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Challenges and Solutions for Offshore Wind Farm Cumulative Effects Assessments for Marine Mammals

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Challenges and Solutions for Offshore Wind Farm Cumulative Effects Assessments for Marine Mammals

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Summary

Environmental Impact Assessments (EIAs) in the UK must include a Cumulative Effects Assessment (CEA), however due to a lack of standardisation or guidance this process varies considerably between assessments (especially by country and by project). This raises the question of the utility and efficiency of the current CEA process. The following are some of the key areas in which CEAs can vary:

1. Zone of Influence (screening range)
2. Timeframe considered
3. Assessment methodology
4. Screening rules
5. Data availability
6. Assumptions made
7. Magnitude definitions and significance scoring.

We recommend that UK wide SNCB guidance is developed so that CEAs can be standardised, leading to enhanced realism, representative and comparable CEAs – therefore streamlining a key element of the consenting process. The following are examples of what could be covered in such guidance:

- Standardisation of the screening range (Zone of Influence, or ZOI), preferably at a scale that is biologically meaningful to the receptor. For example, the management unit population.
- Standardisation of the timeframe included in the assessment. For example, for the assessment of construction noise, screen in all projects constructing at the same time as the Development in question ±2 years.

- Guidance on the information sources to be used in the data gathering stage. For example: obtain information from Environmental Impact Assessment Reports (EIARs) if available.
- Guidance on whether to quantitatively include projects without an EIAR available. If projects are to be included, then further guidance should be provided to standardise the assumptions behind deriving number of impacted animals. For example, the use of Effective Deterrence Ranges (EDRs) and specific density surfaces.
- Standardised approach to the quantitative assessment itself. For example, population modelling to quantify the potential cumulative impact to a receptor at a population level.
- Standardised definitions of magnitude in the significance scoring.
- Guidance and advice on how to make CEAs more realistic rather than assume compounding worst-case scenarios. For example, set realistic limits to the number of piling days available per year, realistic limits to the number of piling vessels able to operate in the area at the same time, etc.

It is recommended that the SNCBs and regulators in the UK hold a workshop to discuss these recommendations with a view of developing UK wide guidance.

An alternative solution could be that future CEAs are led by regulators/government agencies on a strategic/plan level, as is done in the US and the Netherlands. Given the demand and targets for renewable energy, we strongly advise that the current process is critically reviewed and amended to ensure a more streamlined consenting process going forwards.

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1. Introduction

The Overarching National Policy Statement for Energy (EN-1) (2023)[1] (applicable to England and Wales) states that the UK Secretary of State should take into account the "*potential adverse impacts, including on the environment, and including any long-term and **cumulative** adverse impacts*". In Scotland, the MD-LOT consenting and licensing guidance (2020) states that "*Scottish Ministers must take into account the **cumulative** impact of the generating station for which s.36 consent is being sought, together with those for which consents have already been granted and those for which it appears likely that consents will be granted*". In UK waters, all offshore developments that are subject to the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017[2] must prepare an Environmental Statement (ES) describing the aspects of the environment likely to be significantly affected. This should cover "*the direct effects and any indirect, secondary, **cumulative**, transboundary, short, medium, and long-term, permanent and temporary, positive and negative effects at all stages of the project*".

A key challenge is that "*cumulative effects or impacts*" are often not well defined. In the case of offshore wind farm CEAs, the definition is often assumed to be "*multiple occurrences of a single pressure (from single and/or different sources) on a single receptor type (e.g. underwater noise effects on harbour porpoise from a combination of pile-driving vessel movements and seismic surveys)*" (Judd et al. 2015). This aligns with the definition of "*aggregate exposure*" in Tyack et al. (2022): "*the combined exposure of an individual (or defined population) to a specific agent or stressor via relevant routes, pathways and sources*". In some instances, even the same pressure (e.g. underwater noise) is assessed separately for different sources (e.g. pile driving, vessel noise, seismic surveys etc).

For offshore wind farm (OWF) CEAs, the key stressor is underwater noise, resulting in a disturbance effect, and the routes, pathways and sources include UXO clearance, OWF piling, seismic surveys, vessel activity etc. This differs to the assessment of "*cumulative effect*" which is defined by Tyack et al. (2022) as "*the impact on the environment which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions*". Impacts to the environment or ecosystem as a whole, while vitally important to understand, are not the focus of CEAs currently presented for OWF developments, which focus on impacts to a specific receptor only.

2. Guidance for Cumulative Effects Assessments

There is no standard approach to CEA, though there is some limited, high-level guidance available. The Planning Inspectorate (applies to England and Wales only) has provided the following guidance: Nationally Significant Infrastructure Projects: Advice on Cumulative Effects Assessment (2024)[3], which sets out an overview of the

[1] https://www.gov.uk/government/publications/overarching-national-policy-statement-for-energy-en-1
[2] https://www.legislation.gov.uk/uksi/2017/572/contents
[3] https://www.gov.uk/guidance/nationally-significant-infrastructure-projects-advice-on-cumulative-effects-assessment

CEA process for Nationally Significant Infrastructure Projects (NSIPs)[4] under the Planning Act 2008:

- establishing the long list (stage 1)
- establishing the short list (stage 2)
- information gathering (stage 3)
- assessment (stage 4).

While this guidance provides high-level information, it is not prescriptive on exact methods that should be employed for different receptor groups or impact pathways. Given a lack of guidance or standardised methods, the common result is for CEAs to drastically differ in approach and therefore assessed scale of impact, thus limiting a consistent understanding across projects.

The following sections of this report outline how CEAs for OWF projects have varied given the lack of guidance and standardisation.

2.1 Stage 1: Establishing the project CEA long list

NSIP Guidance on CEA (2024): "*To establish which other existing and, or approved developments should be included in the assessment, the applicant should define and document the ZOI for each environmental aspect considered within the Environmental Statement".*

Stage 1 requires the Applicant to identify a Zone of Influence (ZOI) for each environmental aspect within the ES (e.g. benthic ecology, fish ecology, marine mammal ecology, ornithological ecology, etc). All developments within the largest ZOI (usually from ornithology or marine mammals) are then screened into the project CEA long list. The project CEA long list is developed by the EIA lead consultancy, and includes the following information:

- All developments (across multiple regulators and industries) within the largest ZOI across all environmental aspects/receptor groups
- Information on the status of each development (operational, consented, pre-application, decommissioned, not in use, etc)
- Information on the timeline for each development (in each year, each development is marked as pre-construction, construction, operational, decommissioned, unknown, etc)
- Distance of each development to the project
- Brief information on the data confidence (high, medium or low depending on what data is in the public domain and confirmed as 'accurate').

2.1.1 ZOIs for marine mammals

There is no guidance as to an acceptable ZOI for different receptors or impact pathways. Some CEAs have used fixed impact ranges to screen impacts into a CEA. For example, some marine mammals CEAs have screened in offshore energy projects within 500 km, or oil and gas projects within 200 km (Table 4). These ranges are considered the "*maximum distance at which effects could occur*", though there is usually no evidence or justification provided to support these ranges, making them

[4] NSIPs are defined under Sections 15-30A of the Planning Act 2008 (usually larger scale infrastructure projects, developments of national importance in terms energy, transport, water, waste water, and waste)

somewhat arbitrary. Other CEAs have screened in developments within the same body of water (e.g. the Irish Sea) (Table 4). One further approach for marine mammals is to screen in all projects within a species management unit (MU). The justification for this approach follows the definition of a management unit by the Inter Agency Marine Mammal Working Group (IAMMWG 2023): *"Management Unit (MU) typically refers to a geographical area in which the animals of a particular species are found to which management of human activities is applied"*. The largest cetacean Management Unit applicable to UK waters is the Celtic and Greater North Sea (CGNS) MU for minke whales, common dolphins, Risso's dolphins, white-beaked dolphins and white-sided dolphins. This MU encompasses all UK waters and extends out to the seaward boundary used by the European Commission for Habitats Directive reporting (known as Marine Atlantic, MATL), with the eastern boundary determined by OSPAR's Regional Seas boundary. Given the size of the MU, it is a significant task to obtain information on all projects included with the CGNS MU for a CEA.

Given the lack of guidance, it is possible for projects that are adjacent to each other and expecting to construct on the same timeline to have drastically different ZOIs and thus different projects screened into their CEA long lists. **Appendix 1: CEA Screening Ranges** (Table 4) provides a collation of the screening ranges used for marine mammal CEAs in recent OWF EIAs. The screening ranges included:

- Specific distance (e.g. 500 km)
- Species specific MU (in some cases the full CGNS MU is considered; some projects considered the CGNS MU too wide, and assessments have limited the area to the next largest MU)
- Scottish waters
- North Sea
- Irish Sea
- OSPAR regions
- Northern North Sea
- SCANS blocks

An illustration of the variation in different assumed ZOIs for an OWF located in the Irish Sea is provided in Figure 1.

A case study is provided in **Appendix 2: CEA Screening Comparison**, which compares the OWF projects screened into the CEAs for 8 OWF projects located in the Irish Sea, all of which expect to be piling between 2027 and 2029 (Table 6). The CEA for each project has used different ZOI and screening rules, and as such, even though all projects in the case study are expected to construct within the same area within a similar timeframe, the OWF projects included in their assessment of underwater noise from piling differ. On one end of the extreme, the Morecambe CEA screened in 5 OWFs, while on the other end of the extreme, the Arklow Bank Phase 2 CEA screened in >100 OWFs for the assessment of disturbance from piling noise.

It is evident that there is no consistency in screening ranges and thus different CEAs assess different scenarios with little to no comparability across projects.

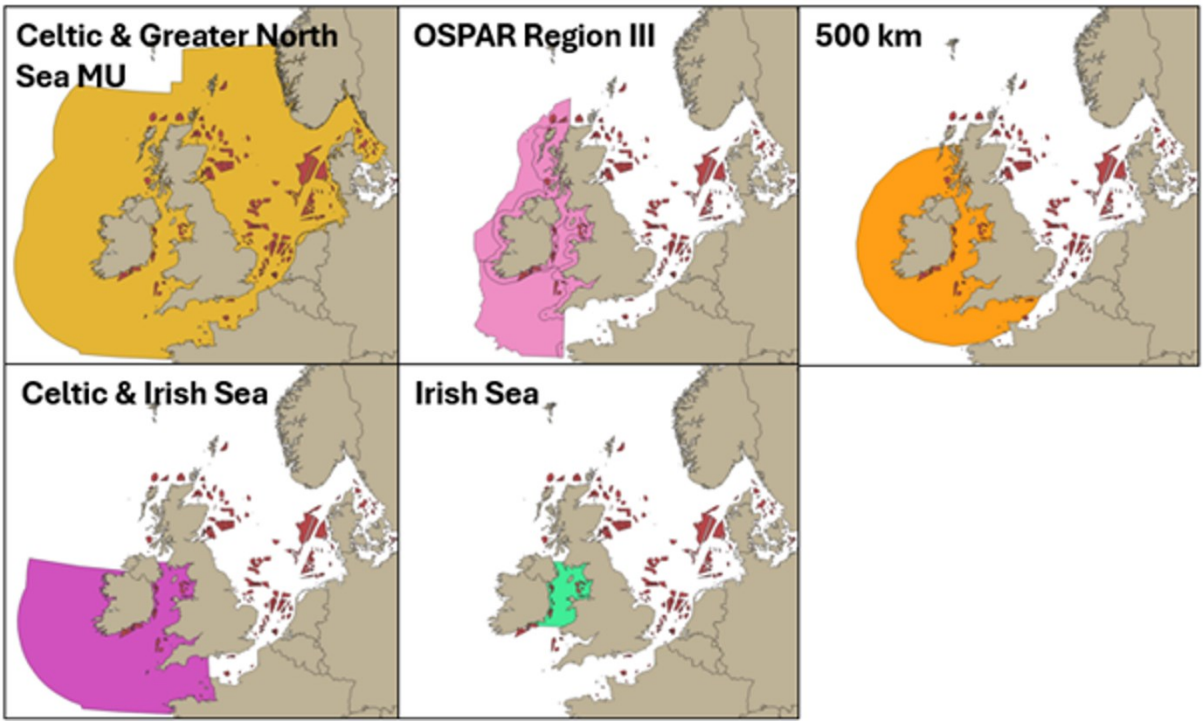

Figure 1 Illustration of the potential variation in the zone of influence (ZOI) areas that could be considered for an OWF in the Irish Sea. Included are OWF boundaries obtained from EMODnet (May 2024) to illustrate the variation in the number of OWFs that would be screened in.

2.1.2 Development timelines

When collating timeline information for CEA long lists, consultants often use large database sources such as The Crown Estate Open Data portal[5], the EMODnet data portal[6] or the 4C Offshore database[7]. Other sources of information include project specific websites, or the latest application submissions relating to a project (e.g. Scoping Report, Preliminary Environmental Information Report (PEIR), EIAR etc). In many cases, construction timelines are published in reports and on websites at different times, resulting in discrepancies where one source contains more up-to-date information than the other. Given a lack of guidance on where construction timeline information should be obtained from, each development may have varying timelines assumed across different CEAs.

2.2 Stage 2: Establishing the marine mammal short list

NSIP Guidance on CEA (2024): "*After Stage 1, applicants should develop and apply threshold criteria to the long list. These criteria should be used to establish a shortlist of the existing and, or approved development to be included in the CEA".*

For Stage 2, the Applicant should consider a proportionate approach that uses clearly presented defined criteria to include or exclude projects for the shortlist. Projects use

[5] https://opendata-thecrownestate.opendata.arcgis.com/
[6] https://emodnet.ec.europa.eu/geoviewer/
[7] https://www.4coffshore.com/

the following screening criteria to screen projects into or out of the receptor specific shortlist:

- Screen in:
  - Potential cumulative impact exists
  - Part of the baseline but has an ongoing impact and is therefore considered relevant to the CEA
- Screen out:
  - Included as part of the topic baseline and hence not considered within the CEA
  - No temporal overlap, nor potential for sequential cumulative effect
  - Low data confidence
  - No physical effect-receptor overlap
  - No effect-receptor pathway.

2.2.1 Part of topic baseline

Typically, marine mammal CEAs screen out impacts from commercial fisheries and shipping and navigation projects as these impacts existed during the baseline surveys and there is a lack of evidence that they will significantly increase in frequency/intensity in the near future. Other offshore developments that were operational during the baseline and will continue to be operational throughout the time period considered in the CEA, will also typically be screened out (e.g. existing and operational OWF, O&G platforms etc.). Thus, the baseline abundance and density estimates are considered to already include ongoing impacts from these existing and continuing pathways such that they do not need to be considered as additional impacts in the CEA.

2.2.2 Temporal overlap

The level of granularity available for the construction timeline for each project screened into the CEA can vary between data sources. For the assessment of disturbance from underwater noise produced by pile driving, the timeline required for each project in the CEA is the “piling window”, however this is often not available. Alternatives such as the “offshore construction” window or the overall “construction” programme are often used instead. This can result in the assumption that projects could potentially be piling over a 10-year construction window, whereas in reality the duration of piling within this construction window will be much shorter. Thus, the piling driving timeline assumed for each project in the CEA can be substantially different to reality.

In addition to this, the timeframe considered (and thus the number of projects considered) within CEAs can vary drastically across CEAs and across receptor groups within the same EIA. Typically, the project CEA long list may be screened for marine mammals to present one of the following temporal scenarios for the assessment of disturbance from underwater noise produced by pile driving:

- All projects that may construct between the time of the baseline data collection and the end of the construction period of the Development in question.
- All projects that may construct between the time of the consent application and the end of the construction period of the Development in question.
- All projects with a construction period that overlaps with the construction period of the Development in question.
- All projects with a construction period that overlaps with piling at the Development in question.

This means that the timeframe considered within a CEA can vary between 2-3 years and >10 years.

The following is a hypothetical scenario to illustrate how these screening rules can change the CEA scope. In total 117 OWFs with construction years between 2021 and 2034 were identified in the ZOI (Celtic and Greater North Seas MU) (details provided in **Appendix 3: Hypothetical CEA long list**, Table 7). The scenario considered was for a Development that conducted its baseline in 2020, submitted its Application in 2024 and is expected to construct between 2027 and 2029 (with piling occurring in 2028 and 2029). Table 1 outlines the number of years considered and the number of OWFs screened into the CEA depending on the timeframe specified.

Table 1 Hypothetical example of how the number of projects screened into a CEA can vary depending on the temporal scenario considered.

Scenario	Start year	End year	# OWF
All projects that may construct between the time of the baseline data collection and the end of the construction period of the Development in question	2021	2029	106
All projects that may construct between the time of the consent application and the end of the construction period of the Development in question	2024	2029	88
All projects with a construction period that overlaps with the construction period of the Development in question ± 1 year	2026	2030	80
All projects with a construction period that overlaps with the construction period of the Development in question	2027	2029	62
Only the piling years for the Development in question	2028	2029	47

2.2.3 Data confidence

The lack of a construction timeline can be used to screen a project out of a shortlist under the “low data confidence” criteria. Conversely, some CEAs take the extremely precautionary approach of assuming all projects with no construction timeline are assumed to potentially construct at the same time as the Development in question. This can result in a highly unrealistic scenario with many multiple projects assumed to be constructing in the same year.

2.2.4 Physical effect-receptor overlap

This refers to activities associated with the Development in question that will not give rise to impacts on a receptor as they are not physically present in the same area. For example, this would include screening out all onshore wind farms, or onshore coastal developments for marine mammals.

2.2.5 Effect-receptor pathway

This refers to activities associated with the Development in question that will not give rise to impacts on a receptor. For example, this could include screening out EMF related impacts to UK marine mammals (e.g. from offshore cables and connectors) since there is no evidence that UK marine mammal species are directly affected by EMF (Copping 2018).

2.2.6 Short list for different impact pathways

Once the marine mammal short list is obtained, this then needs to be further refined to obtain specific lists for each impact pathway. For example, the short list for the impact of disturbance from pile driving noise (only relevant during the construction phase of projects) will result in a very different short list to the impact of disturbance from vessel activities (relevant during the construction, O&M and decommissioning phases of projects).

2.3 Stage 3: Information gathering

NSIP Guidance on CEA (2024): "*At this stage, the applicant should gather information on each of the other existing and, or approved developments shortlisted at Stage 2. The applicant is expected to compile detailed information to inform the Stage 4 assessment".*

2.3.1 Number of animals disturbed

Where available, CEAs tend to use project specific estimates for the number of marine mammals disturbed per day from project specific assessments (PEIR or EIAR). However, even where these data are available, due to the lack of specific guidance, there is no consistency in the disturbance thresholds or density estimates used across assessments.

Density estimates

Different projects will have used different density estimates for the same species in their quantitative assessment. For example, for harbour porpoise the following density estimates have typically been used in recent quantitative assessments:

- Site-specific surveys (average across all surveys, or highest seasonal average)
- SCANS IV block estimates (Gilles et al. 2023)
- SCANS III density surface (Lacey et al. 2022)
- SCANS III block estimates (Hammond et al. 2021)
- MERP distribution maps (Waggitt et al. 2019)
- Modelled distributions around Wales (Evans and Waggitt 2023).

Density estimates can differ markedly across data sources for the same area. For example, this was highlighted as an issue for the Erebus OWF[8] quantitative assessment, where site-specific surveys estimated a density of 1.61 common dolphins/km^2, while the SCANS III block D density estimate for the same area was 0.3743 common dolphins/km^2. Thus, the decision of which density estimate to use in the quantitative assessment can change the predicted number of animals impacted by an order of magnitude in extreme cases.

Disturbance thresholds

Recent EIARs have used a variety of disturbance thresholds including:

- 26 km or 15 km Effective Deterrence Range (EDR) for porpoise (JNCC 2020)
- Aversive behavioural reaction threshold for porpoise (SEL_{ss} 145 dB re 1 µPa^{2}s) (Lucke et al. 2009)

[8] https://www.bluegemwind.com/wp-content/uploads/2020/07/Erebus-ES-Vol-3-Appendix-12.1-Marine-Mammal-and-Turtle-Technical-Report.pdf

- Porpoise avoidance threshold (SEL_{ss} 140 dB re 1 μPa^2s) (ASCOBANS 2014, Heinis et al. 2015)
- Dose response functions for porpoise (Brandt et al. 2016, Graham et al. 2017, Graham et al. 2019) or seals (Russell and Hastie 2017, Whyte et al. 2020)
- Level B harassment threshold (RMS 160 dB re 1 µPa) (NOAA 2005)
- Low level disturbance (SPL 140 dB re 1 µPa) (NOAA 2005)
- TTS as a proxy for disturbance (Southall et al. 2007, Southall et al. 2019).

Details on the various disturbance thresholds can be found in Sinclair et al. (2023). It is key to note that most of these thresholds were derived for harbour porpoise, and while they are often used in EIARs for other species due to a lack of comparable data for these species, there is no evidence that other species will respond in the same way as harbour porpoise, and thus assessments remain highly uncertain.

The lack of guidance (or indeed, changing guidance over time) on the threshold that should be used in the assessment of disturbance from pile driving means that the predicted number of animals impacted are often in no way comparable across projects. Thus, projects located in a similar area, using the same density estimates and the same pile driving parameters (e.g. maximum hammer energy) can predict profoundly different numbers of animals to be disturbed due to differences in the disturbance threshold used.

2.3.2 Other European projects

Depending on the screening range used, there can be multiple other European projects screened into a CEA. These can include OWF projects located in France, Denmark, Germany, the Netherlands, Belgium, Norway etc. The methodology used across different EU countries varies, and most consultancies lack access to these assessments as they are either not public or are provided in another language. Therefore, when other EU projects are included in a CEA, they are generally treated as projects without a quantitative assessment available (section 2.3.3).

2.3.3 Projects without a quantitative assessment

Some CEAs screen out projects where a quantitative assessment of the number of animals impacted is not available (e.g. no PEIR or ES is available). Other CEAs acknowledge that these projects should be considered in some way quantitatively and thus use an EDR approach and a density estimate to provide an illustrative number of animals disturbed. Typically, for OWF projects with no PEIR/EIAR available yet, an EDR is assumed alongside a density assumption for the area each project is located within, in order to estimate the number of animals impacted.

EDRs

The JNCC (2020) guidance recommends a 26 km EDR for unabated monopile installation, and a 15 km EDR for pin-piling (these values are also adopted in the JNCC (2023) Marine Noise Registry Guidance for porpoise). These EDRs are currently under review as there are concerns that there is a lack of suitable data to support them (Brown et al. 2023, Benhemma-Le Gall et al. 2024).

It is important to highlight that no EDR for pile driving disturbance has been suggested for any species other than harbour porpoise at this time. Often the porpoise EDR is applied to other marine mammal species, though there is no evidence that it is applicable. While evidence is absent, it is expected that different species, particularly

from different hearing groups with different hearing capabilities, will respond to underwater noise from pile driving in different ways.

Therefore, there is a lack of confidence in the prediction of the number of animals impacted when assuming an EDR.

Density

CEAs typically use a simple uniform density value to estimate the number of animals impacted by projects with no PEIR/EIAR available yet. Typically, this will involve one of the following:

- SCANS block densities for cetaceans
- Assumed uniform density across an MU (i.e. MU population size/MU area).

This does not take into consideration the spatial and temporal variation of marine mammals and therefore, there is a lack of confidence in the prediction of the number of animals impacted when assuming these broad density estimates.

2.4 Stage 4: Assessment

NSIP Guidance on CEA (2024): *"The applicant should assess the cumulative effects of the proposed NSIP with the other existing and, or approved development identified in Stages 1 to 3".*

2.4.1 Total number impacted

Once the numbers of animals impacted by each project screened into a CEA have been collated, the quantitative assessment is conducted. Typically, an assessment will provide a table of the number of animals predicted to be impacted by each project in each year in the CEA. For example, for the assessment of cumulative disturbance from piling at multiple OWFs, the number of animals disturbed per day per project is summed across all projects expected to be constructing in each year. This provides an estimate of the number of animals potentially disturbed on any one day of piling across all projects and assumes that a) all projects piling that year are piling on the same day and b) that there is no overlap in disturbance ranges between projects. This is often highly unrealistic for a number of reasons, as summarised below.

Caveats: Number of vessels

Given that there is so little information on the construction schedules for OWF projects, and the fact that they are therefore considered to extend over multiple years within a CEA, the result can be that there are many OWFs listed in a CEA as constructing within the same year. For example, the Arklow Bank Wind Park 2 EIAR (Volume II, Chapter 11[9]) marine mammal CEA short list assumed that 35 OWFs could be piling in the Celtic and Greater North Seas MU in 2028.

This is extremely unrealistic given that in 2023, there were only 49 jack-up vessels and 32 heavy lift vessels in Europe in operation (Global Wind Energy Council 2024). The ability of current Wind Turbine Installation Vessels (WTIVs) to accommodate larger and heavier nacelles, towers and foundations has impacted the availability of vessels, and there is a concern that in Europe, WTIV shortages may occur towards the end of this decade unless investment in building new WTIVs is made before

[9] https://www.arklowbank2offshoreplanning.ie/downloads/eiar/abwp2-chapter-11-marine-mammals.pdf

2026/2027 (Global Wind Energy Council 2024). The offshore wind industry is already struggling with the supply of heavy installation vessels not meeting the demand.

Caveats: Worst-case scenario

It is important to understand that what is presented in the EIAR is the worst-case (maximum design) scenario, provided so that the consent application can cover all possible build scenarios. As the EIAR is often submitted 5+ years before the project is constructed, what is assessed in the EIA often bears little resemblance to what is constructed. At the EIAR stage, projects are often technology agnostic, and so WTGs could be installed on monopile, jacket or floating foundations, each of which will result in a different number of animals impacted and a different number of expected piling days. There is also little confidence in the timelines presented in EIARs, as they are estimates that will be influenced by factors such as, consenting timeline, Contracts for Difference (CfD) timeline, manufacturing timelines, vessel availability etc. This means that CEAs combine worst-case scenarios across multiple OWF projects, leading to an assessment that is overly conservative and unrealistic, bearing little resemblance to what is likely to occur in reality.

An example of this is provided in Table 2 for two OWFs in the Moray Firth, Scotland. The construction year and duration, number of piles and number of piling days differs drastically between what was assessed in the EIAR and what was built. For example, at the Moray East OWF, the total number of piles installed was only 21% of the number assumed in the worst-case scenario in the EIAR (i.e. an estimated >70% reduction in projected impact (via the number of piles), all other factors held constant). Likewise, total number of piling days was only 18% of the number assumed in the worst-case scenario in the EIAR (i.e. an estimated >80% reduction in projected impact (via the number of piling days), all other factors held constant). Thus, CEAs conducted using the worst-case parameters from the Moray East OWF EIAR would have significantly over predicted impacts based on the number of piles installed or the number of piling days (compared to the as-built parameters).

Therefore, the use of worst-case EIAR values in CEAs is a key factor that results in unrealistic over-prediction of potential impacts in CEAs. Thus, the use of worst-case scenario values from project EIARs needs to be reconsidered to enable more realistic CEAs going forwards.

Table 2 Examples of the difference between worst-case scenario assessed in the EIAR and the constructed project

	Beatrice Offshore Wind Farm		Moray East Offshore Wind Farm	
	EIAR[10]	**Constructed[11]**	**EIAR[12]**	**Constructed[13]**
Document year	2012	2017	2012	2020
Foundation type	Jacket Quad	Jacket Quad	Jacket Quad	Jacket Tripod
Foundation installation year	2014-16	2017	2016-18	2019-20
Foundation installation months	30	9	36	10
WTG piling days	*Not stated*	104	742	136
# WTGs	277	84	339	100
# WTG piles	1,108	336	1,356	300
# OSPs	3	2	8	3
# OSP piles	12	8	128	9
Total # piles	1,120	344	1,484	309

[10] Beatrice Offshore Wind Farm. Environmental Statement. Section 7: Project Description https://marine.gov.scot/datafiles/lot/bowl/ES/ES%20Volume%201%20-%20ES%20Sections/

[11] Beatrice Offshore Wind Farm. Piling Strategy Implementation Report (2018) https://marine.gov.scot/data/beatrice-offshore-windfarm-piling-strategy-implementation-report

[12] Moray Offshore Renewables Limited - Environmental Statement. Telford, Stevenson and MacColl Offshore Wind Farms and Transmission Infrastructure. Chapter 2: Project Details https://marine.gov.scot/sites/default/files/chapter_2_-_project_details.pdf

[13] Moray East Offshore Windfarm. Piling Strategy Implementation Report (2021) https://marine.gov.scot/sites/default/files/piling_strategy_implementation_report.pdf

2.4.2 Population modelling

Current advice from SNCBs (Natural England and NatureScot) is that a quantitative CEA should conduct population modelling to assess whether a population level effect may occur from the expected disturbance impact across projects in the CEA. To do this, considerable amounts of data need to be gathered or assumed for each project included in the CEA. Population modelling such as iPCoD (Harwood et al. 2014, King et al. 2015) requires information on the number and spread of piling days to create a piling schedule for each project screened in. This information is only available if a project has conducted iPCoD modelling within its EIAR and provided detailed iPCoD inputs. For projects without this detail available in the public domain, assumptions must be made about the potential number of piling days, the timing and duration of the piling window and the spread of piling days within the construction window for each individual project included in the CEA. For example, it could be assumed that it takes 1 day of piling to install a monopile foundation, or 2 days of piling to install a jacket foundation. It could be assumed that there is seasonality to the distribution of piling days, or that piling can be evenly distributed throughout the year. All assumptions made will result in very different piling schedules for every project included in the modelling.

Given the level of assumptions that go into creating piling schedules, in addition to the assumptions on the number of animals disturbed for projects without an EIAR available, the resulting inputs to the iPCoD modelling are often highly uncertain, leading to limited confidence in the realism or reliability of the model outputs. This could be addressed by adhering to specific screening rules for projects included in a CEA. For example, for an OWF project located in English waters in the North Sea, it may be sensible to only include projects in English waters in the North Sea that have a quantitative impact assessment available, rather than attempting to include projects without a quantitative assessment and all EU projects within the North Sea. Guidance from SNCBs and Regulators on this matter would be extremely beneficial to the industry.

2.4.3 Significance scoring

NSIP Guidance on CEA (2024): "*Terminology used to determine significance should be explicit and support a clear outcome of the cumulative effects assessment. Criteria should consider capacity of the receiving environment and receptors to accommodate changes likely to occur. Where bespoke significance criteria are developed, applicants should consider:*

- ***duration of effect (temporary or permanent)***
- ***extent of effect (the geographical area)***
- ***type of effect (whether additive or synergistic)***
- ***frequency of the effect***
- ***value and resilience of the receptor affected***
- ***likely success of mitigation".***

Ultimately, the point of the CEA is to obtain a significance score, to determine if there is likely to be a significant impact from multiple OWF projects to a receptor population.

This is obtained by combining a magnitude score, and a sensitivity score in a significance matrix.

When considering the total number of animals affected, it is challenging to determine whether disturbance to a given proportion of a population aligns with specific magnitude scores in EIAs, since the magnitude definitions rarely provide quantitative thresholds (as there is a lack of evidence to support the setting of any). The potential impact on a population level is also more nuanced than simply the number of animals impacted per day. The potential effect on individual vital rates (such as survival and reproduction) and thus potential population level effects are also driven by the number of days of repeated disturbance an individual experiences. Therefore, in order to satisfactorily assess whether a population level effect may occur, population level modelling should be conducted.

There is no consistent guidance or standardisation for magnitude scores when evaluating the level of impact for a given impact pathway. Different projects apply different magnitude definitions, which can deviate to the extent that the same result may be classified differently, leading to inconsistent evaluations of significance across projects. An example is provided in Table 3. It is concerning that something so fundamental as the definition of magnitude can be allowed to vary so much, making it essentially impossible to compare conclusions across impact assessments. The industry would benefit from guidance on magnitude scores to allow impact assessments to be conducted against the same standardised metrics, thus enabling cross project comparisons.

Table 3 Example differences in magnitude definitions across different EIARs.

Score	Seagreen[14]	Inch Cape[15]	Neart na Gaoithe[16]	Norfolk Boreas[17]
High	The impact would affect the behaviour and distribution of sufficient numbers of individuals, with sufficient severity, to affect the favourable conservation status and/ or the long-term viability of the population at a generational scale.	>20% of population	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements.	Permanent irreversible change to exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >1% of the reference population are anticipated to be exposed to the effect. OR Long-term effect for 10 years or more (but not permanent, e.g. limited to lifetime of the project). Assessment indicates that >5% of the reference population are anticipated to be exposed to the effect. OR Temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that >10% of the reference population are anticipated to be exposed to the effect.
Medium	Temporary changes in behaviour and/ or distribution of individuals at a scale that would result in potential reductions to lifetime reproductive success to some individuals, although not enough to affect the population trajectory over a generational scale. Permanent effects on individuals that may influence individual survival but not affecting enough individuals to	10-20% of population	Loss of resource, but not adversely affecting integrity of resource; partial loss of/damage to key characteristics,	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that between >0.01% and <=1% of the reference population anticipated to be exposed to effect. OR Long-term effect for 10 years or more (but not permanent, e.g. limited to lifetime of the project). Assessment indicates that >1% and <=5% of the reference population are anticipated to be exposed to the effect. OR Temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which

[14] Seagreen Offshore Wind Farm. 2018. Optimised Seagreen Phase 1 Project EIAR, Chapter 10: Marine Mammals. https://marine.gov.scot/sites/default/files/chapter_10_marine_mammals.pdf

[15] Inch Cape Wind Farm. 2018. EIA Report. Volume 1, Chapter 10: Marine Mammals. https://marine.gov.scot/sites/default/files/volume_1a_chapters_1-11.pdf

[16] Neart na Gaoithe Offshore Wind Farm. 2018. Environmental Impact Assessment Report. Chapter 8: Marine Mammals. https://marine.gov.scot/sites/default/files/combined_document_-_revised.pdf

[17] Norfolk Boreas Offshore Wind Farm. 2019. Environmental Statement, Volume 1, Chapter 12: Marine Mammals. https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-000398-6.1.12%20Environmental%20Statement%20Chapter%2012%20Marine%20Mammal%20Ecology.pdf

	alter population trajectory over a generational scale.		features or elements.	are of particular importance to the receptor. Assessment indicates that between >5% and <=10% of the reference population anticipated to be exposed to effect.
Low	Short-term and/or intermittent and temporary behavioural effects in a small proportion of the population. Reproductive rates of individuals may be impacted in the short term (over a limited number of breeding cycles). Survival and reproductive rates very unlikely to be impacted to the extent that the population trajectory would be altered.	<10% of population	Some measurable change in attributes, quality or vulnerability, minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that between >0.001 and <=0.01% of the reference population anticipated to be exposed to effect. OR Long-term effect for 10 years or more (but not permanent, e.g. limited to lifetime of the project). Assessment indicates that >0.01% and <=1% of the reference population are anticipated to be exposed to the effect. OR Intermittent and temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that between >1% and <=5% of the reference population anticipated to be exposed to effect
Negligible	Very short term, recoverable effect on the behaviour and/or distribution in a very small proportion of the population. No potential for any changes in the individual reproductive success or survival, therefore no changes to the population size or trajectory.	NA	Very minor loss or detrimental alteration to one or more characteristics, features or elements.	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that <=0.001% of the reference population anticipated to be exposed to effect. OR Long-term effect for 10 years or more (but not permanent, e.g. limited to lifetime of the project). Assessment indicates that <=0.01% of the reference population are anticipated to be exposed to the effect. OR Intermittent and temporary effect (limited to phase of development or Project timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that <=1% of the reference population anticipated to be exposed to effect.

3. Summary

Given the absence of guidance, CEAs vary considerably across OWF projects and consultancies. The following are key areas in which CEAs can vary:

1) Screening range for the long list as well as the short-list;
2) Timeframe considered based on information in the public domain;
3) Project-specific assessment methodology (threshold vs dose-response approach, choice of appropriate density)
4) Screening rules (e.g. decision regarding screening of projects with limited information in the public domain)
5) Varying levels of data confidence (data from existing quantitative assessments vs projects without quantitative assessment in the public domain)
6) Assumptions on number of piling days and number of projects piling per year
7) Magnitude Definition

Additionally, a key consideration is that when using values reported in EIARs, CEAs combine worst-case scenarios across multiple OWF projects, leading to an assessment that is overly conservative and unrealistic, bearing little resemblance to what is likely to occur in reality. This has been clearly demonstrated for the Moray East OWF where the total number of piles installed was only 21% of the number assumed in the worst-case scenario in the EIAR (i.e. an estimated >70% reduction in projected impact (via the number of piles), all other factors held constant).

This raises the question of the utility of the current CEA process within project specific EIARs and opens up the potential for individual CEAs to tailor their CEA (e.g. screen in fewer projects over a shorter timescale) in order to produce a non-significant conclusion to the assessment.

4. Recommendations

We recommend that guidance is provided so that CEAs can be standardised, more realistic, representative and comparable. The following are examples of what could be covered in such guidance:

- Standardisation of the screening range (ZOI), preferably at a scale that is biologically meaningful to the receptor. For example, the management unit of a population.
- Standardisation of the timeframe included in the assessment. For example, for the assessment of construction noise, screen in all projects constructing at the same time as the Development in question ±2 years.
- Guidance on the information sources to be used in the data gathering stage. For example: obtain information from EIAR reports if available.
- Guidance on whether to quantitatively include projects without an EIAR available. If projects are to be included, then further guidance should be provided to standardise the assumptions behind deriving number of impacted animals. For example, the use of EDRs and specific density surfaces.
- Standardised approach to the quantitative assessment itself. For example, population modelling to quantify the potential cumulative impact to a receptor at a population level.
- Standardised definitions of magnitude in the significance scoring.

- Guidance and advice on how to make CEAs more realistic rather than assume compounding worst-case scenarios. For example, set realistic limits to the number of piling days available per year, realistic limits to the number of piling vessels able to operate in the area at the same time etc.

It is recommended that the SNCBs and regulators in the UK hold a workshop to discuss these recommendations with a view of developing UK wide guidance.

An alternative solution could be that future CEAs are led by regulators/government agencies on a strategic level, as is done in the US and the Netherlands. Given the demand and targets for renewable energy, we strongly advise that the current process is critically reviewed and amended to ensure a more streamlined consenting process going forwards.

5. Next steps

The next steps within this PrePARED task will be to collate further data to show that the worst-case scenarios assessed in EIARs are not comparable to the final as-built scenarios, and demonstrate, using iPCoD modelling, how the results of CEAs can vary when using different screening rules and when using EIAR parameters vs final as-built parameters.

6. References

ASCOBANS. 2014. Concept for the protection of harbour porpoises from sound exposures during the construction of offshore wind farms in the German North Sea (sound protection concept). Page 35 *in* Germany, editor. 21st ASCOBANS Advisory Committee meeting, Gothenburg, Sweden.

Benhemma-Le Gall, A., G. D. Hastie, A. M. Brown, C. G. Booth, I. M. Graham, O. Fernandez-Betelu, V. Iorio-Merlo, R. Bashford, H. Swanson, B. J. Cheney, N. Abad Oliva, and P. M. Thompson. 2024. Harbour porpoise responses to the installation of XXL monopiles without noise abatement; implications for noise management in the Southern North Sea. PrePARED Report, No. 004. August 2024.

Brandt, M. J., A. Dragon, A. Diederichs, A. Schubert, V. Kosarev, G. Nehls, V. Wahl, A. Michalik, A. Braasch, C. Hinz, C. Katzer, D. Todeskino, M. Gauger, M. Laczny, and W. Piper. 2016. Effects of offshore pile driving on harbour porpoise abundance in the German Bight. Report prepared for Offshore Forum Windenergie.

Brown, A. M., M. Ryder, K. Klementisová, U. K. Verfuss, A. K. Darius-O'Hara, A. Stevens, M. Matei, and C. G. Booth. 2023. An exploration of time-area thresholds for noise management in harbour porpoise SACs: literature review and population modelling. Report Number SMRUC-DEF-2022-001. Prepared for Defra. SMRU Consulting. 131pp plus appendices.

Copping, A. 2018. The State of Knowledge for Environmental Effects Driving Consenting/Permitting for the Marine Renewable Energy Industry. Prepared for Ocean Energy Systems On behalf of the Annex IV Member Nations, January 2018.

Evans, P., and J. Waggitt. 2023. Modelled Distributions and Abundance of Cetaceans and Seabirds in Wales and Surrounding Waters. NRW Evidence Report, Report No: 646, 354 pp. Natural Resources Wales, Bangor.

Gilles, A., M. Authier, N. Ramirez-Martinez, H. Araújo, A. Blanchard, J. Carlström, C. Eira, G. Dorémus, C. Fernández-Maldonado, S. Geelhoed, L. Kyhn, S. Laran, D. Nachtsheim, S. Panigada, R. Pigeault, M. Sequeira, S. Sveegaard, N. Taylor, K. Owen, C. Saavedra, J. Vázquez-Bonales, B. Unger, and P. Hammond. 2023. Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys. Final report published 29 September 2023.

Global Wind Energy Council. 2024. GLOBAL OFFSHORE WIND REPORT 2024.

Graham, I. M., A. Farcas, N. D. Merchant, and P. Thompson. 2017. Beatrice Offshore Wind Farm: An interim estimate of the probability of porpoise displacement at different unweighted single-pulse sound exposure levels. Prepared by the University of Aberdeen for Beatrice Offshore Windfarm Ltd.

Graham, I. M., N. D. Merchant, A. Farcas, T. R. C. Barton, B. Cheney, S. Bono, and P. M. Thompson. 2019. Harbour porpoise responses to pile-driving diminish over time. Royal Society Open Science **6**:190335.

Hammond, P., C. Lacey, A. Gilles, S. Viquerat, P. Börjesson, H. Herr, K. Macleod, V. Ridoux, M. Santos, M. Scheidat, J. Teilmann, J. Vingada, and N. Øie. 2021. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys - revised June 2021.

Harwood, J., S. King, R. Schick, C. Donovan, and C. Booth. 2014. A protocol for Implementing the Interim Population Consequences of Disturbance (PCoD) approach: Quantifying and assessing the effects of UK offshore renewable energy developments on marine mammal populations. Report Number SMRUL-TCE-2013-014. Scottish Marine And Freshwater Science, 5(2).

Heinis, F., C. De Jong, and Rijkswaterstaat Underwater Sound Working Group. 2015. Framework for assessing ecological and cumulative effects of offshore wind farms: Cumulative effects of impulsive underwater sound on marine mammals. Project number: 060.11480 & 060.14412. Report number: TNO 2015 R10335-A, TNO.

IAMMWG. 2023. Review of Management Unit boundaries for cetaceans in UK waters (2023). JNCC Report 734, JNCC, Peterborough, ISSN 0963-8091.

JNCC. 2020. Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wales & Northern Ireland). Report No. 654, JNCC, Peterborough.

JNCC. 2023. Marine Noise Registry Help and Guidance. Version 1.1.

Judd, A. D., T. Backhaus, and F. Goodsir. 2015. An effective set of principles for practical implementation of marine cumulative effects assessment. Environmental Science and Policy **54**:254--262.

King, S. L., R. S. Schick, C. Donovan, C. G. Booth, M. Burgman, L. Thomas, and J. Harwood. 2015. An interim framework for assessing the population consequences of disturbance. Methods in Ecology and Evolution **6**:1150-1158.

Lacey, C., A. Gilles, P. Börjesson, H. Herr, K. Macleod, V. Ridoux, M. Santos, M. Scheidat, J. Teilmann, S. Sveegaard, J. Vingada, S. Viquerat, N. Øien, and P. Hammond. 2022. Modelled density surfaces of cetaceans in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys.

Lucke, K., U. Siebert, P. A. Lepper, and M. Blanchet. 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure

to siesmic airgun stimuli. Journal of the Acoustical Society of America **125**:4060-4070.

NOAA. 2005. Endangered Fish and Wildlife; Notice of Intent to Prepare an Environmental Impact Statement., Federal Register 70: 1871-1875.

Russell, D., and G. Hastie. 2017. Associating predictions of change in distribution with predicted received levels during piling. Report produced for SMRU Consulting.

Sinclair, R., S. Kazer, M. Ryder, P. New, and U. Verfuss. 2023. Review and recommendations on assessment of noise disturbance for marine mammals. NRW Evidence Report No. 529, 143pp, Natural Resources Wales, Bangor.

Southall, B., J. J. Finneran, C. Reichmuth, P. E. Nachtigall, D. R. Ketten, A. E. Bowles, W. T. Ellison, D. Nowacek, and P. Tyack. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. Aquatic Mammals **45**:125-232.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. J. Greene, D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals **33**:411-414.

Tyack, P. L., L. Thomas, D. P. Costa, A. J. Hall, C. M. Harris, J. Harwood, S. D. Kraus, P. J. O. Miller, M. Moore, T. Photopoulou, E. Pirotta, R. M. Rolland, L. H. Schwacke, S. E. Simmons, and B. L. Southall. 2022. Managing the effects of multiple stressors on wildlife populations in their ecosystems: developing a cumulative risk approach. Proceedings of the Royal Society B: Biological Sciences **289**:20222058.

Waggitt, J. J., P. G. H. Evans, J. Andrade, A. N. Banks, O. Boisseau, M. Bolton, G. Bradbury, T. Brereton, C. J. Camphuysen, J. Durinck, T. Felce, R. C. Fijn, I. Garcia-Baron, S. Garthe, S. C. V. Geelhoed, A. Gilles, M. Goodall, J. Haelters, S. Hamilton, L. Hartny-Mills, N. Hodgins, K. James, M. Jessopp, A. S. Kavanagh, M. Leopold, K. Lohrengel, M. Louzao, N. Markones, J. Martinez-Cediera, O. O'Cadhla, S. L. Perry, G. J. Pierce, V. Ridoux, K. P. Robinson, M. B. Santos, C. Saavedra, H. Skov, E. W. M. Stienen, S. Sveegaard, P. Thompson, N. Vanermen, D. Wall, A. Webb, J. Wilson, S. Wanless, and J. G. Hiddink. 2019. Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology **57**:253-269.

Whyte, K. F., D. J. F. Russell, C. E. Sparling, B. Binnerts, and G. D. Hastie. 2020. Estimating the effects of pile driving sounds on seals: Pitfalls and possibilities. J Acoust Soc Am **147**:3948.

7. Appendix 1: CEA Screening Ranges

Table 4 Collation of CEA screening ranges used in recent OWF EIAs. References are provided in Table 5.

OWF	CEA Screening Range	Justification provided
Five Estuaries	500 km	This range represents a precautionary maximum distance at which effects from offshore energy could occur.
Outer Dowsing	500 km	This range represents a precautionary maximum distance at which effects from offshore energy could occur.
West Of Orkney	Species specific MUs	The marine mammal management unit.
Salamander	Species specific MUs	Marine Mammal Management Units (MUs) for key species with the potential for an adverse impact from the Salamander Project.
North Falls	Species specific MUs	The study area for marine mammals has been defined on the basis of marine mammals being highly mobile and transitory in nature; therefore, it is necessary to examine species occurrence not only within the offshore project area, but also over the wider area. For each species of marine mammal, the following study areas have been defined based on the relevant Management Units (MUs).
NISA	Species specific MUs	The ZOI for marine mammals is based on the species-specific MUs.
Oriel	Irish Sea	The Regional Marine Megafauna Study Area also informs the assessment where the Zone of Influence (ZoI) for a given impact (e.g. subsea noise) that may extend beyond the Marine Megafauna Study Area. The Regional Marine Megafauna Study Area has also been used to inform the Cumulative Marine Mammal and Megafauna Study Area. The Regional Marine Megafauna Study Area = Irish Sea.
Morgan	• HP: CIS MU • MW: limited to CIS MU • BND: IS MU • GS: OSPAR Region III • HS: Wales + NW England + N Ireland	The CEA screening area initially focussed on projects within the extent of the harbour porpoise CIS MU, rather than the entire extent of the largest MU: the CGNS MU. This was to ensure a proportionate and pragmatic approach was taken, focussing on a region within which receptor-impact pathways are likely (since cumulative effects from the Morgan Generation Assets within the Irish Sea were considered unlikely to occur with projects in the North Sea, for example). However in order to refine the assessment to a more species-specific approach, only projects within the Irish Sea MU will be used for CEA for bottlenose dolphin. For grey seal, following consultation feedback from NRW, an extended screening area was applied (OSPAR Region III). For harbour seal, the HSRP is used as the relevant screening area.
Mona	• HP: CIS MU • MW: limited to CIS MU • BND: IS MU • GS: OSPAR Region III • HS: Wales + NW England + N Ireland	The CEA screening area initially focussed on projects within the extent of the harbour porpoise CIS MU, rather than the entire extent of the largest MU: the Celtic and Greater North Seas (CGNS) MU. This was to ensure a proportionate and pragmatic approach was taken, focussing on a region within which receptor-impact pathways are likely (since cumulative effects from the Mona Offshore Wind within the Irish Sea were considered unlikely to occur with projects in the North Sea, for example). However, in order to refine the assessment to a more species-specific approach, only projects within the Irish Sea MU will be used for CEA for bottlenose dolphin. For grey seal, following

		consultation feedback from NRW, an extended screening area was applied (OSPAR Region III). For harbour seal, the HSRP is used as the relevant screening area.
Morcambe	• HP: CIS MU • MW: limited to CIS MU • CD: limited to CIS MU • WBD: limited to CIS MU • BND: IS MU • GS: IS MU • HS: IS MU	For the marine mammal species in the assessments, the following study areas have been defined, based on the relevant Management Units (MU) (IAMMWG, 2023) and current knowledge and understanding of the biology of each species. For the marine mammal assessment the area used for the CEA project screening was based on that of the CIS MU for harbour porpoise, common dolphin, Risso's dolphin, white-beaked dolphin, and minke whale due to the extensive swimming ranges and transboundary connectivity causing a temporal overlap. For bottlenose dolphin, the CEA screening area boundary was that of the IS MU, and the boundaries for grey and harbour seal were those of all the relevant seal MUs mentioned above.
Berwick Bank	Wider northern North Sea	The regional marine mammal study area: marine mammals are highly mobile and may range over large distances and therefore, to provide a wider context, the desktop review considers the marine mammal ecology, distribution and density/abundance within the wider northern North Sea. The regional marine mammal study area also informs the assessment where the Zone of Influence (ZoI) for a given impact (e.g. underwater noise) may extend beyond the Proposed Development marine mammal study area. For the purposes of CEA screening, any plans or projects outside a ZoI of 332 km were excluded from the long list for marine mammals.
Pentland	Species specific MUs	Projects that overlap the Offshore Study Area, which is receptor species-specific, comprising the relevant cetacean and seal MUs are considered to have the potential to result in cumulative effects for marine mammals.
Moray West	Wider Moray Firth and Scottish east coast region	The offshore search area extent for marine mammals is within the relevant management unit for each key species. For seals this is the Moray Firth Seal Management Area and for bottlenose dolphins this is the East Coast management unit. For harbour porpoise and minke whales, whose management units extend over very large areas beyond the Moray Firth, quantitative assessment of cumulative impacts is carried out for projects in the wider Moray Firth and Scottish east coast region (including Forth and Tay developments) where there is sufficient detailed information, cumulative impacts with other projects throughout the North Sea are considered qualitatively.
Seagreen	Species specific MUs	The Wider Study Area relates to the relevant area describing the reference population for the optimised Seagreen Project impact assessment. This is defined appropriately for each marine mammal species under consideration and is equivalent to the agreed management units for each population.
Neart Na Gaoithe	East coast Scotland	As advised by the Scottish Ministers.
Inch Cape	East coast Scotland	As agreed during consultation with MS-LOT.
Ossian	Wider northern North Sea	Regional marine mammal study area: an area encompassing the wider northern North Sea to account for the highly mobile nature of marine mammals which encompasses the zone of influence (ZoI) for all impacts. The CEA screening area for marine mammals initially focussed on projects within the regional marine mammal study area. For the purposes of CEA screening, any plans or projects outside a ZoI of approximately 739 km, the furthest distance of the regional marine mammal study area, were excluded from the long list for marine mammals.
Hornsea 3	North Sea MU	During the initial screening exercise for marine mammals, projects were considered over the whole of the North Sea MU as the largest CEA study area.

Hornsea 4	500 km	This range represents a precautionary maximum distance at which effects from offshore energy (e.g. underwater noise from piling) could occur.
Norfolk Vanguard East	Species specific MUs	Marine mammals are highly mobile and transitory in nature, therefore it is necessary to examine species occurrence not only within the Norfolk Vanguard site, but also over the wider North Sea region. For each species of marine mammal, the following study areas have been defined based on the relevant Management Units (MUs), current knowledge and understanding of the biology of each species.
Norfolk Vanguard West	Species specific MUs	Marine mammals are highly mobile and transitory in nature, therefore it is necessary to examine species occurrence not only within the Norfolk Vanguard site, but also over the wider North Sea region. For each species of marine mammal, the following study areas have been defined based on the relevant Management Units (MUs), current knowledge and understanding of the biology of each species; taking into account the feedback received during consultation.
Norfolk Boreas	Species specific MUs	Marine mammals are highly mobile and transitory in nature, therefore it is necessary to examine species occurrence not only within the Norfolk Boreas offshore project area, but also over the wider North Sea region. For each species of marine mammal, the following study areas have been defined based on the relevant Management Units (MUs), current knowledge and understanding of the biology of each species; taking into account the feedback received during consultation.
East Anglia One North	Species specific MUs	EU Offshore Windfarms (Status at Time of Writing) within the HP, HS and GS MUs
East Anglia One	east coast of southern England	Due to the highly mobile nature of marine mammals and the need for seals to haul out at coastal sites, published information covering a wider area including the east coast of southern England has also been considered.
East Anglia Two	Species specific MUs	The plans and projects screened in to the CIA are located in the relevant marine mammal reference population areas for harbour porpoise, grey seal and harbour seal.
East Anglia Three	cetaceans: species specific MUs seals: east coast UK and west coast mainland Europe	The Inter Agency Marine Mammal Working Group (IAMMWG) Management Units (MUs) for marine mammals in UK waters have been used as appropriate reference populations for cetacean species (IAMMWG 2013). When considering the foraging and haul-out patterns of harbour and grey seal, the potential impacts of East Anglia THREE have been assessed in relation to a small number of breeding colonies scattered along the east coast of the UK (and the relevant UK MUs) and the west coast of mainland Europe, due to the limits of the MUs being UK territorial waters (12nm).
Awel y Mor	Species specific MUs	Only projects within the relevant species MU.
Erebus	Species specific MUs	All projects within the Celtic and Greater North Sea MU (which encompasses all the other relevant species MUs). For other offshore developments, The Crown Estate website and Emod.net were used to identify projects
Rampion 2	Species specific MUs	The ZOI for marine mammals is the species-specific MU (North Sea MU for porpoise, South and Southeast MUs for seals, Celtic and Greater North Sea MU for minke whales and common dolphins, and Offshore Channel, Celtic Seas & South West England MU and Coastal West Channel MU for bottlenose dolphins).

Sofia (Formerly Dogger Bank Teesside B)	cetaceans: species specific MUs seals: east coast UK and Europe	The IAMMWG MUs for marine mammals in UK waters have been used as appropriate reference populations for cetacean species (IAMMWG 2013). Consideration has also been given to the relevant European populations for seal species, due to the limits of the MUs being UK territorial waters (12nm).
Dogger Bank A (Formerly Dogger Bank Creyke Beck A)	North Sea maritime area	The CIA Project List was generated by undertaking an industry/development specific search on a country by country basis in the North Sea maritime area.
Dogger Bank B (Formerly Dogger Bank Creyke Beck B)	North Sea maritime area	The CIA Project List was generated by undertaking an industry/development specific search on a country by country basis in the North Sea maritime area.
Dogger Bank C (Formerly Dogger Bank Teesside A)	cetaceans: species specific MUs seals: east coast UK and Europe	The IAMMWG MUs for marine mammals in UK waters have been used as appropriate reference populations for cetacean species (IAMMWG 2013). Consideration has also been given to the relevant European populations for seal species, due to the limits of the MUs being UK territorial waters (12nm).
Dogger Bank South West	Species specific MUs	For the marine mammal species in the assessments, the following study areas have been defined, based on the relevant Management Units (MUs) (Inter-Agency Marine Mammal Working Group (IAMMWG) 2023), current knowledge and understanding of the biology of each species.
Dogger Bank South East	Species specific MUs	For the marine mammal species in the assessments, the following study areas have been defined, based on the relevant Management Units (MUs) (Inter-Agency Marine Mammal Working Group (IAMMWG) 2023), current knowledge and understanding of the biology of each species.
Green Volt	Species specific MUs	Initial long list of potential projects is identified with the potential to interact with the proposed Project based on the mechanism of interaction and spatial extent of the reference population for each marine mammal species.
Caledonia	Scottish waters	The ZOI for marine mammals is based on the species-specific MUs (noting only Scottish projects with these MUs were taken forward to the quantitative assessment).
Muir Mhor	Scottish waters	To create the CEA longlist, a Zone of Influence (ZoI) has been applied to screen in relevant offshore projects. The ZoI for marine mammals is based on the species-specific MUs (noting only Scottish projects within these MUs were taken forward to the quantitative assessment as advised in consultation with NatureScot).
Codling	OWF: Species specific MUs Other: OSPAR Region III: Celtic Seas	For the potential effects for marine mammals, planned offshore wind farm projects were screened into the assessment based on the extent of the relevant marine mammal reference population area (MU). For all other planned offshore projects, those occurring in OSPAR Region III: Celtic Seas were screened into the assessment
Arklow Bank 2	OWF: Species specific MUs Other: ICES 7a Celtic Sea	For marine mammals, with respect to offshore windfarm projects, the range is defined as the species-specific Mus. For all other planned offshore projects, the International Council for the Exploration of the Sea (ICES) 7a Celtic Sea Region was used for screening.

Table 5 References used in Table 4

OWF	Reference	Link
Five Estuaries	Five Estuaries Offshore Wind Farm Environmental Statement Volume 6, Part 1, Annex 3.1: Cumulative Effects Assessment Methodology	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010115/EN010115-000398-6.1.3.1%20Cumulative%20Effects%20Assessment%20Methodology.pdf
Outer Dowsing	Outer Dowsing Offshore Wind Environmental Statement Appendix 5.2 Cumulative Effects Assessment Methodology Volume 3	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010130/EN010130-000430-6.3.5.2%20Chapter%205%20Appendix%202%20Cumulative%20Effects%20Assessment%20Approach%20Offshore.pdf
West Of Orkney	Offshore Wind Power Limited West of Orkney Windfarm Offshore EIA Report Volume 1, Chapter 7 - EIA Methodology	https://marine.gov.scot/sites/default/files/west_of_orkney_windfarm_offshore_eia_report_-_chapter_7_-_eia_methodology__1.pdf
Salamander	Salamander Offshore Wind Farm Offshore EIA Report Volume ER.A.4, Annex 6.2: Cumulative Effects Assessment Technical Annex	https://marine.gov.scot/sites/default/files/eia_volume_4_-_cumulative_effects_assessment_technical_annex_-_annex_6.2.pdf
North Falls	North Falls Offshore Wind Farm Environmental Statement Chapter 12 Marine Mammals Volume: 3.1	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010119/EN010119-000448-3.1.14_ES%20Chapter%2012%20Marine%20Mammals.pdf
NISA	NISA Environmental Impact assessment Report Volume 3: Offshore Chapters, Chapter 14 Marine Mammal Ecology	https://northirishseaarraysid.ie/wp-content/uploads/2024/06/Chapter-14-Marine-Mammal-Ecology.pdf
Oriel	Oriel Wind Farm Project Environmental Impact Assessment Report Chapter 10: Marine Mammals and Megafauna	https://orielwindfarm-marineplanning.ie/data/files/Environmental%20Documents/Environmental%20Impact%20Assessment%20Report%20(EIAR)/-Volume%202B:%20Chapters%207%20-%2016%20and%20associated%20technical%20appendices/10.%20Marine%20Mammals%20and%20Megafauna.pdf
Morgan	Morgan Offshore Wind Project: Generation Assets Environmental Statement Volume 2, Chapter 4: Marine mammals	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010136/EN010136-000151-F2.4_Morgan_Gen_ES_Marine%20mammals.pdf
Mona	Mona Offshore Wind Project Environmental Statement Volume 2, Chapter 4: Marine mammals	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010137/EN010137-000365-F2.4_Mona_ES_Marine%20Mammals.pdf
Morcambe	Morecambe Offshore Windfarm: Generation Assets Environmental Statement Volume 5 Appendix 11.4 Marine Mammal CEA Project Screening	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010121/EN010121-000241-5.1.11%20Chapter%2011%20Marine%20Mammals.pdf
Berwick Bank	Berwick Bank Wind Farm Environmental Impact Assessment Report Volume 2, Chapter 10: Marine Mammals	https://marine.gov.scot/sites/default/files/eor0764.pdf https://marine.gov.scot/sites/default/files/berwic4.pdf

	Berwick Bank Wind Farm Offshore Environmental Impact Assessment Appendix 6.4: Cumulative Effects Screening	
Pentland	Pentland floating offshore wind farm Volume 2: Offshore EIAR Chapter 11: Marine Mammals and Other Megafauna	https://marine.gov.scot/sites/default/files/chapter_11._marine_mammals_and_other_megafauna.pdf
Moray West	Moray Offshore Windfarm (West) Limited Environmental Impact Assessment Report. Chapter 9 Marine mammal ecology	https://marine.gov.scot/sites/default/files/00538033.pdf
Seagreen	Seagreen EIA Report Volume 1. Chapter 10: Marine Mammals	https://marine.gov.scot/sites/default/files/chapter_10_marine_mammals.pdf
Neart Na Gaoithe	NnG offshore wind. Chapter 8 Marine Mammals Pelagica Environmental Consultancy Ltd. March 2018	https://marine.gov.scot/sites/default/files/combined_document_-_revised.pdf
Inch Cape	Inch Cape Offshore Limited. Environmental Impact Assessment Report Biological Environment Marine Mammals Chapter 10.	https://marine.gov.scot/sites/default/files/volume_1a_chapters_1-11.pdf
Ossian	Ossian. Chapter 10: Marine Mammals. Array EIA Report 2024 Ossian. Appendix 6.4: Cumulative Effects Screening. Array EIA Report 2024	https://marine.gov.scot/sites/default/files/volume_2_-_technical_assessments_-_chapter_10_-_marine_mammals.pdf https://marine.gov.scot/sites/default/files/volume_3_-_technical_reports_-_appendix_6.4_-_cumulative_effects_screening.pdf
Hornsea 3	Hornsea Project Three Offshore Wind Farm Environmental Statement: Volume 2, Chapter 4 – Marine Mammals **(for general screening range)** Hornsea Project Three Offshore Wind Farm Environmental Statement: Volume 4, Annex 5.2 – Cumulative Effects Screening Matrix **(for specific screening range)**	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-000534-HOW03_6.2.4_Volume%202%20-%20Ch%204%20-%20Marine%20Mammals.pdf https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-000567-HOW03_6.4.5.2_Volume%204%20-%205.2-%20Cumulative%20Effects%20Screening%20Matrix.pdf)
Hornsea 4	Hornsea Project Four: Environmental Statement (ES) Volume A4, Annex 5.3: Offshore Cumulative Effects	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010098/EN010098-000743-A4.5.3%20ES%20Volume%20A4%20Annex%205.3%20Offshore%20Cumulative%20Effects.pdf
Norfolk Vanguard East	Norfolk Vanguard Offshore Wind Farm Chapter 12 Marine Mammals Environmental Statement Volume 1	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001500-Chapter%2012%20Marine%20Mammals%20Norfolk%20Vanguard%20ES.pdf
Norfolk Vanguard West	Norfolk Vanguard Offshore Wind Farm Chapter 12 Marine Mammals Environmental Statement Volume 1	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001500-Chapter%2012%20Marine%20Mammals%20Norfolk%20Vanguard%20ES.pdf

Norfolk Boreas	Norfolk Boreas Offshore Wind Farm Chapter 12 Marine Mammal Ecology Environmental Statement Volume 1	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010087/EN010087-000398-6.1.12%20Environmental%20Statement%20Chapter%2012%20Marine%20Mammal%20Ecology.pdf
East Anglia One North	East Anglia ONE North Offshore Windfarm Environmental Statement Volume 3Appendix 11.3 Marine Mammal Cumulative Impact Assessment (CIA) Screening	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010077/EN010077-001168-6.3.11.3%20EA1N%20ES%20Appendix%2011.3%20Cumulative%20Impact%20Assessment%20Screening.pdf
East Anglia One	East Anglia ONE Offshore Windfarm Chapter 11 Marine Mammals Environmental Statement Volume 2	https://www.scottishpowerrenewables.com/pages/east_anglia_one_document_library.aspx
East Anglia Two	East Anglia TWO Offshore Windfarm Chapter 11 Marine Mammals Environmental Statement Volume 1	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010078/EN010078-001082-6.1.11%20EA2%20Environmental%20Statement%20Chapter%2011%20Marine%20Mammals.pdf
East Anglia Three	East Anglia THREE Chapter 12 Marine Mammal Ecology Environmental Statement Volume 1	https://www.scottishpowerrenewables.com/userfiles/file/6.1.12-Volume-1-Chapter-12-Marine-Mammal-Ecology.pdf
Awel y Mor	Awel y Môr Offshore Wind Farm Category 6: Environmental Statement Volume 2, Chapter 7: Marine Mammals	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010112/EN010112-000193-6.2.7_AyM_ES_Volume2_Chapter7_MarineMammals_vFinal.pdf
Erebus	Project Erebus Environmental Statement Chapter 12: Marine Mammals	https://smrumarine.app.box.com/file/907053551803?s=29ocqsba6fym3lehkzuwz64tcdu75htq
Rampion 2	Rampion 2 Wind Farm Category 6: Environmental Statement Volume 2, Chapter 11: Marine mammals (clean) Date: August 2024 Revision E	EN010117-002016-6.2.11 Environmental Statement Chapter 11 Marine mammals (clean).pdf (planninginspectorate.gov.uk)
Sofia (Formerly Dogger Bank Teesside B)	Dogger Bank Teeside A and B Environmental Statement Chapter 14 Marine Mammals Application Reference: 6.14	https://doggerbank.com/wp-content/uploads/2021/11/Chapter-14-Marine-mammals_Part1.pdf
Dogger Bank A (Formerly Dogger Bank Creyke Beck A)	Environmental Statement Chapter 4 Appendix A Cumulative Impact Assessment Strategy	https://doggerbank.com/wp-content/uploads/2021/11/ES-Chapter-4-Appendix-A-Cumulative-Impact-Assessment-Strategy.pdf
Dogger Bank B (Formerly Dogger Bank Creyke Beck B)	Environmental Statement Chapter 4 Appendix A Cumulative Impact Assessment Strategy	https://doggerbank.com/wp-content/uploads/2021/11/ES-Chapter-4-Appendix-A-Cumulative-Impact-Assessment-Strategy.pdf

Dogger Bank C (Formerly Dogger Bank Teesside A)	Dogger Bank Teeside A and B Environmental Statement Chapter 14 Marine Mammals Application Reference: 6.14	https://doggerbank.com/wp-content/uploads/2021/11/Chapter-14-Marine-mammals_Part1.pdf
Dogger Bank South West	RWE Renewables UK Dogger Bank South (West) Limited RWE Renewables UK Dogger Bank South (East) Limited Dogger Bank South Offshore Wind Farms Environmental Statement, Volume 7 Chapter 11 – Marine Mammals	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010125/EN010125-000437-7.11%20ES%20Chapter%2011%20-%20Marine%20Mammals.pdf
Dogger Bank South East	RWE Renewables UK Dogger Bank South (West) Limited RWE Renewables UK Dogger Bank South (East) Limited Dogger Bank South Offshore Wind Farms Environmental Statement, Volume 7 Chapter 11 – Marine Mammals	https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010125/EN010125-000437-7.11%20ES%20Chapter%2011%20-%20Marine%20Mammals.pdf
Culzean	TotalEnergies E&P North Sea UK Ltd Culzean - Floating Offshore Wind Turbine Pilot Project Environmental Impact Assessment Report – Chapter 6 - EIA Methodology	https://marine.gov.scot/sites/default/files/eia_report_chapter_10_-_marine_mammals_and_other_megafauna.pdf
Green Volt	Green Volt Offshore EIA Report: Volume 2 Technical Appendix 11.1 Marine Mammal Cumulative Impact Assessment Screening	https://marine.gov.scot/sites/default/files/2301233_0.pdf
Caledonia	Caledonia Offshore Wind Farm. Volume 2 Proposed Development (Offshore) Chapter 7 Marine Mammals Caledonia Offshore Wind Farm Ltd	https://marine.gov.scot/sites/default/files/241115_-_caledonia_-_eia_application_-_volume_2_chapter_7_-_marine_mammals.pdf
Muir Mhor	Muir Mhòr Offshore Wind Farm Environmental Impact Assessment Report Volume 2, Chapter 12: Marine Mammals	https://marine.gov.scot/sites/default/files/eia_ch12_marine_mammals.pdf
Codling	Codling Wind Park. Environmental Impact Assessment Report Volume 3 Chapter 11 Marine Mammals	https://shorturl.at/gjqTp
Arklow Bank 2	Arklow Bank Wind Park 2. Environmental Impact Assessment Report. Volume II, Chapter 11: Marine Mammals	https://www.arklowbank2offshoreplanning.ie/downloads/eiar/abwp2-chapter-11-marine-mammals.pdf

8. Appendix 2: CEA Screening Comparison

Table 6 Comparison of CEA screening for 8 OWF projects located in the Irish Sea

Project	Awel y Mor[18]	Morgan[19]	Mona[20]	Morcambe[21]	Oriel[22]	Arklow Bank 2[23]	NISA[24]	Codling[25]
Year of EIAR	2022	2024	2024	2024	2024	2024	2024	2024
Piling	2027-2029	2027-2028	2027-2028	2027	2027	2028	2028	2027
Years in CEA	2025-2031	2025-2029	2025-2029	2025-2029	2027-2028	2021-2034	2023-2031	2023-2028
Maximum CEA ZoI	CGNS MU	OSPAR Region III	OSPAR Region III	CIS MU	Irish Sea	CGNS MU	CGNS MU	CGNS MU
OWFs assessed quantitatively for construction (piling) noise	11 projects Doger Bank C Dublin Array East Anglia 1N East Anglia 2 Erebus Hornsea 3 Hornsea 4 Norfolk Boreas Norfolk Vanguard E Norfolk Vanguard W Sofia	56 projects Anair Phase 1 Aniar Phase 2 Arklow Bank Phase 2 Arranmore Awel y Mor Blackwater Bore Array Celtic Horizon Celtic Sea Array Clogher Head Codling Codling Ext Cooley Point Cork Dublin Array East Celtic Erebus Haven Ilen Inis Ealga Inis Munster Lir Offshore Array	55 projects Aniar Fixed Aniar Floating Arklow Bank Phase 2 Arranmore Awel y Mor Blackwater Bore Array Braymore Point Celtic Horizon Celtic Sea Array Clogher Head Codling Codling Wind Ext Cooley Point Cork Dublin Array East Celtic Erebus Haven Ilen Inis Ealga Inis Munster	5 projects Awel y Mor Erebus Mona Morgan White Cross	8 projects Arklow Bank Phase 2 Awel y Mor Codling Dublin Array Mona Morecambe Morgan Nisa	102 projects Amets Arven Awel y Môr Ayre Beech Bellrock Berwick Bank Borkum Riffgrund 3 Bowdun Broadshore Buchan Caledonia Campion Cedar Cenos Centremanche 1 Centremanche 2 Codling Wind Park Courseullessur-Mer Dieppe Le Tréport Dogger Bank - CB A Dogger Bank - CB B	37 projects Arklow Bank Phase 2 Awel y Môr Berwick Bank Codling Dogger Bank - CB A Dogger Bank - CB B Dogger Bank C Dogger Bank South (E) Dogger Bank South (W) Dublin Array Dudgeon Ext East Anglia One North East Anglia Three East Anglia Two Erebus Five Estuaries Green Volt Hornsea Project Four Hornsea Project Three Inch Cape Mona Moray West	79 projects AMETS Arklow Bank Phase 2 Arven Awel y Môr Bellrock Berwick Bank Borkum Riffgrund 3 Broadshore Caledonia Campion Cedar Cenos Courseulles-sur mer Dieppe Le Tréport Dogger Bank – CB B Dogger Bank C Dogger Bank –CB A Dogger Bank South (E) Dogger Bank South (W) Dublin Array Dudgeon Ext Dunkerque

[18] Table 50 in https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010112/EN010112-000193-6.2.7_AyM_ES_Volume2_Chapter7_MarineMammals_vFinal.pdf
[19] Table 4.50 in https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010136/EN010136-000281-F2.4_Morgan_Gen_ES_Marine%20mammal_F02.pdf
[20] Table 4.50 in https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010137/EN010137-000365-F2.4_Mona_ES_Marine%20Mammals.pdf
[21] Table 11.84 in https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010121/EN010121-000241-5.1.11%20Chapter%2011%20Marine%20Mammals.pdf
[22] Table 10-43 in https://orielwindfarm-marineplanning.ie/data/files/Environmental%20Documents/Environmental%20Impact%20Assessment%20Report%20(EIAR)/-Volume%202B:%20Chapters%207%20-%2016%20and%20associated%20technical%20appendices/10.%20Marine%20Mammals%20and%20Megafauna.pdf
[23] Table 11.61 in https://www.arklowbank2offshoreplanning.ie/downloads/eiar/abwp2-chapter-11-marine-mammals.pdf
[24] Table 14.50 in https://northirishseaarraysid.ie/wp-content/uploads/2024/06/Chapter-14-Marine-Mammal-Ecology.pdf
[25] Table 3 in Volume 4 – Appendices, Appendix 11.1 Cumulative Effects Assessment https://codlingwindparkplanningapplication.ie/environmental-impact-assessment-report-eiar/

		Llyr 1 Llyr 2 Mac Lir Machair Mainstream Malin Sea Wind Mona Moneypoint Mooir Vannin Morecambe Nisa Nomadic North Celtic Sea North Channel Wind 1 North Channel Wind 2 Oriel Pearla Realt Na Mara Rian Phase 1 Rian Phase 2 Setanta Shelmalere Simply Blue Emerald Spiorad na Mara Talisk Tralee Tulca Phase 2 Twin Hub Urban Sea Valentia Phase 1 Valentia Phase 2 Valorous Voyage White Cross	Lir Offshore Array Llyr 1 Llyr 2 Mac Lir Machair Malin Sea Wind Moneypoint Mooir Vannin Morecambe Morgan Nisa Nomadic North Celtic Sea North Channel Wind 1 North Channel Wind 2 Oriel Pearla Realt Na Mara Rian Phase 2 Setanta Shelmalere Simply Blue Emerald Spiorad na Mara Talisk Tralee Tulca Phase 2 Twin Hub Urban Sea Valentia Phase 1 Valentia Phase 2 Valorous Voyage White Cross			Dogger Bank C - T A Dogger Bank South (East) Dogger Bank South (West) Dublin Array Dudgeon Extension Dunkerque East Anglia One North East Anglia Three East Anglia Two Enbw He Dreiht Erebus Fécamp Five Estuaries Gode Wind 3 Green Volt Havbredey Hollandse Kust (Noord) Hollandse Kust (Zuid) Hollandse Kust F Hornsea Project Four Hornsea Project Three Hornsea Project Two Ijmuiden Ver Inch Cape Kaskasi Ii Llyr 1 Llyr 2 Mona Mooir Vannin Moray East Moray West Morecambe Morgan Morven Muir Mhòr N-10.1 N-10.2 N-3.5 N-3.6 N-3.7 N-3.8 N-6.6 N-6.7 N-7.2 N-9.1 N-9.2 N-9.3 N-9.4 Neart Na Gaoithe Nordsren Ii Vest Nordsren Iii Vest Norfolk Vanguard East Norfolk Vanguard West North Channel Wind 1 North Channel Wind 2 North Falls North Irish Sea Array Oriel Outer Dowsing Pentland Floating Rampion 2 Saint-Brieuc Salamander Sceirde Rocks Seagreen Phase 1	Morecambe Morgan Neart Na Gaoithe Norfolk Vanguard E Norfolk Vanguard W North Falls Oriel Outer Dowsing Pentland Floating Rampion 2 Seagreen Phase 1 Sheringham Shoal Ext Sofia West of Orkney White Cross	East Anglia One North East Anglia Three East Anglia Two EnBW He Dreiht Erebus Fécamp Five Estuaries Gode Wind 3 Green Volt Hollandse Kust (Zuid) Hollandse Kust F Hornsea Project Four Hornsea Project Three Ijmuiden Ver Iles d'Yeu Noirmoutier Inch Cape Isle of Man Llyr 1 Llyr 2 Mona Moray West Morecambe Morgan Morven N-3.5 N-3.6 N-3.7 N-3.8 N-6.6 N-6.7 N-7.2 Neart Na Gaoithe Nordsren III vest Norfolk Vanguard E Norfolk Vanguard W Normandie North Falls NISA Oriel Outer Dowsing Pentland Rampion 2 Saint-Brieuc Salamander Sceirde Rocks Seagreen Phase 1 Shearwater One Sheringham Shoal Ext Sofia Spiorad na Mara Stromar Ten Noorden Wadden Thor TwinHub Vesterhav Nord Vesterhav Syd White Cross

						Shearwater One Sheringham Shoal Ext Sofia Spiorad na Mara Stromar Talisk Ten Noorden Wadden Thor Triton Knoll Twinhub Valorous Vesterhav Nord Vesterhav Syd West Of Orkney White Cross		

9. Appendix 3: Hypothetical CEA long list

The list of OWFs and information on construction years for each OWF was taken from an actual CEA long list, but anonymised here such that it is presented for illustrative purposes only

Table 7 Hypothetical OWF CEA long list. Grey = pre-construction, light blue = construction period, dark blue = operational

Project	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
OWF1														
OWF2														
OWF3														
OWF4														
OWF5														
OWF6														
OWF7														
OWF8														
OWF9														
OWF10														
OWF11														
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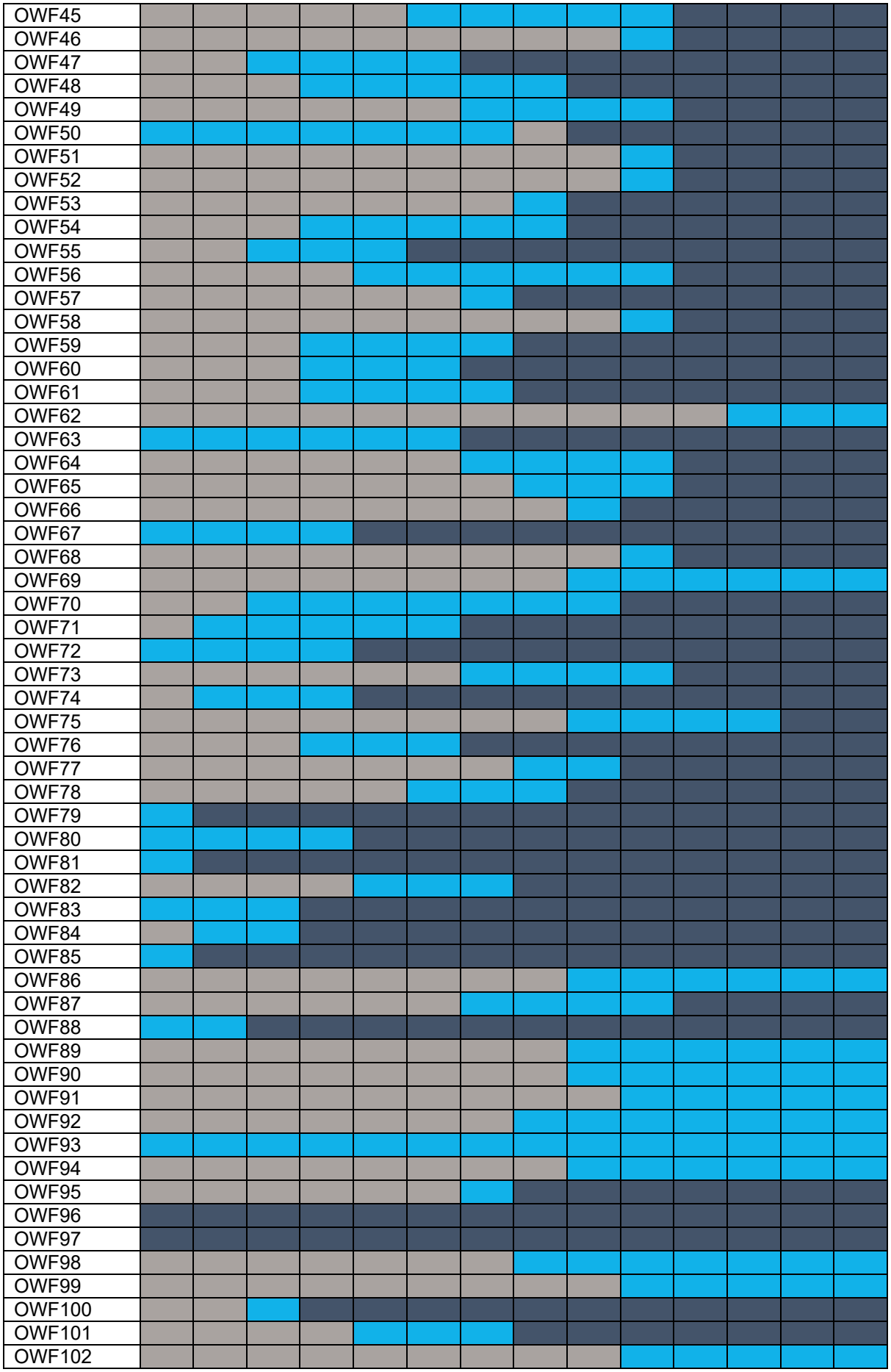
OWF45
OWF46
OWF47
OWF48
OWF49
OWF50
OWF51
OWF52
OWF53
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OWF57
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OWF101
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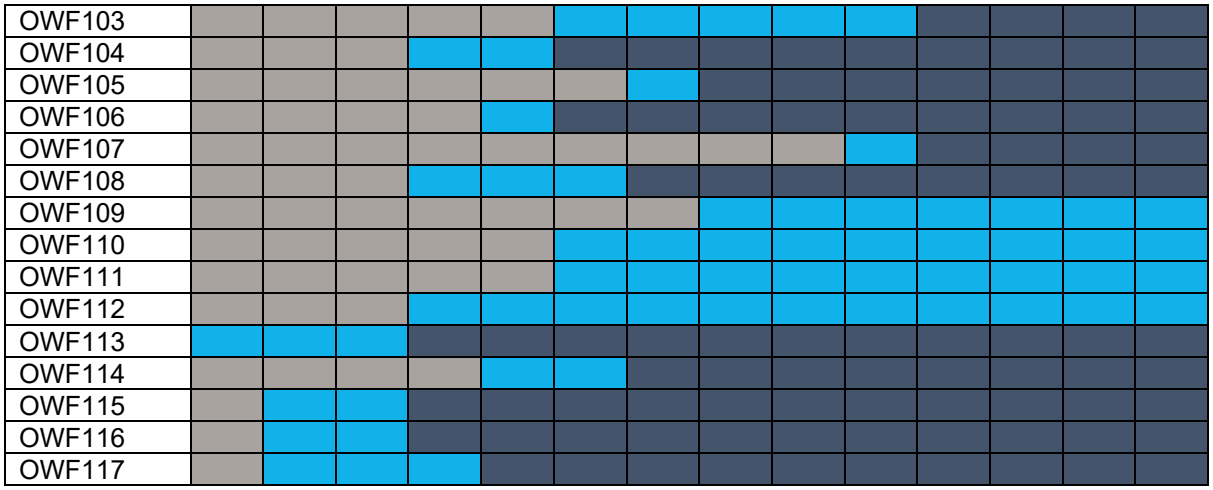
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