particular body of water, even after construction.
II.2.3.5	Benthos monitoring focussed on the research into the colonisation of hard artificial substrates by epiphyte animal and plant communities. a) Benthos monitoring:	a) Benthos monitoring: - The benthos monitoring programme at the OWF area with regard to epiphyte flora and fauna shall be conducted at 5 underwater structural elements of wind turbines and associated infrastructure.	The proposed amendment to the condition applies only to benthic monitoring 4 years before the end of the farm's operation. This will enable timely analysis of the habitat created during the operation of the BC-wind OWF and appropriate planning of its decommissioning in such a way as not to destroy the habitat.

DEC no.	Current wording of conditions of DEC of 16 September 2022	Proposed amendment of the condition	Brief rationale
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	- The benthos monitoring programme at the OWF area with regard to epiphyte flora and fauna shall be conducted at 5 underwater structural elements of wind turbines and associated infrastructure. - Films and photos of the entire vertical space overgrown by macroalgae and epiphyte fauna shall be made at each facility under investigation. - From the water surface to the maximum noted depth of occurrence of growth organisms, samples shall be taken by a diver or ROV from the specified area at various depths with the maximum interval of 2 m for the investigation into the taxonomic composition and biomass of the epiphyte flora and fauna. - Surveys shall be undertaken once a year in June. For the first time, surveys shall be conducted if a minimum of 3 months has passed from the completion of the construction of the wind turbine selected for monitoring purposes. Further surveys shall be carried out after 2 and 4 years from the first survey. The last survey shall be performed one year before the planned dismantling of the wind farm. b) Macrozoobenthos monitoring: - Surveys shall be conducted within 5 wind turbine foundations or supporting structures selected in such a way that the represent construction stages, if any (the structures built at various stages) and that they are located at the various parts of the OWF area. - Six stations including three at the main profile transect (in the demersal current axis) shall be set out at 20, 50 and 100 m from the foundation or supporting structure, and three stations shall be set out at the transect perpendicular to the main profile (the reference one) at the same distances. - Surveys shall be carried out after the completion of the construction of the structures selected for monitoring, at one-off basis, in the period similar to that selected for inventory taking (May to June). The first survey shall be undertaken at the specified period after the completion of construction, and the next surveys after 2 and 4 years from the first survey. The last survey shall be performed one year before the planned dismantling of the wind farm.	- Films and photos of the entire vertical space overgrown by macroalgae and epiphyte fauna shall be made at each facility under investigation. - From the water surface to the maximum noted depth of occurrence of growth organisms, samples shall be taken by a diver or ROV from the specified area at various depths with the maximum interval of 2 m for the investigation into the taxonomic composition and biomass of the epiphyte flora and fauna. - Surveys shall be undertaken once a year in June. For the first time, surveys shall be conducted if a minimum of 3 months has passed from the completion of the construction of the wind turbine selected for monitoring purposes. Further surveys shall be carried out after 2 and 4 years from the first survey. The last survey shall be performed one year before the planned dismantling of the wind farm. b) Macrozoobenthos monitoring: - Surveys shall be conducted within 5 wind turbine foundations or supporting structures selected in such a way that the represent construction stages, if any (the structures built at various stages) and that they are located at the various parts of the OWF area. - Six stations including three at the main profile transect (in the demersal current axis) shall be set out at 20, 50 and 100 m from the foundation or supporting structure, and three stations shall be set out at the transect perpendicular to the main profile (the reference one) at the same distances. - Surveys shall be carried out after the completion of the construction of the structures selected for monitoring, at one-off basis, in the period similar to that selected for inventory taking (May to June). The first survey shall be undertaken at the specified period after the completion of construction, and the next surveys after 2 and 4 years from the first survey. The last survey shall be performed one year before the planned dismantling of the wind farm.	This will make it possible to present the method of decommissioning the farm 2 years before the planned decommissioning.
II.2.3.6	Bat monitoring orientated towards the determination of the species composition and numerical force. a) Equipment shall enable automatic registration and satisfy minimum requirements concerning equipment used for the surveys conducted at the environmental survey stage. Devices may be mounted for example at the mast of the measurement and survey station. b) Post-development monitoring shall cover the period of 3 years in the first year after placing the wind turbine in service and in the second and third year of OWF operation. Monitoring must comprise the spring (April to May) and autumn (August to October) migration periods.	Bat monitoring orientated towards the determination of the species composition and numerical force carry out during the spring migration from 1 April to 30 May and autumn migration from 15 August to 30 Septembers. a) Equipment shall enable automatic registration and satisfy minimum requirements concerning equipment used for the surveys conducted at the environmental survey stage. Devices may be mounted for example at the mast of the measurement and survey station. b) Post-development monitoring shall cover the period of 2 years in the first and second year after placing the wind turbine in service.	Given the low to moderate bat activity found during pre-implementation surveys, post-implementation monitoring has been proposed for the two years of the farm's operation. This data will effectively assess the impacts of the farm on bats and adjust any mitigation measures after the monitoring. As recommended in the Guidelines (Kepel et al. 2013), in offshore areas more than 20 km from the shore, detector inspections can be limited to periods of expected seasonal bat migration, during the spring migration period from April 1 to May 30 and the fall migration period from August 15 to September 30.
	If the preceding items do not provide otherwise, conclusions from the development and post-development monitoring [...] <i>[translator: incomplete sentence]</i> within 6 months of the end of the last season as part of post-development monitoring. The reports of detailed monitoring stages shall be submitted to the Regional Director for Environmental Protection in Gdańsk within 3 month of the end of each year of partial monitoring.	Unchanged	
III. Provide environmental supervision of the project:			
	The project shall be implemented under environmental supervision managed by a person(s) with the knowledge and experience in ornithology, biology and the ecology of marine mammals. That supervision shall comprise: a) training for construction supervisors; b) recommendations as to protection during the works; c) supervision of the performance of the provisions of the environmental decision to the extent of compliance with the Nature Protection Act By an environmental protection specialist responsible for the preparation and application of the emergency procedure (e.g. in the case of sea water contamination with oil-based substances from ships and transformers) at the farm and responsible for training the rescuers of animals coming in contact with oil-polluted waters.	Unchanged	-
IV. THAT IT IS NECESSARY TO UNDERTAKE THE REPEATED ENVIRONMENTAL IMPACT ASSESSMENT AS PART OF THE BUILDING PERMIT PROCEDURE WITH SPECIAL CONSIDERATION FOR THE FOLLOWING:			

DEC no.	Current wording of conditions of DEC of 16 September 2022	Proposed amendment of the condition	Brief rationale
1	2	3	4
IV.1	Determination of the width and significance for bird migration of safety zones around the individual wind turbines and between the adjacent OWF areas.	THAT IT IS <u>NOT</u> NECESSARY TO UNDERTAKE THE REPEATED ENVIRONMENTAL IMPACT ASSESSMENT AS PART OF THE BUILDING PERMIT PROCEDURE	It is proposed to amend the stipulation of point IV of the 2022 Environmental Decision and state that there is no need to conduct a re-evaluation of the environmental impact as part of the construction permit procedure. In connection with: - determining at this stage further details of the development of the farm area and a significant narrowing of technical parameters, - fulfilling the recommendations of the Authority set out in section IV of the Environmental Decision contained in this EIA Report, including re-modelling of collisions with birds, suspended solids dispersion and underwater noise propagation based on realistic technical parameters, and proposing an adjusted method of minimizing impacts and monitoring method, - presenting the relevant results and conclusions in the attached report on the environmental impact of the project, there are no conditions requiring a re-evaluation of the environmental impact.
IV.2	Determination of the foundation methods as well as the precise determination of the areas permanently occupied by the foundations and, based on the above, undertaking the assessment of the influence of that project stage on the various natural components of the environment with the analysis of the maintenance method for the farm structural elements.		
IV.3	Determination of the layout and parameters of the various wind turbine generators and platforms, and of the influence of the above-mentioned elements on the availability of that area to animals including, in particular, marine birds and mammals, as well as the determination of influence on long-distance bird migration routes and passages on the local scale.		
IV.4	Determination of the key parameters of the wind turbines, and possibly of the measurement and survey platform as well as of the accommodation and service platform.		
IV.5	Indication of the detailed location and parameters of the offshore substations as well as the type and size of the foundations on which such stations will be supported.		
IV.6	Model calculations with regard to the propagation range and concentration of suspended solids in water as a result of the works disturbing bottom sediments.		
IV.7	Underwater noise propagation model calculations, which will be based on the size and type of wind turbine foundations.		
IV.8	Bird collision model calculations, which will be based on the parameters of wind turbines in the BC-Wind OWF area.		
IV.9	Proposed solutions minimising noise impact and the reduction of the noise impact range, as suitable for the accepted foundation methods.		
IV.10	Analysis of the option for the use of the temporary switch off system for individual wind turbines or their groups in the case of a greater number of bird species such as long-tailed ducks flying at the collision height, and in the case of passages of larger bird groups.		
IV.11	Indication of the detailed ornithological supervision methodology at the project implementation phase.		
IV.12	Indication of the detailed pre-development marine bird monitoring (before the commencement of the construction works).		
IV.13	Indication of the detailed post-development ichthyofauna and marine bird monitoring.		
V	THAT IT IS NOT NECESSARY TO CONDUCT TRANSBOUNDARY ENVIRONMENTAL IMPACT PROCEEDINGS AS PART OF THE PROCEDURE FOR THE ISSUE OF THE DECISIONS REFERRED TO IN ARTICLE 72 PARA. 1 ITEM 1 OF THE EIA ACT.	Unchanged	-

Source: own elaboration

21.3. THE RATIONALE FOR MOVING AWAY FROM SETTING A THRESHOLD FOR FISH IN THE DEC

The following is a justification for the high level of uncertainty in adopting the underwater noise threshold causing potential TTS risk to fish (cumulative sound exposure) as a condition point for the environmental decision, with reference to conditions in the BC-Wind OWF area, and indicates that the 11 km distance specified in Condition I.3.8 of the DEC is not commensurate with the scale of likely real-world noise impacts on fish.

Pile work during OWF construction generates underwater impulsive noise of varying intensity, which is primarily dependent on the power of the hammer, while the propagation of acoustic waves and their range depends primarily on bathymetry, temperature, salinity and the nature of the bottom sediments. Underwater impulse noise is mainly exposed to marine mammals, but also fish, so at the stage of preparing the Report, underwater noise modelling was carried out taking into account both marine mammals and fish because at this distance from the BC-Wind OWF there are no valuable habitats or spawning grounds of commercially exploited fish and protected species.

The underwater noise modelling performed for the BC-Wind offshore wind farm (June 2024) used the maximum unfavourable assumptions, i.e., the hammer power parameter of 5,500kJ (i.e., more power than currently planned) and assumed the location of the foundation with the greatest foundation depth (all other foundations are more favourably located in terms of underwater noise propagation). The model does not take into account fish movement (escape). As the authors of the underwater noise modelling indicate, the results may be overestimated because they are based on conservative assumptions. As hammer energy will be lower than that used for modelling the impact of noise, due to the use of a "worst-case scenario" in the model, while the receptors (fish) in the real-world scenario will manage to move away from the risk zone defined in the above-mentioned modelling.

The noise exposure criteria for fish, with respect to TTS and reversible hearing damage during the construction phase, were determined in the modelling based on an expert review (Popper et al., 2014), while the behavioural criteria are based on a study by Hawkins et al., 2014 (DHI, 2024). These are unweighted criteria (unlike the criteria for marine mammals) and thus less well defined.

Uncertainty of the value $SEL_{skum} = 186 \text{ dB re } 1 \mu\text{Pa} \cdot \text{s}^{-1}$ in the context of potential impact on TTS for fish

According to Popper (2014), TTS occurs in fish with swim bladders at $SEL(cum) 186 \text{ dB re } 1 \mu\text{Pa}^2\text{s}$. The threshold is based on studies conducted on pike (*Esox lucius*), spotted seatrout (*Coregonus nasus*) and chub fish (*Couesius plumbeus*) and thus for freshwater fish exposed to airgun noise ($SEL(cum) 186 \text{ dB re } 1 \mu\text{Pa}^2\text{s}$, at various frequencies from 100 to 1600 Hz) (Popper et al., 2005). Air gun noise is an impulsive noise most similar to pile driving, with highest energy between 20-50 Hz and decreasing energy at frequencies higher than 200 Hz.

According to a study by Popper et al. (2014), fatal injuries occur in swim bladder fish at $SEL(cum) 207 \text{ dB re } 1 \mu\text{Pa}^2 \text{ s}$. Reversible injuries occur at noise levels of $SEL(cum) 203 \text{ dB re } 1 \mu\text{Pa}^2\text{s}$. Indicative values are based on the lowest measured noise levels with recorded injuries. Other studies have shown that fish die within a few meters of pile driving (Caltrans, 2004), but there are no data on the noise levels to which these fish were exposed.

It should be noted that the TTS threshold (which $SEL_{skum} = 186 \text{ dB re } 1 \mu\text{Pa}^2\text{s}$ is currently considered to be for fish) does not guarantee the absence of behavioural effects, masking and population effects that are difficult to predict for various species over a long period of time below this threshold value, such as $170 \text{ dB re } 1 \mu\text{Pa}^2\text{s}$. And, on the other hand, a level of 186 dB conventionally defined as TTS does not necessarily affect the ecological adaptation of specific species and individuals and stages of fish development.

The SELskum level gives an idea of how much energy a given stationary receptor has received at a certain distance, but realistically the sound level (amount of energy) received by an animal will be different due to its movement (in the case of an avoidance response - directed away from the sound source) or lack of movement (larvae, eggs). Currently, no noise levels are proposed for TTS taking into account fish escape. This is because, unlike physiological damage to internal organs, both escape behaviour and hearing damage itself (sensitivity impairment) are related to the species' specific sensitivity to sound frequency and intensity (Andersson 2017).

As Andersson (2017) points out, a threshold (threshold) is a level of harm or effect that cannot be exceeded/caused by a noise-producing activity. The threshold *“should be administratively manageable, measurable and at the same time biologically meaningful. In other words, it should be relatable to the percentage of the population that can be exposed to harmful noise, and how sensitive the population is.”* The threshold of 186 dB re 1 $\mu\text{Pa}^2\text{s}$ does not meet the above conditions.

In conclusion, the SELskum threshold adopted in the DEC = 186 dB re 1 $\mu\text{Pa} \cdot \text{s}^{-1}$ in the context of potential effects on TTS in fish is not authoritative because:

- There are too few species-specific studies that can be used to determine noise levels that cause damage specific to freshwater species. The levels proposed in the literature are based on studies of specific species, so they cannot be applied to all fish species. They are also not weighted by the frequencies of the hearing ranges of fish.
- The studies that resulted in the estimation of the aforementioned threshold were mainly conducted under laboratory conditions for freshwater fish. Compared to marine mammals, there is much less comparable data on noise response in fish. Observed responses and damage vary by species and noise level.
- Fish exhibit tremendous variation in auditory sensitivity dependent not only on the species, but on the anatomy of the auditory system, the weight of the fish and other aspects of its biology, such as preferred depths. It is not possible to indicate a universal threshold value for impulse noise representing the limit of danger to fish. Also, the behavioral response (including escaping and/or remaining exposed to noise and its accumulation) is also strongly dependent on both sound pressure and frequency, and may vary according to sex, age, condition, functional stage and the importance of the area for fish survival and/or reproduction.

However, the literature guidelines are based on the lowest noise levels at which damage has been reported to affect fish survival.

Conditions in the area of OWF BC Wind on the impact of noise on ichthyofauna

The number of individuals (% of the population) within the population of fish species occurring in the area affected by underwater noise of a certain intensity can be considered as an indicator of the impact of cumulative noise levels.

The estimated number of individuals or percentage of the population can be calculated on the basis of probabilistic models (which is relatively complicated) and depends on the approach (migratory fish are potentially exposed to noise for a shorter time [in a temporal sense] than non-migratory fish). Thus, it is assumed that the number of individuals /% of the population permanently influenced by noise is very difficult to estimate, and thus also the scale of the impact itself is unknown. However, the impact will potentially be greater for non-migratory fish or those spawning in a noise-exposed area.

An attempt to estimate the impact of noise at a certain SEL level on spawning grounds can provide an answer to the question of what proportion of the spawning grounds area and thus indirectly what proportion of the fish population (also in relation to all potential spawning grounds in a given part of the Baltic Sea, for example) will be affected by impulsive noise. If the proportion of exposed potential spawning grounds is relatively small, and the duration of the impact is short, then even at higher noise intensity (piling) one can speak of an insignificant or moderate impact.

An analysis of the catch and productivity of the fish assemblage residing within the BC-Wind OWF cited in the EIA report shows that the OWF area is typical of the southern Baltic in terms of species diversity, with a clear predominance of cod and flounder in the bottom fishery and herring and sprat in the pelagic fishery. The observed occurrence of larvae of such species as gobies, mothballs, horse mackerel, henheads and demersal fish does not indicate that the area is constantly inhabited by adults. Taking into account the literature information and the results of the performed research, it can be assumed that in the area of the BC-Wind offshore wind farm sprat spawning may take place, the intensity of which - compared to other shallow water areas - is relatively low.

In the EIA report, the qualities of the BC-Wind offshore wind farm area with regard to ichthyofauna were assessed as medium. With regard to the impact of underwater noise on fish, the TTS value described above (i.e., conservative) was adopted. Analysing the acreage within the TTS impact range in terms of impact on spawning/spawning grounds, it was concluded that it does not represent a significant breeding area for any fish species. The modelled noise impact area is partially (spatially and temporally) located in the area of spawning migration of sprats between deep-water spawning grounds, but, as indicated in the assessment, will not have a significant impact on the end result of the spawning run, including the abundance of the new generation of fish.

The analysed area of the OWF generally does not play a major role in the overall spawning efficiency of the stocks of occurring species.

The significance of the noise impact was therefore assessed as moderate for all the fish species studied. In the case of protected fish, the inventory identified only larval stages, on which the impact of OWF construction will be local. The occurrence of eggs and larvae of other species - herring, goby or sandeel - in the analysed area will be the result of spawning taking place outside the analyzed area, in shallow coastal waters and in the waters of the Slupsk Bank. Spawning of these species directly in the analyzed area is unlikely.

Experience of other OWF

Impulsive underwater noise and its impact on ichthyofauna is an issue that can be considered insufficiently recognized and requires further research. The consequence of the lack of adequate knowledge is the use of different approach by different authors of EIA reports for the OWF.

One approach is to use a less conservative threshold than TTS (temporary hearing shift) - some EIA reports propose PTS, which in fish is defined as reversible hearing damage. Reference to PTS was used, for example, by the authors of the noise modeling for the Baltica-1 offshore wind farm, pointing out that fish have the ability to restore the cells responsible for perceiving sounds. Therefore, *"...the impact defined as permanent hearing damage (PTS) defined for marine mammals, in the case of fish, is not accurate and should be treated as a reversible phenomenon"*.

Another common approach in the UK, for example, is to use a soft-start procedure to scare away fish residing in the vicinity of the planned start of piling:

- Hornsea 3 OWF the piling was conducted within the spawning grounds of sprat, cod and plaice and the only measure used was a soft-start procedure;
- Dogger Bank OWF (Teesside A i Teesside B) piling was conducted within the spawning areas of sprat, herring, cod and plaice and the only measure used was a soft-start procedure;
- Ossian OWF piling was conducted within the spawning areas of sprat, herring, cod and plaice and the only measure used was the soft-start procedure and the implementation of the piling procedure.

Summary

In summary:

- 1) The impact assessment in the EIA report did not find any negative impact of noise on the status of fish stocks, mainly because the analysed area does not play a major role in the overall spawning efficiency of most fish species. Therefore, the limitation to 11 km does not result in the protection of

important or large spawning areas (such spawning areas do not occur within 11 km of the BC Wind farm).

2) In view of the above and the fact that:

- conservative cumulative noise exposure level of 186 dB re 1 $\mu\text{Pa}^2\text{s}$ is subject to a high degree of uncertainty in terms of actual effects on fish populations and species, and thus has unclear biological significance, and that the
- the DEC requirement to mitigate noise impacts to less than 186 dB at a distance of 11 km is disproportionate and overly cautious compared to the baseline fish populations/habitats and the likely real scale of noise impacts

it is proposed to amend the condition of the DEC relating to impulsive noise during the construction phase in the context of fish, and limit the provisions in Section I.3.8 of the DEC to conditions limiting the intensity of impulsive noise relating to the hearing sensitivity of marine mammals. Mandatory application of methods to minimize impulsive underwater noise, resulting from the need to protect marine mammals, and soft-start procedures will simultaneously benefit fish, (the so-called “umbrella effect”), as it will allow them to temporarily leave the zones of highest noise pollution, minimizing the local/eventual threat of TTS.

The change in conditions resulting from the current status of the BC-Wind offshore wind project (identification of proposed turbine locations) and more advanced modelling of noise propagation has necessitated changes to the condition specified in the DEC for fish by revising (abandoning) the threshold, which was the reference point in earlier modelling. The current modelling results are incomparable to the earlier ones, which formed the basis for the introduction of the fish threshold into the DEC, due to the use of more precise forecasting methods. The analysis showed that the adoption of a noise reduction system for the protection of harbor porpoise (extremely endangered) provides a kind of “umbrella” that simultaneously protects fish from a significant range of noise impacts, and that the final selection of the noise reduction system in combination with the soft-start procedure will be prepared in a so-called “piling strategy.” The piling strategy will be prepared after the final selection by the Investor of the location of the 34 power plants, the design of the foundations and the contracting of the piling hammer, which will enable the performance of noise modelling for realistic assumptions and the adjustment of appropriate underwater noise mitigation measures, taking into account marine mammals and fish. The piling strategy developed on this basis will be submitted to RDEP in Gdansk for approval. The development of a piling strategy prior to piling is a commonly used tool in the UK, among others.

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